WORKING PAPER

TRAC(K)ING THE TRAJECTORY: MAPPING
SUSTAINABLE DEVELOPMENT GOAL 8 IN EU-FUNDED
RESEARCH PROJECTS

Kris Boudt
Yanick Inghels
André Spithoven

**GHENT
UNIVERSITY**

Department of Economics

Trac(k)ing the trajectory: Mapping Sustainable Development Goal 8 in EU-funded research projects

Kris BOUDT [1,2,3], Yanick INGHELS [1], André SPITHOVEN [1,4,5]

[1]Department of Economics, Ghent University, Belgium

[2]Faculty of Social Sciences and Solvay Business School, Vrije Universiteit Brussel, Belgium

[3]School of Business and Economics, Vrije Universiteit Amsterdam, the Netherlands

[4]Monitoring and Evaluation Research and Innovation, Belgian Science Policy Office, Belgium

[5]ECOOM,Vrije Universiteit Brussel, Belgium

Abstract

We introduce a large-scale research project analysis framework to trace and track the prevalence of Sustainable Development Goals (SDGs) within research funded by the European Union since 1984 with a specific focus on Sustainable Development Goal 8. This goal envisages to promote sustained economic growth, full and productive employment, and decent work for all. Using the CORDIS database, we identify to which extent SDG 8 has been represented in the titles and abstracts of projects funded by the EU's Framework Programmes. Our findings reveal that SDG 8 related research projects are dominated by four targets: economic growth, productivity, entrepreneurship and decent work, and full and decent employment. We further find that the adoption of the SDGs by the United Nations in 2015 coincides with an increase of over 45% in SDG 8 related research projects. We also show that EU economic performance in the two years preceding the framework programme is a leading indicator of the prevalence of SDG 8 in the research projects funded by that programme. In terms of project characteristics, we conclude that, on average, an SDG 8 project tends to secure a more substantial budget, engage larger research consortia, and exhibit higher interdisciplinarity than other projects. Finally, we show that SDG 8 ranks among the most (diversely) interconnected SDGs, linking especially with SDG 7 (Affordable and Clean Energy) and SDG 9 (Industry, Innovation, and Infrastructure).

1   Introduction

In 2015, the world witnessed a significant milestone in global development efforts by introducing the Sustainable Development Goals (SDGs), a universal call to action to end poverty, protect the planet, and ensure all people enjoy peace and prosperity by 2030. One integral aspect of achieving these ambitions is research into new insights and methods to promote sustained economic growth, full and productive employment, and decent work for all, corresponding to SDG 8 (UN, 2015). Effective monitoring of the SDGs is seen as an integral part of their successful implementation (UN, 2015; Trane et al., 2021). Consequently, recent literature has started using bibliometric research to monitor SDG research results. We refer to Mishra et al. (2023) and Ciarli et al. (2022) for a general overview on SDGs, and to Ralph and Arora (2024) for SDG 8 in particular. These approaches quantify the research results and, therefore, can be expected to be biased towards positive findings (Scheel et al., 2021). We advocate a complementary approach that monitors the intended research efforts in funded research projects. The analysis traces the heterogeneity in past research and tracks whether currently funded projects are aligned with policy objectives. Such an evidence-based approach can be impactful for progress on the SDGs as research and innovation (R&I) policy has developed into a critical instrument in policy frameworks (Bloch & Sørensen, 2015; Abdullaev et al., 2023; Nature Editorial, 2023). However, there is a lack of studies on effective quantification methods and longitudinal analysis of SDG attention in research funding.

Our research aims to fill these gaps, explicitly focusing on SDG 8. We draw on the increasing use of textual data in economics and policy analysis (Gentzkow et al., 2019; Ash & Hansen, 2023) and on the growing literature on the mapping of SDGs in texts or policy documents through Natural Language Processing (NLP) (Smith et al., 2019; Borchardt et al., 2022; Confraria et al., 2024). We map the SDGs across the titles and abstracts of research projects funded by the EU Framework Programmes (FPs) from 1984 to 2023. We study these programmes for several reasons. First, the CORDIS database, holding information on these research projects, is publicly and readily available. Second, their growing influence and role in propelling R&I have been well-established and quantified (Luukkonen, 1998; Aguiar & Gagnepain, 2017; Szücs, 2020). Third, the most recent FP, Horizon Europe (2021-2027), stands out as the world's first research funding programme to formally incorporate the SDGs into its proposal requirements (European Commission, 2021; Nature Editorial, 2023). These factors make the EU FPs an exemplary case for monitoring how intended research efforts align with the SDGs.

The existing literature identifies two predominant methods for mapping SDGs within textual data: machine learning (ML) techniques and lexicon-based strategies. The rise of artificial intelligence has spurred a growing interest in ML approaches, praised for their ability to catch intricate patterns within complex texts (Minaee et al., 2021). Recent contributions in ML-based SDG classification systems include Gialitsis et al. (2022), Hajikhani & Suominen (2022) and Vanderfeesten et al. (2022). Despite their potential, these techniques are often criticised for their 'black-box' nature and the substantial volume of training data (Linardatos et al., 2020). Conversely, lexicon-based methods offer an alternative by employing a curated list of words specific to a domain, allowing for direct SDG mapping in text (Bird et al., 2009). Nevertheless, such approaches are not without limitations, as they may inadvertently incorporate the biases of the lexicon's creators and typically assume equal significance for all lexicon terms, potentially oversimplifying the dynamic nature of language (Eisenstein, 2017).

Many SDG lexicons exist and have their domain focus (Vanderfeesten et al., 2020; Rivest et al., 2021; Wang et al., 2023). We use the most recently published SDG lexicon developed by the EU Joint Research Centre, namely Borchardt et al. (2022). In response to overcoming the complexities of ML and the traditional challenges with lexicon-based approaches, a multidisciplinary team of SDG experts

created this lexicon by combining their insights with a process of manual mapping and iterative validation. The lexicon comprises 3,253 keywords that encapsulate the diversity of each SDG, including 231 terms dedicated explicitly to all thematic aspects of SDG 8. Importantly, this lexicon's expert-driven creation and rigorous methodology make it an ideal tool for our study.

Using this lexicon, we make four notable contributions. First, to our knowledge, we are the first to systematically map funded research projects to the SDGs. Second, we respond to the need for indicators to track government efforts towards SDGs, as Kim (2018) highlighted. Third, we conduct a longitudinal analysis of the evolution and dynamics of EU research funding for SDG 8 over the past 40 years, offering insights into funding trends. To see whether the EU prioritises certain SDGs over others, as suggested by the literature (Forestier & Kim, 2020; Yang et al., 2020; Confraria et al., 2024), this analysis mainly includes comparing these trends over the different SDG 8 targets, as well as the other SDGs. Fourth, we explore the relationship between macroeconomic conditions and EU funding for SDG 8 research in the subsequent FPs.

Analysing the 40 years of SDG 8 trends reveals that the concepts integral to SDG 8 have long been at the heart of EU funding strategies, predating their formal encapsulation within the SDGs in 2015. More specifically, we find that the second-largest prevalence of SDG 8 was noted in the research projects funded by FP4 (1994-1998). Indeed, 'sustainable economic growth' has a longstanding history in the literature (MacNeill, 1989; Stern et al., 1996; Galor, 2005). Moreover, the International Labour Organization defined the concept of 'decent work' in 1999 (ILO, 1999), with Ralph and Arora (2024) demonstrating its growing prevalence in the scientific literature since the early 2000s. The largest prevalence of SDG 8 was recorded for Horizon 2020 (H2020), with 4.28% of all projects directly mapped to SDG8. The increase of about 45% compared to its predecessor, FP7, echoes the trends Ralph and Arora (2024) found in broader academic research. However, transitioning from H2020 to Horizon Europe (HE), the most recent FP, we now observe a significantly lower prevalence of SDG 8, indicating a divergence from Ralph and Arora's findings.

A further question is the prevalence of SDG 7 relative to all other SDGs. To quantify this, we propose using a relative prevalence measure that quantifies the share of each SDG in a research project. This approach avoids double counting for projects that contribute to multiple SDGs. It is also robust to the trend of addressing multiple SDGs within one research project. This way, we notice that especially SDG 3 (Good Health and Well-being), SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 13 (Climate Action), have historically received much broader attention in the FPs compared to SDG 8 to varying degrees of importance. Most noteworthy is the dominant role of SDG 3, covering health and well-being, in the early phases of the FPs (FP1-FP7) and the shift towards SDG 13 on climate in H2020 and HE.

SDG 8 comprises twelve distinct targets that cover a broad thematic spectrum. This diversity has led some academics to debate its thematic coverage. For instance, Consière et al. (2020) criticise the goal's emphasis on continuous GDP growth, suggesting it overlooks inequality concerns and fosters overconsumption. Likewise, Rai et al. (2019) argue that GDP's productive boundary does not capture substantial social reproductive labour. These critiques steered our analysis to explore how the EU prioritises specific SDG 8 targets. We note a concentrated focus on targets 8.1 (Economic Growth) and 8.2 (Productivity), with varying attention across time. Furthermore, FP4 emphasised target 8.5 (Full and Decent Employment), while target 8.8 (Labour Rights and Safe Working Conditions) was notably present from FP3 until FP5. Finally, target 8.3 (Entrepreneurship and Decent Work) saw a substantial increase in attention, rising from negligible in FP1 to the third most prevalent target in H2020 and HE.

However, despite all targets being officially encapsulated in the SDGs in 2015, other targets, like 8.9 (Sustainable Tourism) and 8.10 (Financial Inclusion), remain entirely overlooked.

Analysing the characteristics of SDG 8 projects, we find that these projects attract a higher average budget per project, engage larger research consortia, and are more multidisciplinary than other (SDG-related) projects, including those aligned with the most prevalent SDGs. Furthermore, SDG 8 demonstrates a higher degree of connectivity with other SDGs compared to the interconnectivity observed among other SDGs. Our examination of these interconnections among the primary targets of SDG 8 confirms its substantial thematic diversity, with the patterns of linkages aligning with our expectations. For example, target 8.8 (Labour Rights and Safe Working Conditions) is mainly linked with SDG 3, while target 8.4 (Sustainable Production and Consumption) predominantly connects to SDG 12 (Responsible Production and Consumption). Furthermore, target 8.1 (Economic Growth) is by far the most diversely connected to other SDGs compared to the other targets.

Finally, we confirm the intuition that there is a negative association between SDG 8 prevalence in EU-funded research and the EU's economic performance when deciding on the framework programme. Specifically, we find a significantly negative predictive relationship between GDP growth and productivity in the two years preceding the start of the FP, on the one hand, and the prevalence of SDG8 in EU-funded research during the FP, on the other hand. This is expected as the economic conditions may influence policymakers' priorities for funding and the most urgent problems to solve by researchers. Indeed, SDGs compete for attention in a context of limited financial resources and time.

The remainder of this paper is organised as follows: Section 2 contextualises the role of the EU FPs in achieving SDG 8 and offers a historical depiction of events, political entities, and macroeconomic indicators that may have influenced SDG 8's integration into the FPs. Section 3 describes the dataset used in this study. Section 4 introduces the lexicon and used methodologies. Section 5 presents the results of our analyses. Finally, Section 6 concludes.

2   EU Framework Programmes

The EU's progress on SDG 8 occurs within a broader context than only the EU's R&I policy. This section provides background information on how policymakers, research institutions, companies, and individuals interact to contribute to the SDG trajectory. In Subsection 2.1, we draw a schematic conceptual framework. Subsection 2.2 describes a selection of historical events relevant to understanding the trajectory.

2.1   Role of research and innovation policy in achieving SDG 8

R&I policy is one of several vital channels to achieve progress towards SDG 8. It includes actions by policymakers, research institutions, companies and individuals. **Fig. 1** illustrates their interaction with a stylised flowchart detailing the position of R&I policy within the larger framework of policymaking activities that drive progress towards SDG 8. The chart starts by recognising that societal needs (people) and economic conditions influence policymakers, research institutions, and companies to contribute to the SDG 8 trajectory. More specifically, in response to these drivers, policymakers, like the EU, deploy a range of policy instruments.

R&I policy is an increasingly important instrument (Abdullaev et al., 2023; Nature Editorial, 2023). It issues calls for proposals inviting research institutions and companies to apply via research proposals, as in the EU FPs. These entities, in turn, can contribute to SDG 8 directly through their internal initiatives or indirectly by participating in R&I projects funded by these calls. Proposals are evaluated on a large set of criteria, like the quality of the applicants, the proposal's excellence, and the proposal's relevance to the call's objectives. Successful proposals receive funding, leading to R&I and directly contributing to the progress towards SDG 8. This progress, in turn, feeds back into economic conditions and societal needs, restarting the cycle.

