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Research and Innovation

Scaling up ideas

Using Technology Readiness Levels to analyse technology progression in Horizon Europe

MONITORING & EVALUATION REPORT

Scaling up ideas. Using Technology Readiness Levels to analyse technology progression in Horizon Europe.

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Scaling up ideas

An analysis of Technology Readiness Levels in Horizon Europe

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Contents

Contents 2

1. Introduction 4

1.1. From ideas to markets 4
1.2. TRL as a standard metric 5
1.3. Use of TRL and its limitations 6
1.4. Other metrics 7

2. Methodology 8

2.1. This analysis 8
2.2. Overview of methodology 8
2.2.1. TRL in the Framework Programme 8
2.2.2. Project sample 8
2.2.3. TRL in topics and calls 9

3. TRL in Horizon Europe: general trends 10

3.1. Overall progression from ideas to market-ready innovation 10
3.2. Mono-beneficiary and collaborative projects 12

4. TRL by Horizon Europe Pillar 16

4.1. Pillar I: Excellent Science 16
4.2. Pillar II: Global challenges and European industrial competitiveness 18
4.3. Pillar III: Innovative Europe 22

5. Participants and outputs 24

5.1. Funding by project partner type 24
5.1.1. SMEs 26
5.1.2. TRL by sector 27
5.2. Intellectual Property Rights (IPR) applications and TRL 29
5.3. TRL in European Partnerships 30
5.3.1. Joint Undertakings 30

5.3.2. Co-programmed Partnerships 31

6. Conclusions 32

6.1. Conclusions 32
6.2. Lessons learned 33

7. Annex 35

7.1. Data sources 35
7.2. Consultation of Project Officers 35
7.2.1. Main findings from the survey and interviews of Project Officers 36
7.2.2. General feedback from Project Officers 36

8. TRL by Pillar II clusters: additional charts 38

8.1. Cluster 1 38
8.2. Cluster 2 39
8.3. Cluster 3 40
8.4. Cluster 4 41
8.5. Cluster 5 42
8.6. Cluster 6 43

9. Note on methodology 43

10. Acknowledgments 44

1. Introduction

1.1. From ideas to markets

Innovation is a complex process. It usually begins with a problem requiring a solution, a creative interpretation of an existing process, or the exploration of a new research frontier. The innovation journey unfolds as the initial idea is nurtured and developed, with planning, testing, and adjustment. This collaborative, multi-stage endeavour evolves through cycles of experimentation, ultimately transforming concepts into tangible solutions that address real-world challenges and deliver practical impact.

Supporting the full innovation journey is essential to strengthening Europe's competitiveness. The European Commission's Competitiveness Compass[1] highlights the importance of closing the innovation gap to boost competitiveness and restore the EU's dynamism. The European Union's flagship Framework Programme (FP) for research and innovation (R&I), Horizon Europe, spans the entire innovation journey – **from foundational research to disruptive innovation, scaling up, and large-scale deployment**. By addressing all stages of R&I and fostering collaboration among a diverse array of stakeholders – including researchers, universities, and companies – Horizon Europe ensures comprehensive support for transformative ideas, enabling their transition from concept to market impact.

Since the process of R&I is inherently uncertain, the risk associated with this uncertainty means that there are different points throughout the innovation journey where capital needs cannot be met by the market. These gaps – often known as the "valley of death" – pose significant risks to promising ideas and inventions. A first "valley of death" typically arises during the pre-commercialisation phase, when innovation struggles to transition from concept to a viable, market-ready product[2].

As the European Commission prepares to define the new Horizon Europe programme, it is important to take stock of how the existing programme has supported R&I across the innovation journey. Central to the proposal for the new Horizon Europe programme is the commitment to creating high-quality knowledge, fostering disruptive innovation, and enabling scaling up.

The Technology Readiness Level (TRL) scale provides a framework to assess progression across the innovation journey. Through a standardised nine-point scale, TRL can readily summarise projects' advancement level and proximity to operationalisation in the real world. By providing a common language and framework, TRL can help to de-risk investments, facilitate collaboration, and accelerate the commercialisation of innovative ideas.