The flowchart in Figure 1 highlights important issues we need to consider when interpreting the results of our analyses. First, there are many channels or instruments through which policymakers can contribute to SDG 8. The EU frequently organises large-scale investment plans to achieve SDG 8 by funding its member states. A notable example is the European Social Fund, which provides financial support to EU members to facilitate (youth) employment, promote social inclusion, and much more (Petri et al., 2023). Second, not all R&I gets funded through policymakers, and research institutions and companies will conduct research or innovate themselves (Ciarly et al., 2022). Third, research institutions and companies contribute to the SDG 8 trajectory through other means, like facilitating training programs (Pham et al., 2020) or adopting a sustainable business model (Ritala et al., 2018).
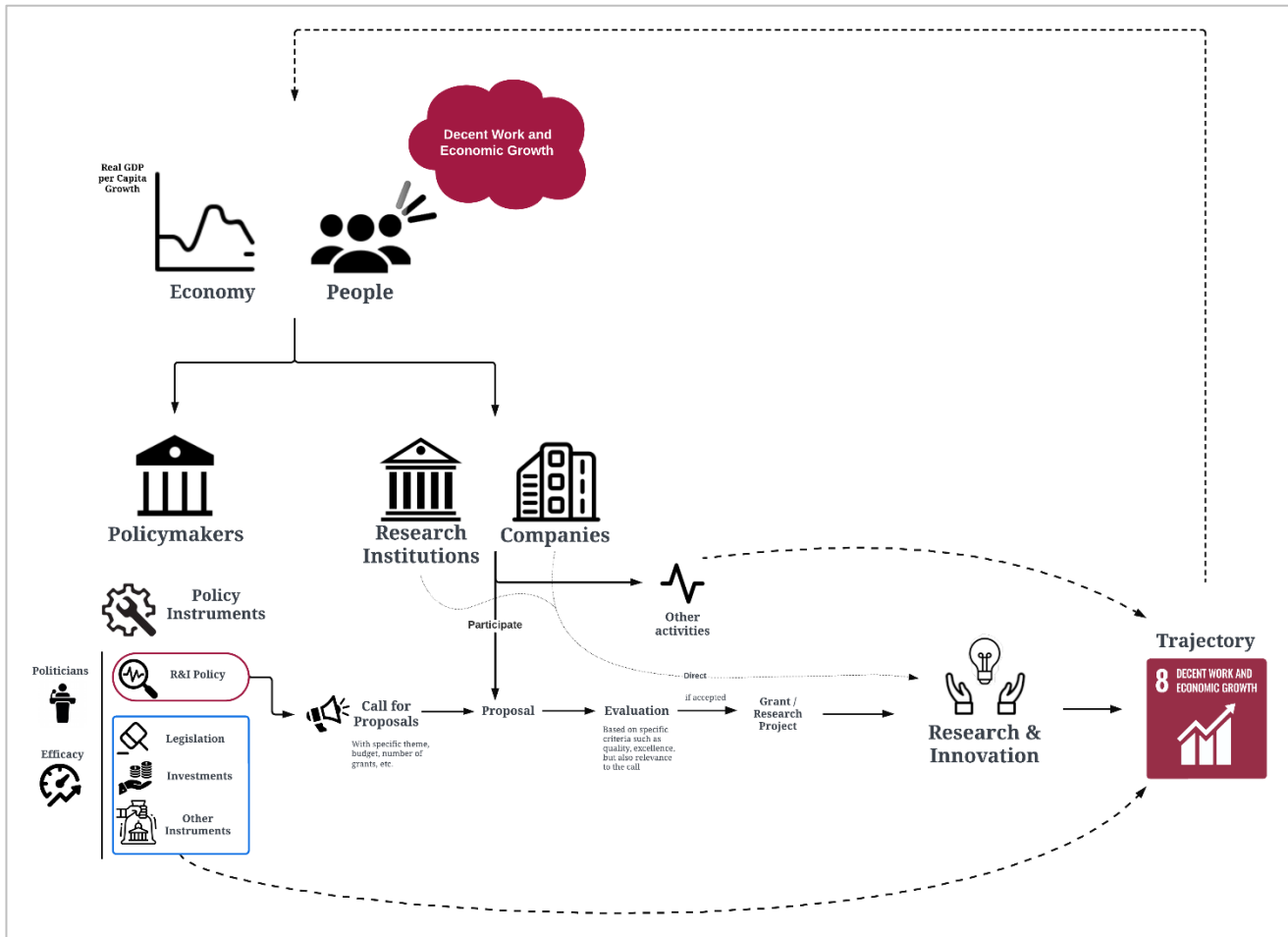
Fig. 1 Flowchart showing how research and innovation policy contributes to the SDG 8 trajectory. This flowchart schematically represents the process by which policymakers, research institutions, companies, and individuals interact to contribute to the SDG trajectory, explicitly focusing on R&I policy.

2.2 Socio-economic and political context of the Framework Programmes

Table 1 summarises the socio-economic and political context of the FPs for which we study the presence of SDGs in the EU-funded research. Based on Reillon (2017), we report the planned budget in billions of EUR in the top panel. The budget has increased in current and constant 2015 prices, with a significant positive level shift for FP7.

Table 1's second and third panels show the European Commission's political leadership during the FPs and highlight key events. It is crucial to outline the evolving priorities and focuses of consecutive commissions. Intergovernmental research initiatives started with the establishment of the European Coal and Steel Community (1951) and the European Atomic Energy Community (Euratom) (1958). However, proponents of community-based research instead of intergovernmental research, used the European Economic Community (1967) to formulate community research actions. These critical events led to the formulation and adaption of FP1, the first community-based research programme to help address the 1970s oil crises and the decreasing competitiveness of EU member states (Reillon et al., 2017). FP1, more specifically, is dedicated to basic and industrial research in its pre-competitive

stage with six thematic objectives: agriculture, development aid, energy, living conditions, industrial competitiveness, and raw materials (Council of European Communities, 1983).

In 1987, the influential report of the Brundtland Commission, active in the UN, stressed the crucial role of the global environment from an economic, social and political viewpoint. Meanwhile, FP2 prioritised collaborative research and technology transfer in a new set of thematic objectives, including biological recourses, development, energy, improving cooperation, modernisation of industrial sectors, ICT, marine resources, and quality of life (Council of European Communities, 1987).

With similar objectives as FP2, FP3 expanded funding across a broader spectrum of scientific and technological disciplines by introducing the concept of interdisciplinarity and improving the links between universities and companies (Council of European Communities, 1990). Meanwhile, the formulation of FP4 was heavily influenced by the Maastricht Treaty, signed in 1993. Research policy could now cover basic research and expand towards more scientific disciplines. Covering the same thematic objectives as the previous FPs, FP4 introduced socio-economic research as a new priority (European Parliament, 1994).

The Prodi Commission oversaw the implementation of Framework Programmes FP5 and FP6. While socio-economic research was introduced in FP4, FP5 made industrial competitiveness and socio-economic research the most critical thematic priorities. A novelty in FP5 is introducing a thematic approach to research funding and its focus on sustainable development. While employment issues were not explicitly highlighted as a priority, job creation and economic growth were primarily promoted through R&I in ICT, biotechnology and the environment (European Parliament, 1998; Reillon, 2017). In 2000, the European Research Area was established as part of the Lisbon Strategy, aiming to make the EU the most competitive and dynamic knowledge-based economy in the world. FP6 was formulated entirely as a tool to implement this European Research Area (Reillon, 2017). While it maintained most of FP5's priorities, it stressed integrating research efforts and promoting innovation to spur economic growth (European Parliament, 2002).

The EU enlargement in 2004, the reinvigoration of the Lisbon Strategy, and the pressing need for science and technology to solve climate change urged the EU to increase the FPs in scope and thematic priorities massively. FP7 aimed to strengthen the European Research Area, promote international cooperation, and address societal challenges through collaborative research projects. FP7 had become the world's most extensive research funding programme then. While FP7 adopted similar thematic objectives as its predecessors under the Cooperation pillar, it also introduced three other pillars, each covering broader objectives. For instance, the Ideas pillar supported individual researchers via grants from the European Research Council (European Commission, 2006).

H2020 was initiated under the Barroso Commission and continued under the Juncker Commission. It aimed to drive economic growth and job creation through research and innovation, particularly tackling societal challenges and supporting industrial competitiveness. The programme transformed the four pillars of FP7 into three pillars: industrial leadership (aimed at supporting industrial competitiveness), excellent science (aimed at supporting science in Europe), and societal challenges (supporting R&I for breakthrough solutions). The societal challenges pillar is similar to the cooperation pillar in FP6 and the thematic priorities in the earlier FPs but with an enlarged scope. (Reillon, 2017). Furthermore, H2020's 2016-2017 working programme, in which the specific topics are detailed for the calls of proposals between 2016-2017, mentions how they will contribute to the SDGs.

HE (2021-2027) was launched under the von der Leyen Commission and builds on the achievements of previous Framework Programmes, focusing on driving innovation, addressing global challenges, and strengthening European scientific excellence and competitiveness. Priority areas include excellent science, global challenges, European industrial competitiveness, and innovative Europe. Hence, it continues to prioritise employment-related concerns, recognising the role of research and innovation in fostering inclusive growth, supporting job creation, and enhancing workforce skills. The programme addresses employment challenges through research projects focusing on digitalisation, green transition, social innovation, and industrial competitiveness. It also supports initiatives to promote social inclusion, address inequalities, and ensure fair and inclusive labour markets.

Throughout its history, the FPs have evolved in response to changing priorities, societal needs, technological advancements and EU policies under different European Commissions, reflecting the EU's commitment to supporting research and innovation as drivers of economic growth, prosperity, and societal progress. While employment issues may not have been explicitly highlighted in all Framework Programmes, EU research and innovation funding has increasingly recognised the importance of addressing labour market dynamics, promoting job creation, and fostering social inclusion as essential components of sustainable development and economic growth.

Table 1 History of the European Union Framework Programmes, the European Commission, and SDG 8 indicators

		FP1	FP2	FP3	FP4	FP5	FP6	FP7	H2020	HE
Framework Programme	Period active	1984-1987	1987-1991	1990-1994	1994-1998	1998-2002	2002-2006	2007-2013	2014-2020	2021-2027
	Planned budget*	3.75	5.40	6.60	13.10	14.96	17.90	50.50	77.00	95.50
	Planned budget in 2015 EUR**	22.6	26.7	25.5	26.9	22.5	23.7	59.1	77.3	87.7
European Commission	Commission Leader	Thorn (LU) (1981-1985)	Delors (FR) (1985-1995)	Delors (FR) (1985-1995)	Delors (FR) (1985-1995)	Santer (LU) (1995-1999)	Prodi (IT) (1999-2004)	Barroso (PT) (2004-2014)	Barroso (PT) (2004-2014) Junker (LU) (2014-2019)	von der Leyen (DE) (2019-present)
	Leader Affiliation	Conservative	Social Democrat	Social Democrat	Social Democrat	Conservative	Liberal	Conservative	Conservative	Liberal
	Minister of Science Policy		Narjes (DE)	Pandolfi (IT)	Ruberti (IT)	Cresson (FR)	Busquin (BE) Michel (BE)	Potočnik (SI)	Geoghegan-Quinn (IE) Moedas (PT)	Ivanova (BG)
	Minister Affiliation		Conservative	Conservative	Social Democrat	Social Democrat	Social Democrat Liberal	Independent	Liberal Conservative	Conservative
Key Events around the FPs		European Coal and Steel Community (1951); Euratom (1958); European Economic Community (1957); 1970s Oil Crisis (1974-1980);	Brundtland Report (1987); Single European Act (1987)	Maastricht Treaty (1993); European Economic Area (1994); Fall of the Berlin Wall & Communism in Europe (1989-1991); Black Wednesday (1992)	European Monetary Institute (1994); European Investment Fund (1994)	Treaty of Amsterdam (1997); Dot-com Bubble (2000); European Research Area (2000); Lisbon Strategy (2000)	Implementation euro (2002); European Strategy Forum on Research Infrastructures (2002); EU Expansion – Old Soviet States (2004)	Global Financial Crisis (2007); Research Executive Agency (REA) (2007); European Institute of Innovation and Technology (2008); European Debt Crisis (2010)	Extension REA's (2013); European Refugee Crisis (2015); Adoption UN SDGs (2015)	European Green Deal (2020); Brexit (2020); Covid-19 Pandemic (2020); Next Generation EU (2020); Ukraine War (2022)
SDG 8 Indicators*	8.1.1: Annual real GDP / capital growth	0.85	2.23	1.85	0.18	2.71	1.62	2.54	-0.49	-1.97
	8.2.1: Annual real GDP / employed person growth				1.80	1.84	1.38	1.11	-0.01	-1.55
	8.3.1: Proportion of informal employment in total employment							9.78	8.20	7.67
	8.5.2: Unemployment rate			7.70	11.23	10.70	9.75	9.15	11.10	6.86

Note:*The planned FP budget, in current billions of EUR, incorporates conversions from European Currency Units to EUR for FP1-FP5, as detailed by Reillon (2017);**Planned budget adjusted for inflation using the EU-27 Consumer Price Index (CPI) with 2015 base year, applying CPI values from the start dates of each programme as the conversion points (Source: IMF);***These are the average values of the official SDG 8 indicators two years before the start of the FP, authors' calculations (Source: IMF World Economic Outlook 2023).

3   Data

Our study maps the presence of SDGs in research projects funded under the EU FPs and coordinated by research-oriented organisations. Our primary data source is the CORDIS database, a public repository of all EU-funded research projects and their results. It provides detailed project information, participant information, and information about project outcomes, allowing users to study their impact. This section details the variables we focus on, the methods to obtain them, and the data cleaning and filtering processes.

3.1   Data retrieval

For each project funded by the FPs, we aim to retrieve seven variables crucial for our analysis:

1) Title of the project
2) Abstract of the project

Input for the SDG mapping procedure

3) Name of the project's coordinator
4) Country of the project's coordinator
5) Received EU budget
6) Scientific disciplines identified in the project (EuroSciVoc[1])

Project characteristics

Used for selecting projects

7) Main activity type of the project's coordinator

coordinated by research organisations

For all research projects funded from FP7 onwards, this information was readily available in the publicly provided data dumps from the CORDIS database. Variables one to five are available for the projects funded under FP5-FP6, while FP1-FP4 did not include the fifth variable on the received EU budget. Presumably, because FP5 marked the budget transition from European currency units to euros.

For FP1-FP6, we obtain variable six, the identified scientific disciplines, using the SEDIA and SPARQL APIs provided by the European Commission, to access an updated version of the CORDIS database for these research projects, which includes these scientific disciplines. For research projects funded by FP6, we used the eCORDA[2] database provided by BELSPO to obtain the seventh variable, the main activity type of each project's coordinator. However, for the remaining research projects funded under FP1-FP5, we still need a way to gauge the research activity of their coordinators. For this purpose, we developed the following advanced solution.

The activity type variable (variable seven) classifies a project's coordinator into one of five categories: higher education institutions (HES), research organisations (REC), private companies (PRC), public research organisations (PUB), or others (OTH). As mentioned, we focus on projects led by research organisations, specifically those categorised under HES or REC (Enger & Castellacci, 2016). We

---

[1] EuroSciVoc is a multilingual taxonomy that systematically categorizes the primary fields of science. This classification is derived and regularly updated, using research projects funded from FP1 through Horizon Europe, utilizing semi-automatic natural language processing (NLP) techniques. Its foundational structure aligns with the main scientific disciplines as outlined in the 2015 Frascati Manual by the Organisation for Economic Co-operation and Development (OECD), forming its top-level or 'parent' categories. (OECD, 2015)

[2] The eCORDA database is the closed-source counterpart of the CORDIS database, containing also information on non-funded project proposals. It is mainly used by the European Commission and other national bodies for internal management, monitoring, and reporting on research projects and proposals under the FPs.

adopted the following strategy to predict if the coordinators of projects funded under FP1-FP5 can indeed be classified under HES or REC:

1) We used the 'rapidfuzz' Python package[3] to fuzzy match coordinators from FP1 to FP5 with those in FP6- HE, setting a cutoff score of 93 to ensure accuracy. This method matched 48.63% of coordinators (4,597 out of 14,079), representing 60.35% of all projects in this period. Of these, 49.82% were identified as research-oriented.
2) We constructed a vocabulary in 14 European languages, including terms like 'university', 'research', and 'institute'. This approach, tested for effectiveness on the FP7-HE dataset[4], identified an additional 1,978 research-oriented organisations. Still, 7,504 coordinators remained unidentified.
3) To reduce this amount, we only focused on the 1,593 recurring coordinators, as we were mainly concerned with SDG8 research being concentrated with certain entities.
4) To reduce this list further, we developed a second vocabulary comprising corporate indicators (e.g., 'Ltd', 'Inc', 'Plc', 'Llc', 'Lp') in multiple languages. By applying this method, we conclusively categorised 1,048 coordinators as non-research-oriented, reducing our list of unidentified coordinators to only 545.
5) For these remaining 545 recurring organisations, we used a combination of manual validation and OpenAI's GPT-4[5] to gauge their research orientation. This led to the identification of another 135 research-oriented organisations.

Ultimately, this approach enabled us to classify 31.27% of coordinators during FP1-FP5 as research-oriented, covering about 62% of the projects funded during this period.

3.2 Project selection and data cleaning

The concatenation of the public CORDIS data dumps resulted in 162,263 research projects from 1984 to November 2023. The initial phase of our data cleaning process included removing entries with missing critical variables such as the project's abstract, title, acronym, and start-and end-dates. After these steps, our refined dataset consisted of 98,548 research projects from 1984 to 2023.

Next, we removed research projects for which the activity type of the coordinator was not identified (see section 3.1) and kept only research projects coordinated by a research-oriented organisation. Our final dataset comprises 72,536 research projects, or 73.60%, funded over all FPs from 1984 to November 2023. **Fig. 2** shows the number of projects per FP. Analysing the aggregate number of funded research projects, indicated by combining the coloured and dotted bars, reflects an expansion in the scope and significance of Framework Programmes (FPs) within the EU's R&I policy (Nepelski

11

---

[3] rapidfuzz is a Python library designed for efficient string matching. It utilizes advanced algorithms to identify similarities between sequences, crucial for our study's fuzzy matching process. We employed rapidfuzz to align organization names across various Framework Programmes, effectively identifying similar entities despite minor variances in spelling or format.

[4] This strategy's effectiveness was validated using the FP7-Horizon Europe dataset. Our approach achieved a recall (true positive rate) of 82.21%, a specificity (true negative rate) of 93.01%, and an F1 score of 79.60%.

[5] For the classification of ambiguous cases, we employed prompt engineering with OpenAI's GPT-4. The system prompt used was: "You are a classifier tasked with determining whether a given organisation name (or sometimes just a name) relates to a research oriented organization. Your output should be a binary classification: Return 1 if the entity is classified as a research oriented organisation, and 0 if it is not. You take into account your own knowledge. So, if you are not sure about a name at all or can not predict if it is in fact research oriented, you return NaN. You will receive a list of names. Your task is to generate an output in JSON format, listing each name with its corresponding classification (1 or 0)". This approach allowed us to efficiently process the large quantity of remaining coordinators.

& Van Roy, 2020; Szücs, 2020). Specifically, with the transition to FP7, the European Commission called for a renewed and more ambitious scope for their FPs to address global challenges (European Commission, 2006). Additionally, the observed reduction in the number of projects from the FP5 to FP6 is attributed to an increase in the size of research projects, which in turn drew more partners and larger budgets (Breschi & Malerba, 2011). Additionally, we note a higher share of removed projects for the initial FPs (FP1-FP5). This is linked to the previously mentioned data cleaning process, the imputation of activity types of coordinators, and the increase in research projects coordinated by universities in later FPs (Cavallaro, 2024).
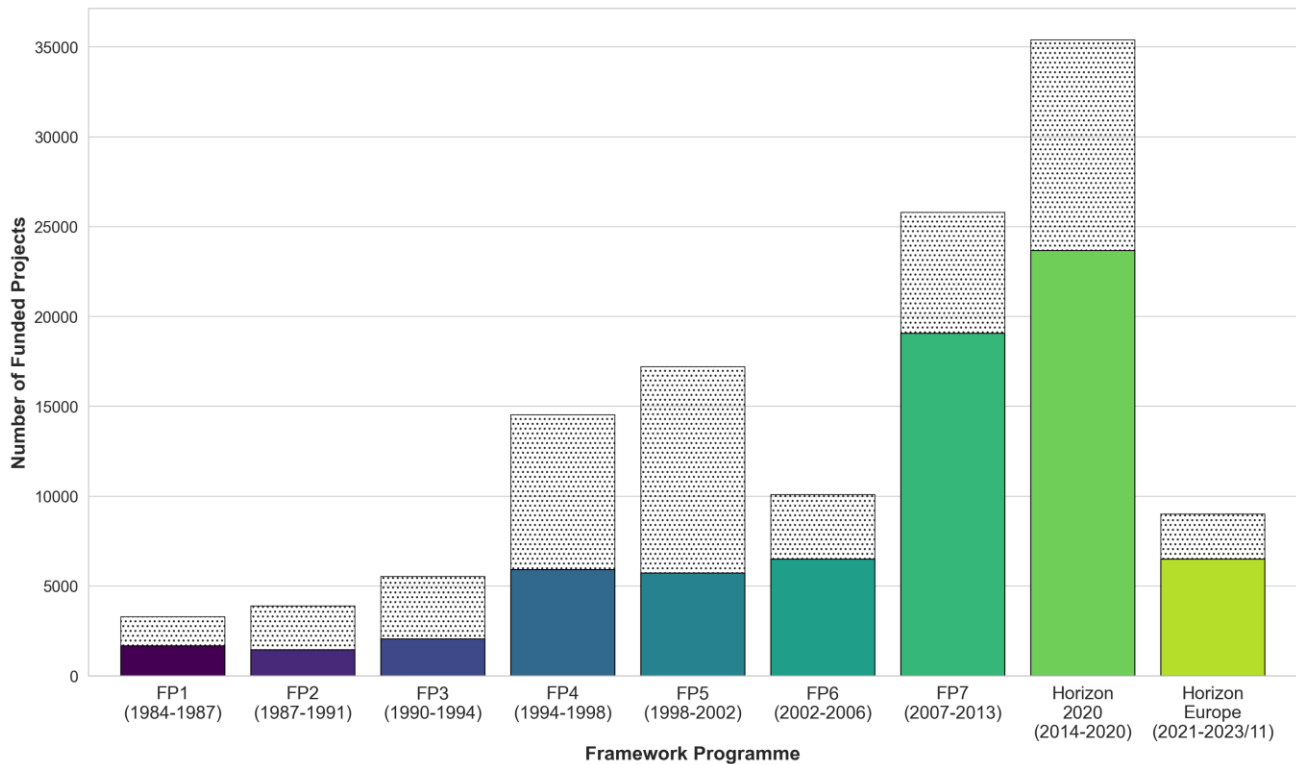

Fig. 2 Results from the data cleaning process and selection of research projects coordinated by research entities. The coloured area represents the number of included projects in our final dataset for each EU Framework Programme. The dotted area represents the projects removed during the data cleaning process and the selection of projects led by research-oriented entities, as described in 3.2.

4   Methodology

This section explains how we calculated the prevalence of the SDGs in the title and abstract of the funded research projects.

4.1   SDG – adjusted text preprocessing

Following Borchardt et al. (2022), our analysis incorporates an extensive preprocessing phase. To ensure that we detect every keyword in our corpus of research projects (title and abstract), our text preprocessing protocol treated the research projects and the lexicon words. The process started by replacing hyphens with spaces across all texts to unite word forms. Subsequently, each document was tokenised into individual words, which were converted to lowercase to eliminate any variations coming from capitalisation. We removed all non-alphabetic and non-numeric characters to refine the texts further, removing punctuations and special characters that could obscure keyword detection.

Furthermore, stopwords[6] were deleted from the text to retain only the most significant words. Finally, we applied the Porter Stemming algorithm, created by Porter (1980), reducing words to their root form (e.g. variations like "economics," "economical", and "economic" are all stemmed from the root "econom"). This allows us to boost the probability of detecting a keyword from our lexicon, as it effectively deals with plurals or other word variations. One significant limitation of the Porter stemming algorithm is its tendency for over-stemming, where words are reduced too much, and under-stemming, where the reduction is insufficient. An important example for our lexicon is the word 'productivity', which is reduced to 'product' when subjected to Porter stemming. This clearly illustrates where the stemming algorithm 'over-stems' and productivity loses its semantic meaning. To address this, we iteratively identified words in our lexicon susceptible to over-stemming or under-stemming and excluded them from the stemming process[7]. As a result, phrases like 'improve productivity' are now processed correctly as 'improv productivity'.

Fig. 3 depicts a WordCloud generated from mapping SDG 8 in the research projects. It explicitly depicts the number of times each word in our SDG 8 lexicon was detected in the abstract and title of the funded research projects. The most prominent terms identified are 'technological innovation', 'unemployment', 'entrepreneurship', 'economic development', and 'economic growth'. The varied sizes of the words demonstrate that no keywords completely dominated our lexicon, demonstrating its robustness.

---

[6] Stopwords are high-frequency words that do not add additional semantic information, while reducing the probability of detecting keywords (Bird et al., 2009). We used the list of stopwords from the NLTK library in python, but filtered out some that were important in our lexicon, including 'all', 'being', 'under', 'up', and 'out'.

[7] The words that we withheld from the stemming process were: AIDS, R&D, biodiversity, cohesion, communal, communication, communities, community, course, decarbonisation, decision, decisions, defence, digitalization, disbursement, disposed, diversity, drinking, early, enterprise, enterprises, environmental, Erasmus, erosion, exceed, exceeding, exceeds, exposed, farm-to-fork, financial, gas, generated, generating, generation, generations, industrialization, intensities, intensity, intercontinental, international, intolerance, invasive, loans, management, mitigation, modernisation, multidimensional, nonagriculture, obesity, off grid, offensive, pollution, preparedness, procurement, procurements, productivity, provision, refugee, refugees, regulation, release, remittance, remittances, responsibilities, responsibility, rights, sanitation, sanitised, status, universal, universities, university, unreliable, urbanisation, waste to energy. These words are included in the SDG world list as is, without stemming.
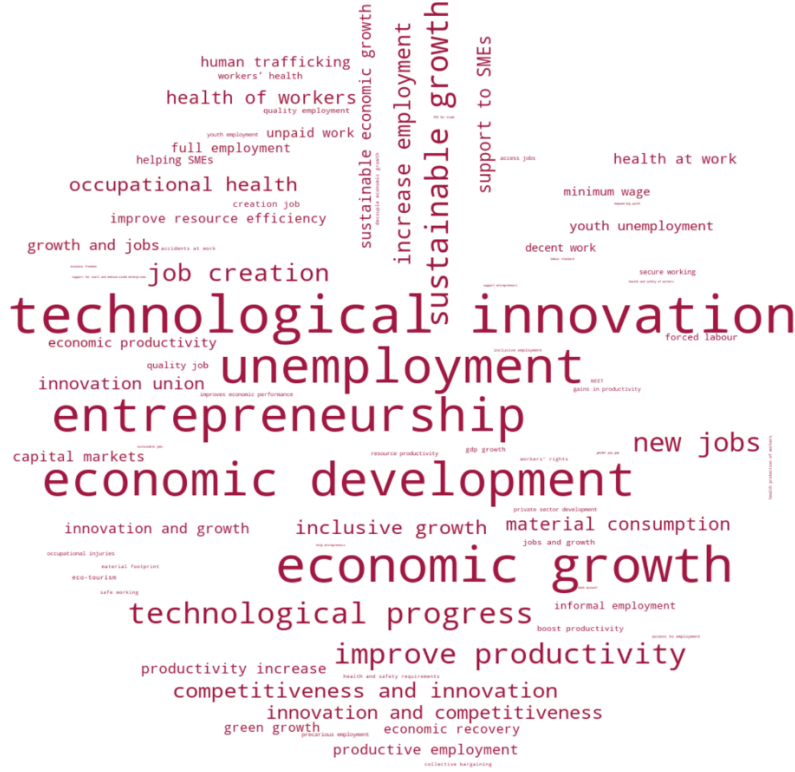
Fig. 3 SDG 8 WordCloud. The dimensions of each term in the WordCloud signify their relative frequency compared to other terms within the SDG 8 lexicon.

4.2 Mapping research to SDGs

We map research projects to SDGs based on the presence of an SDG keyword in either the title or abstract of the funded research project. Adopting the methodological framework of Borchardt et al. (2022), we utilize their established lexicon as part of a binary classification strategy for SDG relevance. We create dummy variables $x_{i,s}$ that are 1 if in project i a keyword of the lexicon for SDG s is present. Formally, this can be represented as:

$$x_{i,s} = I(\sum_{q \in \boldsymbol{Q}_s} f_{i,q} \geq 1),$$

(1)

where $f_{i,q}$ is the count of keyword q in the title and abstract of project i, $\boldsymbol{Q}_s$ is the list of keywords for SDG s, and $x_{i,s}$ is the binary indicator which is 1 when at least one keyword of SDGs i mentioned in the title and abstract of the research project.

4.3 Relative measure

It is further interesting to compute the share of SDG 7 in the number of research projects associated to the SDGs. When computing this share, it is important to avoid overweighting projects that are mapped to multiple SDGs. Indeed, preliminary findings of our SDG mapping revealed that 8,705 projects, representing 12%, were associated with two or more SDGs, $\sum_{u=1}^{17} x_{i,u} > 1$. Ignoring this fact leads to a double-counting of projects, which skews the analysis towards more generic or broadly used SDGs.