This analysis goes beyond the requirements of TRL monitoring set by Article 50 of the Regulation on Horizon Europe[3] and seeks to provide an overview of the distribution of different TRLs in the programme, TRL progression in specific programme parts, and the types of beneficiaries that are most involved at different TRL stages. It concludes with some lessons for the future Horizon Europe programme and particularly emphasising the need to invest even further into the latest stages of innovation.

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[1] COM(2025) 30 final. (2025). *A Competitiveness Compass for the EU*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025DC0030

[2] COM(2025) 270 final. (2025). *The EU Startup and Scaleup Strategy: Choose Europe to start and scale*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025DC0270

[3] Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination.

1.2. TRL as a standard metric

The concept of Technology Readiness Levels (TRL) was first developed by NASA in the late 1970s to evaluate the maturity of technologies used in space exploration[4]. The system provided a uniform metric for assessing progress across different technological projects, enabling better risk management and decision-making. The TRL scale originally had seven levels, which NASA expanded to nine in the 1990s, covering the evolution of technologies from theoretical concept to fully operational technology[5].

The primary purpose of TRLs is to provide a standardised framework for assessing and communicating the maturity of technologies. This framework facilitates a common understanding among engineers, researchers, and decision-makers, allowing for informed discussion and planning related to technology development and deployment. The TRL scale offers a clear roadmap for the evolution of a technology, identifying the necessary steps to advance from basic research to deployment. This, in turn, allows for more efficient allocation of funding and resources and better prioritisation of projects. Having a standard measurement scale also served the purpose of facilitating communication of technical topic to a broader public.

In the current Horizon Europe, the TRL scale is used to ensure a balanced approach to funding different parts of the innovation journey[6]. For this reason, Horizon Europe beneficiaries are asked to report on their project's TRL as part of the routine project deliverables.

As illustrated in Horizon Europe's Work Programmes, the TRL scale comprises nine distinct steps, as illustrated in Table 1. These range from TRL1, which is the initial stage in the technology development process where the basic principles of a concept or technology are observed and reported, to TRL9, which represents the final stage of technology development and signifies that the actual system has been proven to work successfully in its operational environment.

Table 1: Technology Readiness Levels (TRLs) as defined in Horizon Europe

TRL	Description
TRL1	Basic principles observed
TRL2	Technology concept formulated
TRL3	Experimental proof of concept
TRL4	Technology validated in a lab
TRL5	Technology validated in a relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL6	Technology demonstrated in a relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL7	System prototype demonstration in an operational environment
TRL8	System completed and qualified

[4] EARTO. (2014). *The TRL Scale as a Research & Innovation Policy Tool, EARTO Recommendations*. Retrieved from https://www.earto.eu/wp-content/uploads/The_TRL_Scale_as_a_R_I_Policy_Tool_-_EARTO_Recommendations_-_Final.pdf

[5] This corresponds to a state in which the innovation is ready to be put to use in real-world environments.

[6] Article 7, Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination.

TRL	Description
TRL9	Actual system proven in an operational environment (competitive manufacturing in the case of key enabling technologies, or in space)

Source: European Commission Decision C(2025) 2779 of 14 May 2025. *Horizon Europe Work Programme 2025. 14. General Annexes*.

1.3. Use of TRL and its limitations

While the TRL scale is a valuable tool for assessing technological maturity, it is not without its limitations. As a technology-neutral metric, it may not fully capture the nuances and specificities of certain disciplines or technologies. Its simplicity and universality make it an attractive tool for evaluating and communicating the progression of disparate technologies. Yet, these same characteristics also impose inherent limitations. The TRL scale's ability to reduce complex technologies to a nine-step scale inevitably sacrifices nuance and precision, making it more of a summary than an exact representation of the state of R&I.

For example, proposals have been put forth to adapt the nine-step TRL scale, such as modifying its granularity or introducing additional criteria. Some disciplines have introduced variants with different levels of granularity[7], while others have incorporated additional criteria to suit their needs, yet still adhere to the original nine-level scale[8].

However, it can be argued that the primary purpose of the TRL scale is to provide a broad, high-level overview of the innovation progress accessible to a broad audience, rather than a detailed, specialist-targeted analysis. Nevertheless, some limitations should be borne in mind when using the TRL scale.