Consequently, in case of multiple SDGs in a research project, we recommend adjusting for the number of SDGs mentioned in the project by quantifying the prevalence of SDG in project i as the inverse of the number of SDGs present in the title and abstract of that project. Formally, the relative SDG classification $\tilde{x}_{i,s}$ is given by:

$$\tilde{x}_{i,s} = \frac{x_{i,s}}{\sum_{u=1}^{17} x_{i,u}} \quad \text{for } \sum_{u=1}^{17} x_{i,u} \geq 1 \text{ else } \tilde{x}_{i,s} = 0. \tag{2}$$

5   Results

The SDG mapping leads to an SDG characterisation of each single research project. To quantify the SDG trajectory of EU-funded research, we now aggregate across projects and FPs to obtain insights about the time series trends and determinants of the observed SDG heterogeneity across projects.

5.1   Time series trends in SDG prevalence

This section analyses the evolution of SDG prevalence within the EU-funded projects from FP1 through HE. **Table 2** outlines the core findings from our SDG mapping analysis spanning these FPs, describing the prevalence of each SDG across the FPs. Prevalence is quantified as the percentage of projects referencing each SDG, as detailed in section 4.2. Two-sided t-tests were included to detect significant shifts across consecutive programmes, with changes of statistical significance at the 5% level highlighted in grey.

A general trend across the FPs is the increasing prevalence of most SDGs in the EU-funded research project. This indicates a growing alignment between the SDGs and the funded research project. It supports the hypothesis of an increased acknowledgement of the need to tackle global challenges through research and research and innovation policy (Kallerud et al., 2013; Kastrinos & Weber, 2020; Yeh et al., 2022). This evolving focus is further evidenced by a steady reduction in projects not associated with any SDGs, dropping from 66.03% in FP1 to 50.99% in HE. Particularly noteworthy are the two consecutive and significant declines from FP7 to H2020 and from H2020 to HE. This aligns with H2020's increased emphasis on solving the Societal Challenges, as well as the adoption of the SDGs by the United Nations in 2015. Meanwhile, the pronounced decrease from H2020 to HE, from 57% to only 51%, mirrors the formal integration of the SDGs into the HE programme.

Zooming in on SDG 8, a general increase in the FPs becomes apparent. Starting from a modest 1.26% in FP1, the prevalence of SDG 8 projects peaked at 4.28% during H2020 before decreasing to 3.7% in HE (as of November 2023). This decrease stands out, especially as recent bibliometric studies indicate that the prevalence of SDG 8 in the broader research continues to grow, with no apparent decline in related publications (Ralph & Arora, 2024). Furthermore, Borchardt et al. (2022) highlight a growing emphasis on SDG 8 within EU policy documents, which the authors attributed primarily to the socio-economic repercussions of the COVID-19 pandemic and efforts towards economic recovery. This suggests that the dynamics of global policy and general research concerning SDG 8 are not necessarily aligned with the SDG 8 research funding strategies the EU pursues.

Other SDGs also reveal insightful trends. SDG 3 (Good Health and Well-being) consistently ranks among the most prevalent SDGs in the FPs, although its representation has declined from its peak in FP2 of almost 15% to around 10% in HE. Conversely, SDG 9 (Industry, Innovation, and Infrastructure) exhibits a steady increase in prevalence, culminating at 10.1% in Horizon Europe. Meanwhile, the

trajectory of SDG 7 (Affordable and Renewable Energy) highlights a noteworthy and distinct evolution. Initially, it captured about 7% of projects in FP1-FP3, coinciding with the oil crises, the Chernobyl disaster, and the Euratom collaboration. However, its focus diminished during FP4-FP6 to around 3.5% before significantly increasing again since the 2010s (FP7-HE), concurring with the increasing demand for renewable energy.

Finally, the most remarkable rise is the emphasis on SDG 13 (Climate Action), mainly from H2020 to HE, where its prevalence nearly doubled from 5.76% to 11%. This surge suggests that the EU research and innovation policy prioritises funding research projects on climate change, reflecting a global urgency in environmental sustainability. Importantly, this growing importance of SDG 13 was not observed by Borchardt et al. (2022) in the EU's policy documents, again alluding to the difference between the trends in global policy priorities and their priorities in research policy.

Table 2 Prevalence of the SDGs in the EU Framework Programmes

	FP1	FP2	FP3	FP4	FP5	FP6	FP7	H2020	HE	
SDG 1 (Poverty)	0.18	0.34	0.63	1.42	1.17	0.94	0.9	1.24	1.11	
		(-0.88)	(-1.23)	(-3.4)	(1.18)	(1.25)	(0.31)	(-3.48)	(0.89)	
SDG 2 (Hunger)	2.22	2.06	3.68	2.74	2.18	2.77	2	2.31	3.14	
		(0.31)	(-2.9)	(2.03)	(1.92)	(-2.09)	(3.37)	(-2.18)	(-3.51)	
SDG 3 (Health)	10.94	14.8	12.12	12.72	11.05	11.78	11.13	10.09	10.39	
		(-3.19)	(2.28)	(-0.72)	(2.79)	(-1.27)	(1.41)	(3.46)	(-0.69)	
SDG 4 (Education)	0.12	0.62	1.16	1.74	1.82	2.77	2.44	4.09	3.93	
		(-2.24)	(-1.74)	(-1.98)	(-0.32)	(-3.54)	(1.43)	(-9.68)	(0.58)	
SDG 5 (Gender)	0	0.07	0	0.07	0.26	0.48	0.27	0.64	1	
		(-1)	(1)	(-2)	(-2.57)	(-1.97)	(2.25)	(-5.8)	(-2.71)	
SDG 6 (Clean Water)	1.32	1.65	2.33	2.43	2.73	2.03	1.22	1.16	1.74	
		(-0.75)	(-1.43)	(-0.27)	(-1)	(2.5)	(4.24)	(0.52)	(-3.28)	
SDG 7 (Energy)	7.04	5.57	7.46	3.97	3.6	3.29	5.62	6.58	8.85	
		(1.68)	(-2.26)	(5.53)	(1.04)	(0.92)	(-8.4)	(-4.13)	(-5.84)	
SDG 8 (Decent Work)	**1.26**	**1.45**	**2.18**	**3.41**	**2.88**	**2.89**	**2.95**	**4.28**	**3.7**	
		(-0.44)	(-1.64)	(-3.09)	(1.63)	(-0.03)	(-0.24)	(-7.35)	(2.14)	
SDG 9 (Industry, Infrastructure)	4.33	4.89	5.53	6.4	5.63	6.81	6.45	8.37	10.1	
		(-0.74)	(-0.84)	(-1.47)	(1.76)	(-2.7)	(0.98)	(-7.59)	(-4.15)	
SDG 10 (Equality)	1.74	1.65	1.75	1.99	2.38	2.49	1.95	3.07	3.38	
		(0.2)	(-0.21)	(-0.73)	(-1.41)	(-0.42)	(2.52)	(-7.46)	(-1.23)	
SDG 11 (Sustainable Cities)	0.66	1.38	2.47	2.57	2.69	1.99	2.07	3.1	3.48	
		(-1.96)	(-2.39)	(-0.24)	(-0.42)	(2.56)	(-0.4)	(-6.77)	(-1.51)	
SDG 12 (Production and Consumption)	4.99	3.65	4.07	3.23	2.87	2.69	2.35	3.45	5.89	
		(1.85)	(-0.65)	(1.72)	(1.13)	(0.58)	(1.5)	(-6.82)	(-7.72)	
SDG 13 (Climate)	2.1	1.38	3.54	2.69	2.36	3.29	4.55	5.76	11	
		(1.56)	(-4.25)	(1.86)	(1.12)	(-3.13)	(-4.67)	(-5.66)	(-12.58)	
SDG 14 (Life Water)	1.02	0.69	1.79	2.13	1.84	1.88	1.32	1.12	1.53	
		(1.02)	(-3.04)	(-0.97)	(1.14)	(-0.18)	(2.99)	(1.88)	(-2.46)	
SDG 15 (Life Land)	2.95	3.1	5.72	3.95	3.3	2.88	2.41	2.62	4.01	
		(-0.24)	(-3.83)	(3.1)	(1.88)	(1.35)	(2)	(-1.42)	(-5.23)	
SDG 16 (Peace, Justice, Institutions)	0.06	0.34	0.82	0.9	1.07	1.34	1.36	1.79	1.97	
		(-1.72)	(-1.91)	(-0.31)	(-0.93)	(-1.39)	(-0.12)	(-3.57)	(-0.96)	
SDG 17 (Partnerships)	0.6	1.72	2.23	2.57	1.52	2.56	1.78	1.85	1.76	
		(-2.87)	(-1.08)	(-0.88)	(4)	(-4.07)	(3.54)	(-0.52)	(0.5)	
No SDG	66.03	62.28	56.28	59.86	61.49	60.69	62.36	57.68	50.99	
		(2.17)	(3.58)	(-2.83)	(-1.81)	(0.9)	(-2.38)	(9.84)	(9.57)	

The prevalence is calculated as the % of projects that mention each SDG theme. We applied two-sided T-tests to evaluate the statistical significance of the variation in proportions across consecutive programmes, with changes significant at the 5% level of significance denoted in grey. The t-statistics are presented in parentheses.
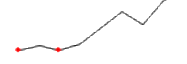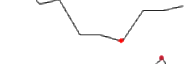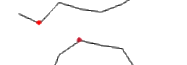
5.2 Relative popularity of SDG 8

Increasingly, the literature suggests that policymakers prioritise SDGs based on their national realities. HE stands out as the world's first research funding programme to formally incorporate the SDGs into its proposal requirements (European Commission, 2021). It has been seen as a reference for re-aligning their national priorities with the global ones (Nature Editorial, 2023). The schematic representation in **Figure 1** describes the practical challenge of coordination when implementing these priorities. Policymakers still depend on the individual actions of researchers applying for funding and the decisions of experts evaluating them. It is, therefore, important to monitor the effective prevalence of the different SDGs in the EU FPs. To compare and rank the prevalence between the SDGs, we recommend using the relative prevalence measure, outlined in section 4.2, which differs from the previous me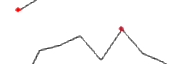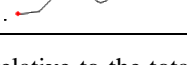asure by adjusting for overweighting projects mapped to multiple SDGs. Indeed, the proportion of research projects, including multiple SDGs, has increased from 10% in FP7 to around 19.4% in HE. The relative prevalence measure is robust to all these effects.

Table 3 shows the results of this relative prevalence measure over the FPs. It is important to note that for this analysis, we focus exclusively on SDG-related projects. We observe that SDG 8 is lowly prioritised compared to the other SDGs. More specifically, throughout the earlier programmes (FP1-FP3), SDG 8 was ranked 10th-12th as the most important SDG. From FP4 to H2020, however, SDG 8 was consistently ranked as the sixth or fifth most important SDG. As for November 2023, the first stage of HE shows that SDG 8 has significantly lost in prevalence, again being ranked the 10th most important SDG in the FP. Our results strike a middle ground between the study of Borchardt et al. (2022) indicating that SDG 8 is ranked as the most prevalent SDG in EU policy documents versus the bibliometric trend analysis from Ciarli et al. (2022), who finds that SDG 8 is ranked as one of the least prevalent SDGs. Ciarli et al. (2022) also find that SDG 8 is much more prevalent in funded research projects compared to the broader scientific literature.

Looking at the other SDGs, SDG 3 remains the most prominent SDG across all FPs. Accounting for over 25% of SDG-related projects from FP1-FP7, its prevalence has diminished in favour of other SDGs since H2020. Despite this, SDG 3 continues to be the leading SDG in the EU's research funding strategy, fully in line with the findings of Ciarli et al. (2022) and Borchardt et al. (2022), where SDG 3 is identified as the most prevalent SDG in both scientific literature and EU policy documents. SDGs 7 and 9 also maintain significant prevalence, consistently ranking as the second, third, or fifth most prominent SDGs throughout the FPs. While the ranking of SDG 7 is consistent with the findings of Ciarli et al. (2022), the high prevalence of SDG 9 diverges from their observations, with it being ranked the third most prevalent SDG in policy documents (Borchardt et al., 2022). Finally, SDG 13 shows variability in its ranking, fluctuating from seventh to 11th, most prevalent from FP1 to FP5, before ascending to the fourth rank in FP6 through H2020. Most notably, transitioning from H2020 to HE, the prevalence of SDG 13 surged, replacing SDG 9 as the second most prevalent SDG in the EU FPs. This marks a unique trend for research projects not observed in the broader scientific literature or EU policy documents, as per Ciarli et al. (2022) and Borchardt et al. (2022).

Table 3 Relative prevalence of the SDGs in the EU Framework Programmes

	FP1	FP2	FP3	FP4	FP5	FP6	FP7	H2020	HE	
SDG 1 (Poverty)	0.31	0.56 (0.73)	0.87 (0.76)	2.10 (2.78)	1.84 (-0.72)	1.43 (-1.29)	1.39 (-0.17)	1.63 (1.49)	0.98 (-3.23)	
SDG 2 (Hunger)	5.35	4.26 (-0.9)	6.40 (1.86)	4.55 (-2.39)	4.50 (-0.09)	4.87 (0.66)	3.64 (-3.07)	3.47 (-0.68)	3.98 (1.56)	
SDG 3 (Health)	28.58	35.23 (2.49)	23.63 (-5.05)	27.07 (2.11)	25.65 (-1.14)	26.35 (0.57)	26.13 (-0.23)	19.91 (-10.14)	17.54 (-3.11)	
SDG 4 (Education)	0.35	1.28 (1.83)	2.07 (1.19)	3.18 (1.85)	3.51 (0.66)	5.28 (3.22)	4.85 (-0.94)	7.00 (6.34)	5.40 (-3.48)	
SDG 5 (Gender)	0.00	0.09 (1.02)	0.00 (-1.28)	0.15 (1.2)	0.43 (2)	0.75 (1.66)	0.49 (-1.72)	0.91 (3.65)	1.20 (1.72)	
SDG 6 (Clean Water)	3.42	3.39 (-0.03)	3.64 (0.28)	3.69 (0.08)	5.15 (2.71)	3.19 (-3.82)	1.94 (-4.26)	1.55 (-2.29)	1.95 (1.85)	
SDG 7 (Energy)	17.10	12.77 (-2.12)	13.51 (0.42)	7.52 (-5.75)	7.57 (0.07)	6.46 (-1.59)	11.62 (7.96)	11.65 (0.07)	12.44 (1.33)	
SDG 8 (Decent Work)	**2.98**	**2.54** (-0.49)	**3.22** (0.84)	**5.41** (2.99)	**5.31** (-0.16)	**4.84** (-0.82)	**5.12** (0.63)	**6.07** (3.07)	**4.03** (-5.18)	
SDG 9 (Industry, Infrastructure)	9.94	10.42 (0.28)	9.24 (-0.8)	11.43 (2)	11.21 (-0.26)	12.89 (1.94)	12.53 (-0.53)	13.53 (2.16)	12.83 (-1.15)	
SDG 10 (Equality)	3.83	3.65 (-0.17)	2.68 (-1.15)	3.28 (1)	4.76 (2.79)	4.42 (-0.62)	3.91 (-1.23)	5.01 (3.75)	4.35 (-1.68)	
SDG 11 (Sustainable Cities)	1.42	2.93 (4.19)	3.88 (-2.27)	4.47 (-0.24)	5.27 (-0.42)	3.57 (2.59)	3.94 (-0.4)	4.65 (-6.63)	3.99 (-1.55)	
SDG 12 (Production and Consumption)	11.27	8.14 (-1.88)	7.22 (-0.68)	5.83 (-1.61)	5.48 (-0.55)	4.68 (-1.38)	4.16 (-1.25)	5.25 (3.71)	7.27 (4.92)	
SDG 13 (Climate)	4.19	2.72 (-1.47)	6.13 (3.18)	4.98 (-1.43)	4.46 (-0.9)	5.95 (2.54)	8.08 (3.97)	8.50 (1.12)	13.10 (9.06)	
SDG 14 (Life Water)	2.52	1.43 (-1.38)	3.44 (2.42)	4.06 (0.89)	3.84 (-0.42)	3.69 (-0.28)	2.34 (-4.03)	1.63 (-3.79)	1.80 (0.75)	
SDG 15 (Life Land)	7.44	6.46 (-0.68)	9.21 (2.04)	6.65 (-2.82)	6.33 (-0.48)	4.79 (-2.6)	4.06 (-1.81)	3.64 (-1.67)	4.61 (2.96)	
SDG 16 (Peace, Justice, Institutions)	0.18	0.73 (1.45)	1.29 (1.12)	1.50 (0.5)	1.87 (1.08)	2.32 (1.19)	2.63 (0.93)	2.86 (1.02)	2.49 (-1.24)	
SDG 17 (Partnerships)	1.12	3.39 (2.85)	3.58 (0.21)	4.14 (0.83)	2.82 (-2.71)	4.50 (3.37)	3.18 (-3.47)	2.76 (-1.81)	2.03 (-2.61)	
Multiple SDGs	6.07	6.81 (-0.84)	10.66 (-4.06)	11.29 (-0.78)	8.53 (4.99)	10.55 (-3.8)	9.96 (1.33)	13.89 (-12.57)	19.39 (-10.19)	

The relative prevalence is calculated as the proportion of projects that mention each SDG, relative to the total number of SDGs each project mentions. Here, we only focus on projects that mention at least one SDG. The final row shows the proportion of research projects related to multiple SDGs. We applied two-sided T-tests to ascertain significant variations in proportions across consecutive programmes, with changes significant at the 5% level of significance denoted in grey. The t-statistics are presented in parentheses.

5.3 SDG 8 project characteristics

Table 4 shows the project characteristics of each FP. While our primary focus is on SDG 8, we also include the most prevalent SDGs for comparison. The results show that SDG 8 projects consistently exceed the general trends in project size (both budget and consortium size) observed across all projects. A prime example was observed during H2020, where SDG 8 projects received an average budget of around €3,200,000 and exhibited an average consortium size of 9.6, higher than the overall averages and those of other SDGs.

Furthermore, SDG 8 projects stand out in terms of their predominantly multidisciplinary approach, marking SDG 8 as one of the most diverse among the SDGs. Notably, economics and business are the predominant disciplines driving SDG 8 projects, affirming our lexicon's effectiveness in accurately mapping project focuses.

We also observe that the average number of SDGs in the SDG 8 project is systematically among the highest. For some FPs, SDG 8 projects engage on average with one additional SDG. An interesting trend is the increasing engagement of SDG 8 projects with a broader range of SDGs in the later stages of the FPs, specifically during H2020 and HE. Finally, our analysis points to a significant geographic shift in the coordinators of SDG 8 projects. Historically dominated by the United Kingdom, HE sees Italy assuming a leadership role. This transition is likely influenced by the United Kingdom's departure from the EU. Therefore, this shift reflects the changing political landscape and highlights the dynamic nature of research leadership within the EU. Ultimately, the characteristics of SDG 8 projects, as outlined in Table 4, demonstrate a notable progression towards larger-scale, interdisciplinary research with extensive cross-SDG collaboration.

5.4 SDG 8 target decomposition

This section examines which SDG 8 targets are most prevalent in the FPs. **Fig. 4** shows our prevalence measure for SDG 8 as in Table 2, but it is now decomposed in the different targets using normalisation. We have assigned descriptive names to these targets based on our interpretation of their official definitions, details of which are provided in **Appendix 1**.

Our results show that in FP1, SDG 8 research projects were mainly focused on target 8.2 (Productivity), with target 8.8 (Labour Rights and Safe Working Conditions) ranked second but with a considerably lower prevalence. While negligible in FP1, target 8.5 (Full-and Decent Employment) emerges as the dominant target in FP2. The prevalence of 8.2 sees a substantial reduction, while target 8.8 maintains its attention. FP3 shows a resurgence of 8.2, alongside a notable shift towards target 8.1 (Economic Growth), which gains significant traction for the first time. Meanwhile, target 8.5 loses its previously gained prominence. Furthermore, 8.8 maintains its presence, accompanied by an increased focus on target 8.4 (Sustainable Production and Consumption).

Recovering from a substantial economic crisis in the UK caused by Black Wednesday, the landscape transforms again in FP4, where targets 8.1 and 8.5 become the most prevalent SDG 8 targets within the programme. As target 8.2 decreases to a lower rank of importance, target 8.3 (Entrepreneurship and Decent Work) climbs to the third rank, marking its first noticeable appearance in the FPs. This shift contributes to the peak in SDG 8 discussions in FP4, predominantly driven by the emphasis on targets 8.5 and 8.3. Moving on to FP5, there is a general decline in the prevalence of all targets except for target 8.2, which regains its position as the second most prevalent. This trend of rising prominence for target 8.2 and decreasing focus on target 8.5 continues into FP6 and FP7, with 8.2 again re-establishing itself as the leading SDG 8 target.

However, H2020 introduces completely different trends. Despite a general increase in the prevalence of SDG 8, as discussed in section 5.1, this surge is primarily driven by a significant increase in target 8.3. This coincides with the EU's growing commitment to support small and medium-sized enterprises by allowing them to coordinate research projects in the FPs (Mina et al., 2021), which again signifies the robustness of our lexicon in being able to detect these important but well-documented change in the EU's SME priorities. Notable, however, is that we also observe rises in the prevalence of targets 8.1 and 8.2. Conversely, HE once again presents a shift, as detailed in section 5.1, with an overall significant decline in the prevalence of SDG 8. While targets 8.1 and 8.5 maintain their positions, this decrease can be mainly attributed to decreases in targets 8.2 and 8.3.

In terms of prioritisation of targets within SDG 8, we find that 8.1, 8.2, 8.3, and 8.5 have been the predominant targets of varying importance. Conversely, targets 8.8 and 8.4 only saw some prominence in specific FPs, while the other targets, including 8.6 (Youth Employment), 8.7 (Forced Labour), 8.9 (Sustainable Tourism), and 8.10 (Financial Inclusion), were left entirely out of the SDG 8 discourse. This target prioritisation was also evident for all EU policy documents from 2021 and 2022 by Borchardt et al. (2022). These authors, however, found that the discourse was dominated entirely by 8.1, 8.3, and 8.5 and, to a lesser degree, 8.2 and 8.8. Furthermore, they found that the other targets were nearly neglected.
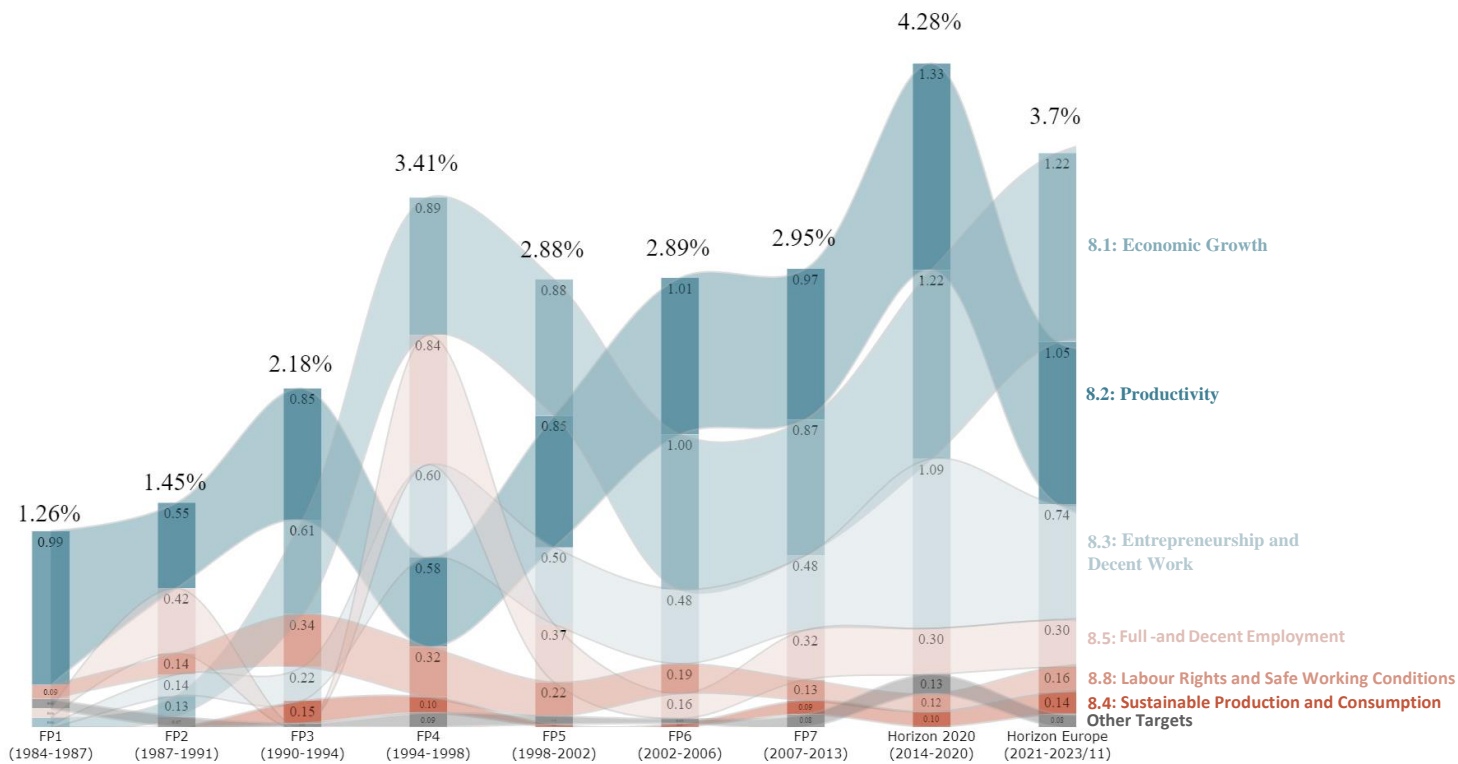
Fig. 4 Prevalence of SDG 8 projects in the EU Framework Programmes, decomposed by its targets. This figure shows the contribution of each SDG 8 target to the overall engagement with SDG 8 across various Framework Programmes. The prevalence of SDG 8 projects is quantified as the percentage of all projects aligned with this goal in each programme. By normalising the contribution of each project to account for overlapping targets, we show the contribution of each target to the total prevalence of SDG 8 in research projects.

Table 4 Characteristics of research projects in the EU Framework Programmes.