- **Non-linear nature of innovation**: The TRL scale generally assumes a linear progression from idea to market as a series of well-defined steps; however, this rarely reflects the actual innovation process. Innovation often involves trial and error, incremental improvements, and unexpected breakthroughs, making the TRL scale's sequential steps in some cases an oversimplification. This limitation is particularly noticeable in fields where innovation is more iterative and adaptive, unlike the space industry, where the TRL scale was originally developed and where linearity is more pronounced, usually due to the presence of a single buyer and a well-defined mission objective.
- **Complexity of innovation projects**: Even small-scale projects funded by Horizon Europe can comprise multiple workstreams (referred to as "work packages"), each advancing at different speeds. Collaborative projects, which account for a significant share of the Horizon Europe budget, involve multiple stakeholders, making it challenging to apply the TRL scale uniformly. For instance, in a project with multiple partners and work packages, basic science challenges may hinder progress in one area, while existing technologies provide an incremental platform for innovation in another.
- **Uncertainty and failure**: The TRL scale is designed with an inherent assumption of linear progress and successful outcomes. However, not all projects succeed, and failure is an inherent risk of the innovation process. The TRL scale does not explicitly account for the possibility of project failure or the need to revisit earlier stages of development.
- **Domain-specific limitations**: Certain scientific and technical domains, such as societal innovation processes or artificial intelligence (AI), may not fit neatly into the current TRL

[7] Charalambous, G., Fletcher, S. R., & Webb, P. (2017). The development of a Human Factors Readiness Level tool for implementing industrial human-robot collaboration. *The International Journal of Advanced Manufacturing Technology*, 91(5-8), 2465-2475.
[8] Buchner, G. A., Stepputat, K. J., Zimmermann, A. W., & Schomäcker, R. (2019). Specifying technology readiness levels for the chemical industry. *Industrial & Engineering Chemistry Research*, 58(17), 6957-6969.

framework. In the case of AI, for example, TRL can be applied to different groups of functionalities, each of them solving a specific aspect of a broader, more complex task, sometimes independently of other functionalities[9]. Another example is societal innovation, which often involves complex, non-technological factors that cannot be easily captured by the TRL scale's focus on product or service innovation with immediate economic impact.

Despite these limitations, the TRL scale remains a valuable and effective tool for tracking the evolution of projects over time. Its simplicity and universality make it a useful framework for communicating innovation progress to a broad audience. By acknowledging the limitations of the TRL scale, researchers, innovators and policymakers can use it in a more informed and nuanced manner, acknowledging both its strengths and weaknesses.

1.4. Other metrics

Alongside the TRL scale, several alternative metrics have been developed to try capture R&I advancement in an intuitive and standardised way. These metrics aim to address specific aspects of innovation that may not be fully captured by TRL, such as market proximity, societal impact, and adoption potential. They can offer a more nuanced understanding of R&I advancement, allowing for a more tailored approach to innovation development and assessment. Most notably, three key scales have been proposed:

- **Commercial Readiness Level** (CRL). The Commercial Readiness Level (CRL), originally developed by the Australian Renewable Energy Agency as a six-level index[10], was later adopted as a nine-point scale by both the US Advanced Research Projects Agency and the European Institute of Technology[11]. CRL focuses on assessing the proximity to market of innovation. Unlike TRL, which primarily concentrates on the technical maturity of a technology, CRL evaluates the commercial viability of an innovation, including its potential for market adoption and revenue generation. This makes CRL a suitable metric for innovations with a strong commercial focus.
- **Adoption Readiness Level** (ARL). This scale, developed by the US Department of Energy, is now widely used in US government-funded research to assess how far a technology is from being adopted or commercialised. It encompasses all phases of research, development, demonstration, and deployment. It assesses projects through four key lenses: value proposition, market acceptance, resource maturity, and licensing requirements[12]. In contrast to TRL, it considers the broader ecosystem and stakeholder landscape that can influence the adoption of an innovation, making it more adept for innovations requiring significant stakeholder engagement.
- **Social Readiness Level** (SRL). The concept of "social readiness" aims to enhance the consideration of social needs in innovation and how potential societal uptake is factored in when developing innovations. Developed by the Danish Innovation Fund in 2010[13], it is