		Budget*	Consortium Size	Disciplines		SDGs	Top Countries
				Number	Top		
FP1	All Projects		2.3	2.4	CHEM	0.42	FR
	SDG3		2.3	2.7	CHEM	1.27	FR
	SDG7		3.0	2.2	ENV	1.46	DE
	SDG8		**3.0**	**3.5**	**CHEM**	**1.43**	**DE**
	SDG9		2.6	2.5	CHEM	1.49	UK
	SDG13		5.2	2.2	EARTH	1.86	DE
FP2	All Projects		4.4	2.4	CHEM	0.45	FR
	SDG3		3.2	2.7	BIO	1.21	UK
	SDG7		4.1	2.6	ENV	1.33	DE
	SDG8		**5.0**	**2.5**	**ECO**	**1.81**	**FR**
	SDG9		4.9	2.2	COMP	1.42	FR
	SDG13		6.6	2.7	EARTH	1.65	UK
FP3	All Projects		5.9	2.4	BIO	0.57	UK
	SDG3		5.5	2.7	BIO	1.35	UK
	SDG7		4.8	2.5	ENV	1.52	DE
	SDG8		**6.5**	**2.4**	**ECO**	**2.02**	**DE**
	SDG9		7.6	2.5	COMP	1.70	UK
	SDG13		6.1	2.3	EARTH	1.59	UK
FP4	All Projects		4.5	2.3	BIO	0.55	
	SDG3		4.3	2.8	BIO	1.36	UK
	SDG7		6.1	2.7	ENV	1.59	DE
	SDG8		**5.4**	**2.6**	**ECO**	**2.00**	**UK**
	SDG9		6.6	2.4	COMP	1.68	UK
	SDG13		6.8	2.7	EARTH	1.62	UK
FP5	All Projects	€ 1,240,792	5.8	2.1	BIO	0.49	UK
	SDG3	€ 1,419,998	6.4	2.5	HEALTH	1.25	UK
	SDG7	€ 1,358,519	7.0	2.2	ENV	1.50	DE
	SDG8	**€ 1,510,056**	**7.3**	**2.0**	**ECO**	**1.81**	**UK**
	SDG9	€ 1,478,585	7.4	2.2	COMP	1.57	DE
	SDG13	€ 1,331,315	7.6	2.3	EARTH	1.65	DE
FP6	All Projects	€ 1,775,490	6.1	2.6	BIO	0.53	UK
	SDG3	€ 1,969,106	6.7	2.9	BIO	1.28	UK
	SDG7	€ 2,160,962	10.1	2.8	ENV	1.57	DE
	SDG8	**€ 2,453,472**	**9.4**	**2.8**	**ECO**	**1.93**	**UK**
	SDG9	€ 2,602,859	9.0	2.7	COMP	1.62	UK
	SDG13	€ 1,834,920	8.2	2.7	EARTH	1.71	UK
FP7	All Projects	€ 1,637,721	4.4	2.2	BIO	0.51	UK
	SDG3	€ 1,988,050	4.9	2.7	BIO	1.28	UK
	SDG7	€ 2,509,496	7.4	2.5	ENV	1.56	UK
	SDG8	**€ 2,257,810**	**7.6**	**2.3**	**ECO**	**1.97**	**UK**
	SDG9	€ 2,385,657	7.8	2.3	BIO	1.68	UK
	SDG13	€ 1,810,981	6.1	2.6	EARTH	1.87	UK

Table 4 (*continued*)

		Budget*	Consortium Size	Disciplines		SDGs	Top Countries
				Number	Top		
H2020	All Projects	€ 1,911,772	4.9	2.7	BIO	0.62	UK
	SDG3	€ 2,304,956	5.4	3.0	HEALTH	1.42	UK
	SDG7	€ 3,262,008	8.1	2.9	ENV	1.66	ES
	SDG8	**€ 3,239,562**	**9.6**	**2.9**	**ECO**	**2.10**	**UK**
	SDG9	€ 3,041,272	9.7	2.8	COMP	1.83	UK
	SDG13	€ 2,271,605	7.0	3.0	EARTH	2.03	UK
HE	All Projects	€ 1,934,138	5.3	2.5	BIO	0.77	DE
	SDG3	€ 2,458,417	6.2	2.9	HEALTH	1.45	DE
	SDG7	€ 2,543,523	7.3	2.8	ENV	1.80	ES
	SDG8	**€ 2,303,885**	**8.8**	**2.7**	**ECO**	**2.34**	**IT**
	SDG9	€ 3,092,869	9.3	2.6	COMP	2.04	IT
	SDG13	€ 2,780,003	8.8	2.9	EARTH	2.17	ES

*Note: *Budgets have been adjusted for inflation based on the IMF's EU27 Consumer Price Index with 2015 as the base year (2015=100). Authors' calculations. ** The disciplines represent the NT1 category of the EuroSciVoc taxonomy. CHEM = chemical sciences, ENV = environmental engineering, EARTH = earth and related environmental sciences, BIO = biological sciences, COMP = computer and information sciences, ECO = economics and business, and HEALTH = health sciences.*

This table shows the critical attributes of projects mapped to SDG 8 across various EU Framework Programmes, comparing them with the aggregate characteristics of all projects. We evaluate the average budget, consortium size, discipline diversity, and the extent of interconnectedness with other SDGs. The table also highlights these projects' most common discipline and leading country. For context, we include prominent SDGs in our analysis and provide metrics for all projects to establish a benchmark.

5.5 SDG 8 target interlinkages

The concept of SDG interlinkages refers to the complex network of interactions existing within and between SDGs (Fronza et al., 2023). Since SDGs are 'integrated and indivisible' (UN, 2015), many of its goals and targets are interconnected by design. The literature focuses on uncovering these interlinkages, answering whether actions to meet one specific SDG will improve or hamper progress towards another (Allen et al., 2019; Dawes, 2021; Fronza et al., 2023). However, in the context of our research, finding links between the SDGs will reveal how different goals contribute to specific research questions. Consequently, in this section, we explore how SDG 8 is linked with other SDGs but take a deeper approach and look at SDG 8's targets to consider their thematic diversity. **Fig. 5** shows the results of this analysis in pie charts for the most prevalent targets in the FPs: 8.1 (Economic Growth), 8.2 (Productivity), 8.3 (Entrepreneurship and Decent Work), 8.4 (Sustainable Production and Consumption), 8.5 (Full -and Decent Employment), and 8.8 (Labour Rights and Safe Working Conditions), uncovered in section 5.4. For each, the pie chart represents the proportional distribution of SDG links for research projects mapped to that target and at least one other SDG (not including SDG 8). We only show the top 4 SDGs; the remaining are aggregated in the 'Other' category.

Starting with the research projects mapped to target 8.1, we see that these are mostly interlinked with SDG 9, followed closely by goals 13, 7, and 10. All these links are to be expected. For SDG 9, it is believed that to achieve sustainable economic growth, developing and underdeveloped nations require long-term infrastructural investments, industrial breakthroughs, and innovation (Küfeoğlu, 2022). For

SDGs 13 and 7, the bibliometric literature shows, ever since the Kyoto Protocol (1997), an increasing trend of research discussing both climate change and economic growth (Chen et al., 2023) and renewable energies and economic growth (Oliveira & Moutihno, 2021). Although research trends on the relationship between inequality and economic growth do not show a definitive upward trajectory, their interrelation is well-known in economics (Kuznets, 1955).

Moving to 8.2, we see that, like 8.1, SDG 9 is the most important interconnection. This is followed by SDG goals 7, 3, and 12. Since productivity is a widely used concept in many domains, it is easy to understand that research projects regarding industry, innovation, infrastructure, affordable and renewable energy, responsible consumption and production will likely look for new ways to improve productivity. Although the interlinkage with SDG 3 is more challenging to interpret, it might suggest research surrounding the link between improving productivity by ensuring good (mental) health, as discussed in Loeppke et al. (2009) and Bubonya et al. (2018).

Next, the results for 8.4 and 8.8 are easier to interpret. The dominant interlinkages between 8.4 and SDG 12, mainly through 12.4 (Efficient use of natural recourses) and 8.8 and SDG 3, respectively, are part of the inherent interdependencies between the SDGs (Howden-Chapman et al., 2017; Lenzen et al., 2022). Furthermore, the remaining SDGs linked with 8.4 are 8.1 and SDG goals 7, 13, and 9. We will not go into detail here about how they are interlinked as we would be mostly exploring the links of SDG 12, which is beyond the scope of our study. Subsequently, the remaining SDGs linked to 8.8 are goals 1, 4, and 9. However, because of the relatively low prevalence of this target, the small percentages are difficult to interpret.

Looking at target 8.5, we see that it is primarily linked with SDG goals 1 and 10, closely followed by goals 9 and 4. The interlinkages with goals 1 and 10 show the inherent interdependencies between full -and decent employment on the one hand and poverty and inequality on the other hand (Cerra et al., 2022). Likewise, the link between quality education and decent employment has also been studied. Conversely, the substantial difference between 8.5 and SDG 9 is more challenging to interpret.

Like 8.2, target 8.3 is predominantly interlinked with SDG 9, followed by SDG 7, SDG 12, and, uniquely, SDG 4. The link between target 8.3 and SDG goals 7 and 12 can be explained by the increasing conviction that the renewable energy industry and circular economy, respectively, will be large contributors to decent jobs in the economy (Schroeder et al., 2018; Van Der Ree, 2019; Goodwin et al., 2020). The latter interlinkage between 8.3 and SDG 4, could be explained by the growing importance of the concepts of 'skills development' and 'entrepreneurship education' in the literature (Von Graevenitz et al., 2010) and outlined in the UN's Entrepreneurship Policy Framework and Implementation Guidance as key concepts to promote entrepreneurship in developing countries (UN, 2012). Furthermore, Duffy et al. (2022) argue that quality education (or decent education) is a critical predictor for decent work.

This section proves the value of understanding the interlinkages between the SDGs. Furthermore, finding many expected links confirms the validity of our lexicon-based. However, many of the links require a more thorough keyword or topic-based investigation, which goes beyond the scope of this study.
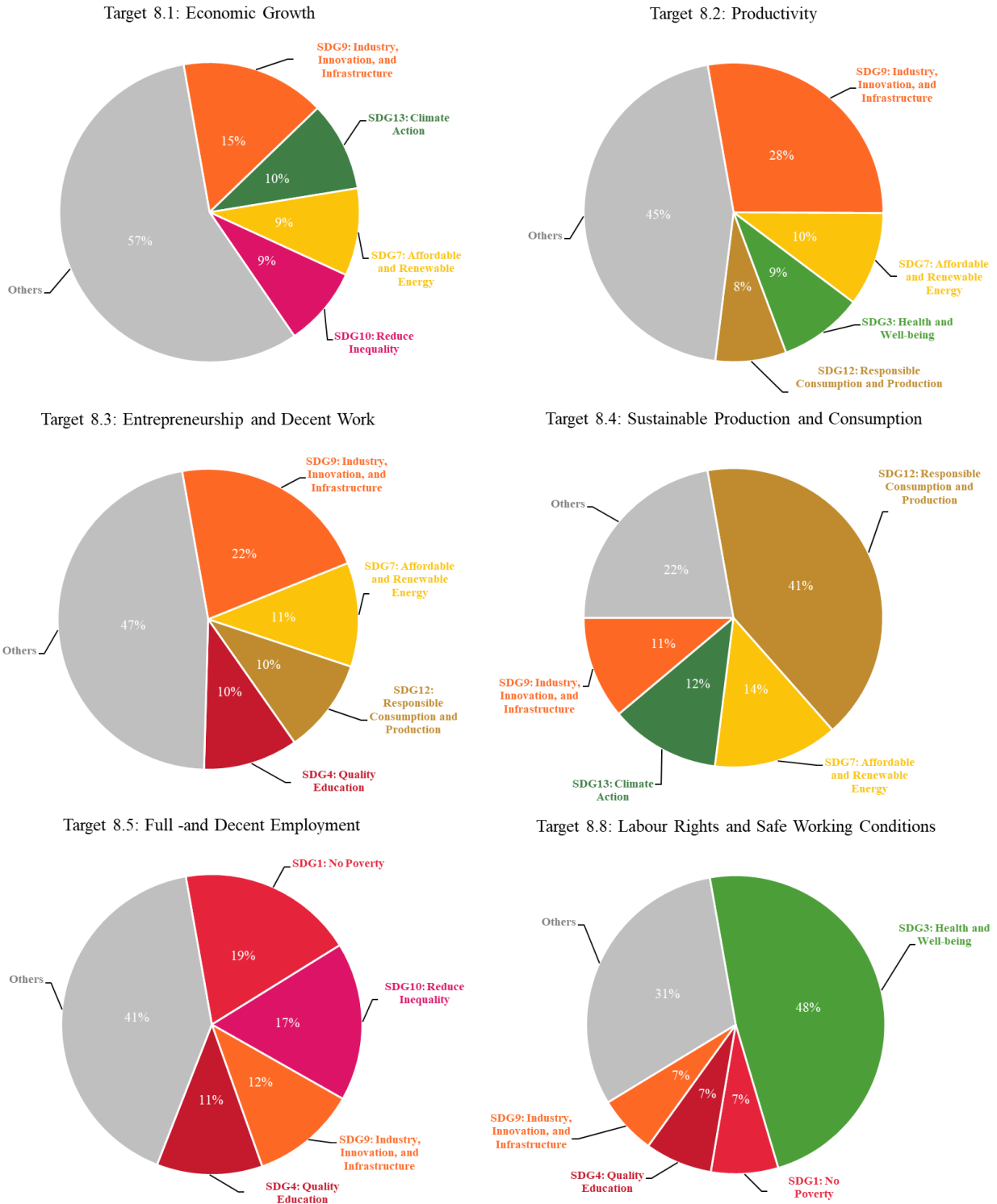
Fig. 5 Distribution of SDG 8 target interlinkages with other SDGs in the EU Framework Programmes. Each pie chart in this figure presents the proportional distribution of the links between the SDG 8 targets and other SDGs. Each of the most prevalent SDG 8 targets shows this distribution for the subset of projects mapped for that target and another SDG. We only show the top 4 goals and a 'Others' category aggregating the links between the remaining SDGs.

5.6 Economic drivers of SDG 8 prevalence

To conclude, we study the intertemporal relation between various official macroeconomic indicators used to monitor progress towards SDG 8 and the prevalence of SDG 8's specific targets, as outlined in section 5.4. Our analysis mainly focuses on Economic Growth (targets 8.1), Productivity (8.2), and Full and Decent Employment (8.5) alongside their respective official indicators: real GDP per capita growth, real GDP per employed person growth, and the unemployment rate for the EU-27 aggregate. Despite the significance of Entrepreneurship and Decent Work (target 8.3) within SDG 8, it was excluded from our analysis due to the unavailability of data regarding its official indicator, informal employment.

Table 5 presents the estimated regression coefficient ($\hat{\beta}$) and predictive power (R^2) derived from Ordinary Least Squares regressions, as described in the table's notes. We regress the outcomes for targets 8.1, 8.2, and 8.5, depicted in figure 3, for each FP against the two-year average of the official indicators preceding those FP. We must emphasise the limited sample size used in our analysis, which ranges from only 8 to 7 observations. Each variable aggregates thousands of observations (projects, economic decisions) and represents macroeconomic conditions. Our results should be interpreted as descriptive and not causal.

We expect negative coefficients to be observed on the diagonal for targets 8.1 and 8.2, suggesting that periods of low economic growth and productivity before an FP would correlate with a higher emphasis on these targets within the subsequent FP. Conversely, for target 8.5, a positive relationship with the unemployment rate was anticipated, indicating that higher unemployment levels would lead to a greater focus on this target in the next FP. Our findings support these hypotheses, particularly the relationship between target 8.1 and real GDP per capita growth, which shows significance at the 10% level. Notably, the strongest detected relationship was between target 8.1 and the real GDP per employed person growth, the official indicator for target 8.2. Despite some relationships not reaching statistical significance, the small sample size may limit the statistical power to make these conclusions, which is why the R² values were also considered to evaluate the predictive accuracy of each macroeconomic variable.

The R² values reveal intriguing insights. Once again, the predictive strength of the official indicators in forecasting target prevalence in the subsequent FP is highlighted. The real GDP per employed person growth rate, in particular, demonstrates the highest predictive power with an R² of 0.777 concerning target 8.1. Notably, the two-year average of the unemployment rate only shows predictive value for target 8.5, underscoring the distinct dynamics between GDP growth rates and unemployment rates. Overall, the findings suggest that researchers and policymakers tend to respond to adverse shifts in SDG 8 indicators, with poor performance in these indicators before an FP usually leading to increased attention to the corresponding targets within that FP.

Table 5 Macroeconomic performance as a leading indicator for SDG 8 prevalence in EU-funded research

$\bar{X}_{t-1,t-2}$	y_t	Target 8.1: Economic Growth	Target 8.2: Productivity	Target 8.5: Full -and Decent Employment
Real GDP per Capita Growth (8)	$\hat{\beta}$	**-0.13***	-0.06	-0.03
	R^2	0.391	0.158	0.032
Real GDP per Employed Person Growth (6)	$\hat{\beta}$	**-0.1****	-0.12	0.08
	R^2	0.777	0.428	0.21
Unemployment Rate (7)	$\hat{\beta}$	0.01	-0.01	0.09
	R^2	0.006	0.009	0.326

This table evaluates the predictive power of key macroeconomic indicators (rows) related to SDG 8 targets within subsequent EU Framework Programmes (columns). We estimate OLS regressions $y_t = \alpha + \beta \bar{X}_{t-1,t-2} + \epsilon_t$, where $\bar{X}_{t-1,t-2}$ is the average value of the official indicator two years preceding the Framework Programme. The table depicts the R^2 and the estimated regression coefficient, $\hat{\beta}$, resulting from this equation. The number of observations available for each macroeconomic indicator is noted between the brackets. Source: International Monetary Fund, World Economic Outlook October 2023. *Note: '*', '**', and '***' depict the 10%, 5%, and 1% levels of significance respectively.*

6   Conclusion

We propose a large-scale textual analysis approach for tracking and tracing SDGs' current and past trajectories in EU-funded research. The tracing allows us to identify past trends and understand the historical drivers of SDG prevalence in EU-funded research. The tracking is insightful about actions to take in order to steer future SDG prevalence in EU-funded research in alignment with policy targets.

The proposed SDG tracking and tracing method has a bottom-up approach. The first step consists of identifying SDG keywords in the title and abstract of each funded research project, as published in the CORDIS database. For this, we recommend to use the SDG lexicon of Borchart et al. (2022). The second step then aggregates the observed SDG prevalence to a time series at different levels of granularity. Subsetting the data based on period allows the identification of trends, while conditioning on fund characteristics reveals insights on differences in research approaches across SDGs.

Our findings reveal that SDG 8 related research projects are dominated by only four of its targets: 8.1 (Economic Growth), 8.2 (Productivity), 8.3 (Entrepreneurship and Decent Work), and 8.5 (Full and Decent Employment), in varying order of importance over time. The adoption of the SDGs by the United Nations in 2015 marked a significant increase in SDG 8 related research projects by over 45%, primarily driven by targets 8.1 and 8.3. The ongoing Horizon Europe has shown a pivot towards especially SDG 13 (Climate Action), leading to a relative decline in the emphasis on SDG 8. We also find empirical evidence that supports the conjecture that EU economic performance is a leading indicator of SDG 8 in the research project funded by that program. Specifically, the real GDP per employed person growth rate is highly predictive for research attention to target 8.1.

We further find that an SDG 8 project tends to be larger in budget and consortium sizes compared to other EU-funded projects. Over the period 1984 to 2023, the typical SDG 8 consortium size has tripled and is always larger than the average consortium size. SDG 8 research consortia also exhibit a higher degree of multidisciplinarity than other projects. SDG 8 ranks systematically among the most (diversely) interconnected SDGs across all framework programmes. The strongest connections are with SDG 7 (Affordable and Clean Energy) and SDG 9 (Industry, Innovation, and Infrastructure)

through targets 8.1, 8.2, and 8.3 and with SDG 3 through target 8.8 (Labour Rights and Safe Working Conditions).

Overall, we thus uncover substantial differences in received funding across SDGs and targets within SDGs. Even if strategic policy choices primarily drive these inequalities, we expect that there are still unintentional gaps between effective and desired SDG due to the lack of coordination between researchers, project evaluators and policymakers. We call upon EU policymakers to reduce this coordination problem by implementing the proposed SDG trace and track analysis in a publicly available dashboard showing the presence of SDGs in EU-funded research projects.

Acknowledgements

7   Bibliography

Abdullaev, B., Israilov, Z., Sotvoldiev, A., Hojiboev, M., & Makhliyokhon, M. (2023). Leading research trends on innovation funding: a bibliometric analysis approach. *Journal of Data Acquisition and Processing, 38*(1), 461. https://doi.org/zenodo.7656995

Aguiar, L., & Gagnepain, P. (2017). European cooperative R&D and firm performance: Evidence based on funding differences in key actions. *International Journal of Industrial Organization, 53*, 1-31. https://doi.org/10.1016/j.ijindorg.2016.12.007

Allen, C., Metternicht, G., & Wiedmann, T. (2019). Prioritising SDG targets: Assessing baselines, gaps and interlinkages. *Sustainability Science, 14,* 421-438. https://doi.org/10.1007/s11625-018-0596-8

Ash, E., & Hansen, S. (2023). Text algorithms in economics. *Annual Review of Economics, 15*, 659-688. https://doi.org/10.1146/annurev-economics-082222-074352

Bird, S., Klein, E., & Loper, E. (2009). *Natural language processing with Python: analyzing text with the natural language toolkit*. O'Reilly Media, Inc.

Bloch, C., & Sørensen, M. P. (2015). The size of research funding: Trends and implications. *Science and Public Policy, 42*(1), 30-43. https://doi.org/10.1093/scipol/scu019

Borchardt, S., Barbero Vignola, G., Buscaglia, D., Maroni, M. and Marelli, L., Mapping EU Policies with the 2030 Agenda and SDGs, *EUR 31347 EN*, Publications Office of the European Union, Luxembourg. https://doi.org/10.2760/87754

Breschi, S., & Malerba, F. (2011). Assessing the scientific and technological output of EU Framework Programmes: evidence from the FP6 projects in the ICT field. *Scientometrics, 88*(1), 239-257. https://doi.org/10.1007/s11192-011-0378-x

Bubonya, M., Cobb-Clark, D. A., & Wooden, M. (2017). Mental health and productivity at work: Does what you do matter?. *Labour Economics, 46,* 150-165. https://doi.org/10.1016/j.labeco.2017.05.001

Budd, A. (2005). Black Wednesday-A Re-examination of Britain's Experience in the Exchange Rate Mechanism. *IEA Occasional Paper*, (135). https://doi.org/10.2139/ssrn.734203

Cerra, V., Lama, R., & Loayza, N. (2022). Links between growth, inequality, and poverty. In V. Cerra (Ed.), *How to achieve inclusive growth* (Online ed.). Oxford Academic. https://doi.org/10.1093/oso/9780192846938.003.0002

Chen, M., Yao, T., & Wang, K. (2023). The economic impact of climate change: a bibliometric analysis of research hotspots and trends. *Environmental Science and Pollution Research, 30*(16), 47935-47955. https://doi.org/10.1007/s11356-023-25721-2

Ciarli, T., AlDoh, A., Arora, S., Arza, V., Asinsten, J., Assa, J., ... & Yegros, A. (2022). Changing Directions: Steering science, technology and innovation towards the Sustainable Development Goals. https://doi.org/10.20919/FSOF1258

Confraria, H., Ciarli, T., & Noyons, E. (2024). Countries' research priorities in relation to the sustainable development goals. *Research Policy, 53*(3), 104950. https://doi.org/10.1016/j.respol.2023.104950

Costanza, R., Daly, L., Fioramonti, L., Giovannini, E., Kubiszewski, I., Mortensen, L. F., ... & Wilkinson, R. (2016). Modelling and measuring sustainable wellbeing in connection with the UN Sustainable Development Goals. *Ecological Economics, 130*, 350-355. https://doi.org/10.1016/j.ecolecon.2016.07.009

Council of the European Communities. (1983). Council resolution of 25 July 1983 on framework programmes for Community research, development and demonstration activities and a first framework programme 1984 to 1987. Official Journal of the European Communities, C 208, 1-4. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31983Y0804(01)

Council of the European Communities. (1987). Council Decision of 28 September 1987 concerning the framework programme for Community activities in the field of research and technological development (1987 to 1991). Official Journal of the European Communities, OJ L 302, pp. 1-23. Retrieved from https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:31987D0516

Council of the European Communities. (1990). Council Decision of 23 April 1990 concerning the framework Programme of Community activities in the field of research and technological development (1990 to 1994). Official Journal of the European Communities, OJ L 117, pp. 28-43. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31990D0221

Dawes, J. H. P. (2022). SDG interlinkage networks: Analysis, robustness, sensitivities, and hierarchies. *World Development, 149*, 105693. https://doi.org/10.1016/j.worlddev.2021.105693

Duffy, R. D., Kim, H. J., Perez, G., Prieto, C. G., Torgal, C., & Kenny, M. E. (2022). Decent education as a precursor to decent work: An overview and construct conceptualization. *Journal of Vocational Behavior, 138*, 103771. https://doi.org/10.1016/j.jvb.2022.103771

Eisenstein, J. (2017, February). Unsupervised learning for lexicon-based classification. In *Proceedings of the AAAI Conference on Artificial Intelligence* (Vol. 31, No. 1). https://doi.org/10.1609/aaai.v31i1.10965

Enger, S. G., & Castellacci, F. (2016). Who gets Horizon 2020 research grants? Propensity to apply and probability to succeed in a two-step analysis. *Scientometrics, 109*, 1611-1638. https://doi.org/10.1007/s11192-016-2145-5

European Commission. (2006). *Amended proposal for a Decision of the European Parliament and the Council concerning the 7th framework programme of the European Community for research, technological development and demonstration activities (2007-2013)* (*COM(2006) 364 final*). EUR-Lex. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2006%3A364%3AFIN&qid=1702560221757

European Commission, Directorate-General for Research and Innovation, (2021). *Horizon Europe : strategic plan 2021-2024*. Publications Office of the European Union. https://doi.org/10.2777/083753

European Parliament. (1994). Decision No 1110/94/EC of the European Parliament and of the Council of 26 April 1994 concerning the fourth framework programme of the European Community activities in the field of research and technological development and demonstration (1994 to 1998). Official Journal of the European Communities, OJ L 126, pp. 55-87. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.1994.126.01.0001.01.ENG

European Parliament. (1998). Decision No 182/1999/EC of the European Parliament and of the Council of 22 December 1998 concerning the fifth framework programme of the European Community for research, technological development and demonstration activities (1998 to 2002). Official Journal of the European Communities, OJ L 26, pp. 1-33. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31999D0182

European Parliament. (2002). Decision No 1513/2002/EC of the European Parliament and of the Council of 27 June 2002 concerning the sixth framework programme of the European Community for research, technological development and demonstration activities, contributing to the creation of the European Research Area and to innovation (2002 to 2006). Official Journal of the European Communities, OJ L 232, pp. 1-33. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32002D1513

Forestier, O., & Kim, R. E. (2020). Cherry-picking the Sustainable Development Goals: Goal prioritization by national governments and implications for global governance. *Sustainable Development, 28*(5), 1269-1278. https://doi.org/10.1002/sd.2082

Fronza, V., Barbero Vignola, G., Borchardt, S., Valentini, S., Buscaglia, D., Maroni, M. and Marelli, L., Uncovering SDG Interlinkages: interconnection at the core of the 2030 Agenda, Publications Office of the European Union. https://doi.org/10.2760/45005

Galor, O. (2005). From stagnation to growth: unified growth theory. *Handbook of economic growth, 1,* 171-293. https://doi.org/10.1016/S1574-0684(05)01004-X

Gentzkow, M., Kelly, B., & Taddy, M. (2019). Text as data. *Journal of Economic Literature, 57*(3), 535-574. https://doi.org/10.1257/jel.20181020

Howden-Chapman, P., Siri, J., Chisholm, E., Chapman, R., Doll, C. N., & Capon, A. (2017). SDG 3: Ensure healthy lives and promote wellbeing for all at all ages. In D. J. Griggs, M. Nilsson, A. Stevance, & D. McCollum (Eds.), *A guide to SDG interactions: from science to implementation* (pp 81-126). Paris, France: International Council for Science.

International Labour Organisation. (1999). *Decent work. Report of the Director-General to the 87th Session of the International Labour Conference*. Retrieved 19 February, 2024, from https://www.ilo.org/public/english/standards/relm/ilc/ilc87/rep-i.htm

Kallerud, E., Amanatidou, E., Upham, P., Nieminen, M., Klitkou, A., Olsen, D. S., Toivanen, M. L., Oksanen, J., & Scordato, L. (2013). Dimensions of research and innovation policies to address grand and global challenges. Working Paper 13/2013. NIFU.