[9] Martínez-Plumed, F., Gómez, E., & Hernández-Orallo, J. (2020). *AI Watch, assessing technology readiness levels for artificial intelligence*. Publications Office. Retrieved from https://data.europa.eu/doi/10.2760/15025

[10] Australian Renewable Energy Agency. (2014). *Commercial Readiness Index for Renewable Energy Sectors*. Retrieved from https://arena.gov.au/assets/2014/02/Commercial-Readiness-Index.pdf

[11] European Institute of Technology. (2025). *Commercial Readiness Scale*. Retrieved from https://www.eiturbanmobility.eu/wp-content/uploads/2023/05/Annex_Commercial-Readiness-Level_V1.pdf

[12] US Department of Energy (2025). Adoption Readiness Levels (ARL) Framework. Available at: https://www.energy.gov/technologycommercialization/adoption-readiness-levels-arl-framework (accessed: 17 July 2025).

[13] Centre national de la recherche scientifique (CNRS). (2023). *Gravir l'échelle de l'innovation sociale*. Retrieved from https://www.cnrs.fr/fr/actualite/gravir-lechelle-de-linnovation-sociale

currently being trialled in the Horizon Europe Work Programme 2025 for Cluster 5[14]. In addition to promoting the consideration of social aspects in Research and Innovation (R&I), it seeks to foster the engagement of all types of project partners in an interdisciplinary setup. SRL prioritises the social impact and societal acceptance of an innovation, making it a suitable metric for innovations with significant social implications.

2. Methodology

2.1. This analysis

This analysis arises from the requirement to monitor the performance of Horizon Europe-funded collaborative research using TRL[15]. Since project-level data on TRL is available for Pillar II (Global Challenges and European Industrial Competitiveness), as well as Pillar I (Excellent Science) and Pillar III (Innovative Europe), the analysis in this report includes all these three parts of Horizon Europe.

2.2. Overview of methodology

2.2.1. TRL in the Framework Programme

TRLs were first introduced in the Regulation establishing Horizon 2020[16]. They help determine the stage of technology development when considering proposals and allocating funding. TRLs provide tangible benchmarks for applicants, evaluators, and Project Officers to assess whether specific technologies are ready for the level of funding and type of development proposed. The rationale for using TRLs in EU research programmes lies in the need for a coherent, transparent method to assess the readiness of diverse technologies. The standardisation of TRL usage promotes clarity about a project's developmental status, which is insightful for both project stakeholders and policymakers.

2.2.2. Project sample

This analysis is centred on a subset of projects for which TRL data is available. Out of 15 148 projects (as of January 2025), this analysis utilises data on 2 462 projects (16%) that report at least one TRL measurement: at the start of the project, at the time of submission of the Periodic Reporting[17], or at the end (expected or achieved, depending on whether the project is still ongoing). In some cases, a smaller sample of 2 385 projects, where both start and end TRL data are available (16%), is used. This is mostly due to the timeliness of the Periodic Reporting. Of the projects used in the analysis, 525 are closed (less than one-quarter), while the rest were

[14] European Commission Decision C(2025) 2779 of 14 May 2025. (2025). *Horizon Europe Work Programme 2025, 8. Climate, Energy and Mobility*. Retrieved from https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2025/wp-8-climate-energy-and-mobility_horizon-2025_en.pdf

[15] Article 50, Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination.

[16] Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination

[17] The Periodic Reporting is an official document submitted by beneficiaries at specific points in time during their projects. For more information, see Annex Section 9.

still ongoing at the time of the data download (Annex Section 7.1). In case of ongoing projects, the TRL "at project end" is an expectation of the TRL that will be achieved on project completion.

2.2.3. TRL in topics and calls

In Horizon Europe Work Programmes, specific "topics"[18] may sometimes indicate the TRL that proposals should start from or achieve under a given call. This helps applicants to understand what is expected from proposals and it clarifies whether a certain project can meet the requirements of the call.

As a result, not all topics specify a TRL that projects should start from when applying for funding or that they are expected to reach by the end of the project. Moreover, even when end-of-project TRLs are specified in the topic, there is no obligation for beneficiaries to attain the indicated TRL, which is often expressed as a range.

The following table (Table 2) links two types of data: on one side, topics with an indication of an expected end TRL in the Work Programme; and on the other, the expected or achieved TRL of projects funded under those topics.

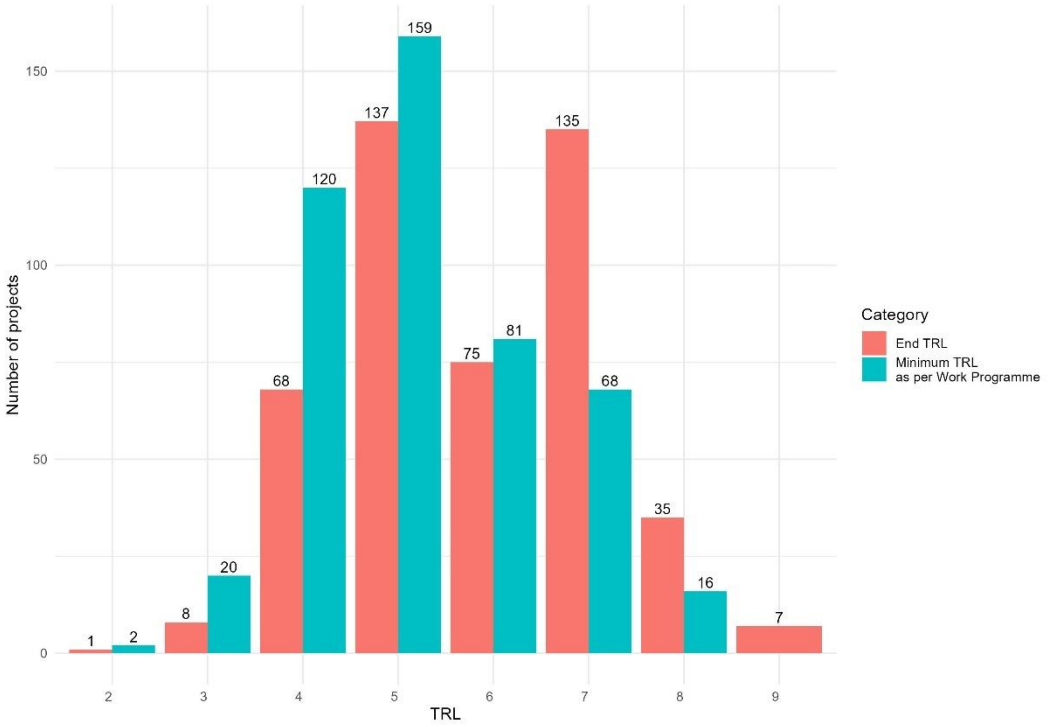
Table 2: Summary of TRL indications in Horizon Europe topics

Difference between topic end TRL and TRL declared in Periodic Reporting	Number of projects	Percentage of total
-5	1	0.2%
-4	2	0.4%
-3	8	1.7%
-2	48	10.3%
-1	187	40.1%
0	198	42.5%
+1	17	3.6%
+2	4	0.9%
+3	1	0.2%

It appears that the TRL reported by project beneficiaries in the Periodic Reporting is generally in line with the suggested TRL in the topic description: for nearly 43% of projects (198) there is no difference between the TRL they expect to achieve and the "target" TRL specified in the topic of a call. Similarly, 40% of projects (187) fall just one TRL step short of the expected target. The variation for the remaining projects is entirely normal, as projects might encounter implementation difficulties along the way. The same data is presented in Figure 1, which shows side-by-side the distribution of projects by TRL in the Periodic Reporting and in the Work Programme.

[18] In Horizon Europe, "topics" are thematic areas under which specific calls for funding are published. Topics are defined in the Work Programmes and reflect the general intervention logic of Horizon Europe, including its objectives and expected impacts in a specific area of research.

Figure 1: TRL in Work Programmes vs expected or achieved TRL



Base: 466 projects. Note: The chart includes only projects associated to calls with a TRL in their Work Programme, as reported in the European Commission's Call Passport System (CPS).