Kastrinos, N., & Weber, K. M. (2020). Sustainable development goals in the research and innovation policy of the European Union. *Technological Forecasting and Social Change, 157*, 120056. https://doi.org/10.1016/j.techfore.2020.120056

Kim, N. (2018). Comparison of indicators for identification of least developed countries and for measuring progress towards the sustainable development goals. *UN CDP Policy Review, (7)*. https://doi.org/10.2139/ssrn.3299967

Kuratko, D. F. (2005). The emergence of entrepreneurship education: Development, trends, and challenges. Entrepreneurship theory and practice, 29(5), 577-597. https://doi.org/10.1111/j.1540-6520.2005.00099.x

Kuznets, S. (1955). Economic Growth and Income Inequality. *The American Economic Review, 45*(1), 1–28. http://www.jstor.org/stable/1811581

Lenzen, M., Geschke, A., West, J., Fry, J., Malik, A., Giljum, S., ... & Schandl, H. (2022). Implementing the material footprint to measure progress towards Sustainable Development Goals 8 and 12. *Nature Sustainability, 5*(2), 157-166. https://doi.org/10.1038/s41893-021-00811-6

Linardatos, P., Papastefanopoulos, V., & Kotsiantis, S. (2020). Explainable ai: A review of machine learning interpretability methods. *Entropy, 23*(1), 18. https://doi.org/10.3390/e23010018

Loeppke, R., Taitel, M., Haufle, V., Parry, T., Kessler, R. C., & Jinnett, K. (2009). Health and productivity as a business strategy: a multiemployer study. *Journal of Occupational and Environmental Medicine, 51*(4), 411-428. https://doi.org/10.1097/JOM.0b013e3181a39180

Luukkonen, T. (1998). The difficulties in assessing the impact of EU framework programmes. *Research Policy, 27*(6), 599-610. https://doi.org/10.1016/S0048-7333(98)00058-4

Mestdagh, B., Sempiga, O., & Van Liedekerke, L. (2023). The impact of external shocks on the sustainable development goals (SDGs): Linking the COVID-19 pandemic to SDG implementation at the local Government level. *Sustainability, 15*(7), 6234. https://doi.org/10.3390/su15076234

Mina, A., Di Minin, A., Martelli, I., Testa, G., & Santoleri, P. (2021). Public funding of innovation: Exploring applications and allocations of the European SME Instrument. *Research Policy, 50*(1), 104131. https://doi.org/10.1016/j.respol.2020.104131

Minaee, S., Kalchbrenner, N., Cambria, E., Nikzad, N., Chenaghlu, M., & Gao, J. (2021). Deep learning--based text classification: a comprehensive review. *ACM Computing Surveys (CSUR), 54*(3), 1-40. https://doi.org/10.48550/arXiv.2004.03705

Mishra, M., Desul, S., Santos, C. A. G., Mishra, S. K., Kamal, A. H. M., Goswami, S., ... & Baral, K. (2023). A bibliometric analysis of sustainable development goals (SDGs): a review of progress, challenges, and opportunities. *Environment, Development and Sustainability,* 1-43. https://doi.org/10.1007/s10668-023-03225-w

Nature Editorial. (2023). Rich countries must align science funding with the SDGs. *Nature, 621*, 444. https://doi.org/10.1038/d41586-023-02847-4

Nepelski, D., & Van Roy, V. (2021). Innovation and innovator assessment in R&I ecosystems: the case of the EU Framework Programme. *The Journal of Technology Transfer, 46*(3), 792-827. https://doi.org/10.1007/s10961-020-09814-5

OECD. (2015). Frascati Manual 2015: Guidelines for collecting and reporting data on research and experimental development, *The measurement of scientific, technological and innovation activities*. OECD Publishing. https://doi.org/10.1787/9789264239012-en

Oliveira, H., & Moutinho, V. (2021). Renewable energy, economic growth and economic development nexus: a bibliometric analysis. *Energies, 14*(15), 4578. https://doi.org/10.3390/en14154578

Pham, N. T., Vo-Thanh, T., Shahbaz, M., Huynh, T. L. D., & Usman, M. (2020). Managing environmental challenges: Training as a solution to improve employee green performance. *Journal of Environmental Management, 269*, 110781. https://doi.org/10.1016/j.jenvman.2020.110781

Petri, E. (Ed.), Hametner, M., Kostetckaia, M., Patki, P., Best, A., Bueb, B., Knoblauch, D., Landgrebe, R., Scholl, L., Stein, U., Velten, E. K., De Rocchi, A., Kohli, A., Petry, C., Shatrov, K., & Steinemann, M. (2023). *Sustainable development in the European Union: Monitoring report on progress towards the SDGs in an EU context : 2023 edition*. (7th ed.) Publications Office of the European Union. https://doi.org/10.2785/403194

Rai, S. M., Brown, B. D., & Ruwanpura, K. N. (2019). SDG 8: Decent work and economic growth– A gendered analysis. *World Development, 113*, 368-380. https://doi.org/10.1016/j.worlddev.2018.09.006

Ralph, A., & Arora, A. (2024). Mapping the literature on decent work: A bibliometric analysis of sustainable development goal 8. *Sustainable Development*, 1–16. https://doi.org/10.1002/sd.2879

Reillon, V. (2017). *EU Framework Programmes for Research and Innovation: Evolution and Key Data from FP1 to Horizon 2020 in View of FP9: In-depth Analysis*. European Parliament. https://doi.org/10.2861/60724

Ritala, P., Huotari, P., Bocken, N., Albareda, L., & Puumalainen, K. (2018). Sustainable business model adoption among S&P 500 firms: A longitudinal content analysis study. *Journal of Cleaner Production, 170*, 216-226. https://doi.org/10.1016/j.jclepro.2017.09.159

Rivest, M., Kashnitsky, Y., Bédard-Vallée, A., Campbell, D., Khayat, P., Labrosse, I., ... & James, C. (2021). Improving the Scopus and Aurora queries to identify research that supports the United

Nations Sustainable Development Goals (SDGs) 2021. *Mendeley Data, 2*. https://doi.org/10.17632/9sxdykm8s4.4

Schroeder, P., Anggraeni, K., & Weber, U. (2019). The relevance of circular economy practices to the sustainable development goals. *Journal of Industrial Ecology, 23*(1), 77-95. https://doi.org/10.1111/jiec.12732

Scheel, A. M., Schijen, M. R., & Lakens, D. (2021). An excess of positive results: Comparing the standard psychology literature with registered reports. *Advances in Methods and Practices in Psychological Science, 4*(2). https://doi.org/10.1177/25152459211007467

Smith, T. B., Vacca, R., Mantegazza, L., & Capua, I. (2021). Natural language processing and network analysis provide novel insights on policy and scientific discourse around Sustainable Development Goals. *Scientific Reports, 11*(1), 22427. https://doi.org/10.1038/s41598-021-01801-6

Stern, D. I., Common, M. S., & Barbier, E. B. (1996). Economic growth and environmental degradation: the environmental Kuznets curve and sustainable development. *World Development, 24*(7), 1151-1160. https://doi.org/10.1016/0305-750X(96)00032-0

Szücs, F. (2020). Do research subsidies crowd out private R&D of large firms? Evidence from European Framework Programmes. *Research Policy, 49*(3), 103923. https://doi.org/10.1016/j.respol.2020.103923

Trane, M., Marelli, L., Siragusa, A., Pollo, R., & Lombardi, P. (2023). Progress by Research to Achieve the Sustainable Development Goals in the EU: A Systematic Literature Review. *Sustainability, 15*(9), 7055. https://doi.org/10.3390/su15097055

United Nations. (2015). Resolution adopted by the general assembly on 27 July 2015. A/RES/69/313. 12 August 2015.

United Nations Conference on Trade and Development. (2012). *Entrepreneurship policy framework and implementation guidance*.

Vanderfeesten, M., Otten, R., & Spielberg, E. (2020). Search queries for "mapping research output to the sustainable development goals (SDGs)" v5. 0. *Zenodo*. https://doi.org/10.5281/zenodo.3817445

Vanderfeesten, M., Jaworek, R., & Keßler, L. (2022). AI for mapping multi-lingual academic papers to the United Nations' Sustainable Development Goals (SDGs) (1.0). *Zenodo*. https://doi.org/10.5281/zenodo.6487606

van der Ree, K. (2019). Promoting Green Jobs: Decent Work in the Transition to Low-Carbon, Green Economies. *International Development Policy, 11*, (248-272). https://doi.org/10.4000/poldev.3107

Von Graevenitz, G., Harhoff, D., & Weber, R. (2010). The effects of entrepreneurship education. *Journal of Economic Behavior & Organization, 76*(1), 90-112. https://doi.org/10.1016/j.jebo.2010.02.015

Wang, Q., & Huang, R. (2021). The impact of COVID-19 pandemic on sustainable development goals– a survey. *Environmental Research, 202*, 111637. https://doi.org/10.1016/j.envres.2021.111637

Wang, W., Kang, W., & Mu, J. (2023). Mapping research to the Sustainable Development Goals (SDGs). https://doi.org/10.21203/rs.3.rs-2544385/v3

Yang, S., Zhao, W., Liu, Y., Cherubini, F., Fu, B., & Pereira, P. (2020). Prioritizing sustainable development goals and linking them to ecosystem services: A global expert's knowledge evaluation. *Geography and Sustainability, 1*(4), 321-330. https://doi.org/10.1016/j.geosus.2020.09.004

Yeh, S. C., Hsieh, Y. L., Yu, H. C., & Tseng, Y. H. (2022). The trends and content of research related to the Sustainable Development Goals: a systemic review. *Applied Sciences, 12*(13), 6820. https://doi.org/10.3390/app12136820

Appendix

Appendix 1 SDG 8 Targets, Indicators, and Stemmed Lexicon

	Description	Indicators	Stemmed Lexicon
SDG 8	Decent Work and Economic Growth		sustain develop goal 8, sdg 8, sustain econom growth, repair labour market, boost job growth, protect worker job, econom recoveri
8.1	Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries	Annual growth rate of real GDP per capita	econom growth, econom develop, gdp growth, growth rate real gdp, growth rate gdp, gross domest product growth, gross ad valu, growth job, inclus growth, sustain growth, product sector growth
8.2	Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors	Annual growth rate of real GDP per employed person	econom **productivity**, technolog innov, innov union, technolog progress, innov growth, competit innov, innov competit, improv econom perform, gain **productivity**, boost **productivity**, improv **productivity**, **productivity** increas
8.3	Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services	Proportion of informal employment in total employment, by sector and sex	job creation, creat qualiti job, entrepreneurship, support entrepreneur, support product activ, nonagriculture employ, increas employ, new job, financ enterprises, job growth, creation job, encourag **enterprises** innov, support small medium size **enterprises**, help sme, help small medium size **enterprises**, support sme, creativ job, sustain job, emerg industri job, job innov sector, access job, job rich recoveri, worker live extrem poverti, stimul busi environ, stimul invest climat, stimul busi climat, eas busi index, econom freedom, support micro small medium **enterprises**, support msme, privat sector organ promot, privat sector develop, support privat sme, privat sector advocaci, capit market, regulatori framework sme develop, help entrepreneur, creat busi climat, creat busi environ, creat invest climat, support innov sme, support innov **enterprise**, support innov small medium size
8.4	Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead	1. Material footprint, material footprint per capita, and material footprint per GDP 2. Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP	decoupl econom growth, improv resourc effici, materi footprint, materi consumpt, resourc productivity, green growth, climat resili growth, econom growth decoupl resourc use, resourc effici consumpt product

Appendix 1 (*continued*)

	Description	Indicators	Stemmed Lexicon
8.5	By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	**1**. Average hourly earnings of female and male employees, by occupation, age and persons with disabilities **2**. Unemployment rate, by sex, age and persons with disabilities	full employ, product employ, decent work, unemploy, inclus employ, equal pay, high skill employ, help vulner return labour, qualiti employ, minimum wage, fair work condit, gender pay gap, gender balanc labour market, decent job, inclus job, qualiti job, job creation vulner, creation job opportun, decent labour, protect job, women particip labour forc, inform employ, underutil women labour forc, help women make steadi incom, vocat rehabilit, employ peopl disabl, recruit person disabl, decent employ, access employ, unpaid work, underutilis women labour forc, poor job search skill
8.6	By 2020, substantially reduce the proportion of youth not in employment, education or training	Proportion of youth (aged 15-24 years) not in education, employment or training	unemploy among youth, youth employ, youth unemploy, youth train, youth work, job youth, young peopl employ, young peopl unemploy, help young peopl get work, young peopl age 15 29 employ educ train, educ insert labour market, neet, help 35 million young peopl year get train educ work, help young peopl get train educ work, young peopl employ educ train
8.7	Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms	Proportion and number of children aged 5-17 years engaged in child labour, by sex and age	forc labour, child labour, forc slaveri, human traffick, child soldier, child domest worker, protect children affect arm conflict, prevent recruit minor, recruit youth extremist group
8.8	Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	**1**. Fatal and non-fatal occupational injuries per 100,000 workers, by sex and migrant status **2**. Level of national compliance with labour rights (freedom of association and collective bargaining) based on International Labour Organization (ILO) textual sources and national legislation, by sex and migrant status	labour right, safe work, secur work, precari employ, occup injuri, occup accid, accid work, collect bargain, labour union, employe rights, health safeti requir, health safeti worker, health protect worker, health safeti result workplac, health surveil worker, protect worker health, protect worker risk health, health requir work, health relat workstat, worker safeti health, health worker, safeti health worker, occup health, health safeti requir regard exposur worker risk, exposur worker risk, worker health, health exposed worker, protect all worker, health work, health protect work, health safeti condit work, protect health safeti worker, safeti requir workplac, protect labour, labour standard, improv labour condit, worker **rights**

Appendix 1 (*continued*)

	Description	Indicators	Stemmed Lexicon
8.9	By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products	Tourism direct GDP as a proportion of total GDP and in growth rate	impact sustain tourism, monitor sustain tourism, evalu sustain tourism, sustain tourism evalu, sustain tourism monitor, plan sustain tourism, eco tourism, cultur link tourism, agri tourism, green tourism, inclus tourism, respons tourism, respons ecotour, promot local cultur, promot local product,
8.10	Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all	**1**. (a) Number of commercial bank branches per 100,000 adults and (b) number of automated teller machines (ATMs) per 100,000 adults **2**. Proportion of adults (15 years and older) with an account at a bank or other financial institution or with a mobile-money-service provider	access bank, access **financial** servic, access insur, commerci bank branch, number atm, autom teller machin, mobil money servic, bank account, **financial** inclus, access credit **financial** servic, **financial** servic provid, microfin, micro credit,
8.a	Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-Related Technical Assistance to Least Developed Countries	Aid for Trade commitments and disbursements	aid trade, aid disbursement, trade relat technic assist, trade relat assist, trade relat direct foreign invest, fdi trade, trade polici develop support,
8.b	By 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labour Organization	Existence of a developed and operationalized national strategy for youth employment, as a distinct strategy or as part of a national employment strategy	strategi youth employ, polici youth employ, global job pact, youth employ strategi, increas profession abil youth, increas employ youth, youth unemploy rise, opportun youth enter labour market, enabl youth entrepreneurship, enhanc youth entrepreneurship, empow youth, reinforc youth particip, reinforc youth leadership, opportun youth employ, enhanc youth employ, creat opportun youth, creat incent entrepreneurship youth, creat incent innov youth, employ opportun youth, instrument fight youth unemploy, youth employ polici

NOTE: The words in bold are not stemmed to avoid false positives, as explained in section 4.2.