3. TRL in Horizon Europe: general trends

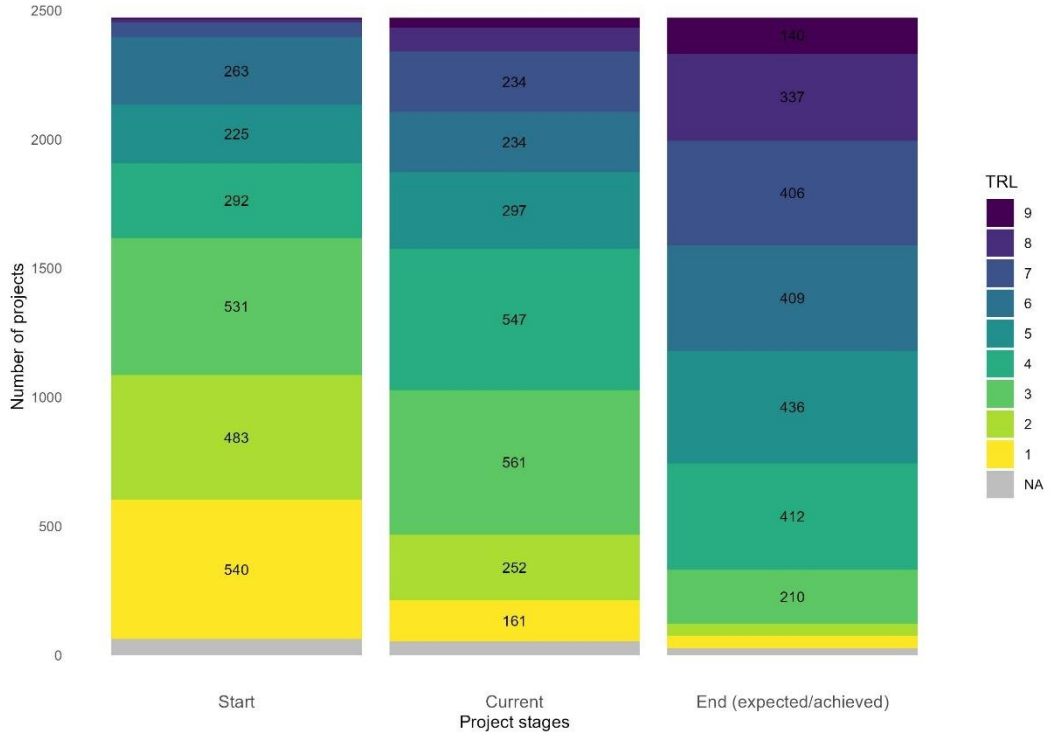
3.1. Overall progression from ideas to market-ready innovation

The analysis of TRL data for projects funded under Horizon Europe reveals a consistent trend of progression from lower to higher TRLs over the project lifecycle. The Periodic Reporting framework provides three main data points for assessing TRL progression: the TRL at the start of the project, the current TRL at the time of reporting, and the achieved TRL (or the expected TRL for ongoing projects) at the end of the project.

By comparing these three data points, a clear picture of TRL progression towards higher TRLs during the project lifecycle emerges (Figure 2). Most projects (63%, or 1 554 projects) begin at TRL3 or lower, indicating they are in the early stages of development. However, as the projects advance, the proportion of projects at lower, basic research TRLs (TRL1-TRL3) decreases. At the intermediate reporting stage, the share of TRL1-TRL3 projects drops to 39% (974 projects), and by the project's completion, this figure decreases further to 12% (304 projects). Conversely, the proportion of projects at higher, development TRLs (TRL6-TRL8) increases substantially over the project lifecycle. Overall, there is a clear, gradual trend from lower stages of development (particularly initial concept formulation and proof of concept) to higher maturity (for example, demonstration and beyond).

There are relatively fewer projects that start with a high TRL. At the onset, only 13% of projects (331 projects) are classified as TRL6-TRL8, but by the project's completion, this figure rises to nearly half (47%, or 1 152 projects). This trend suggests that many projects are successfully advancing towards higher levels of technological maturity, with a significant proportion reaching the critical stages of demonstration, testing, and validation.

Figure 2: TRL evolution in Horizon Europe (number of projects)

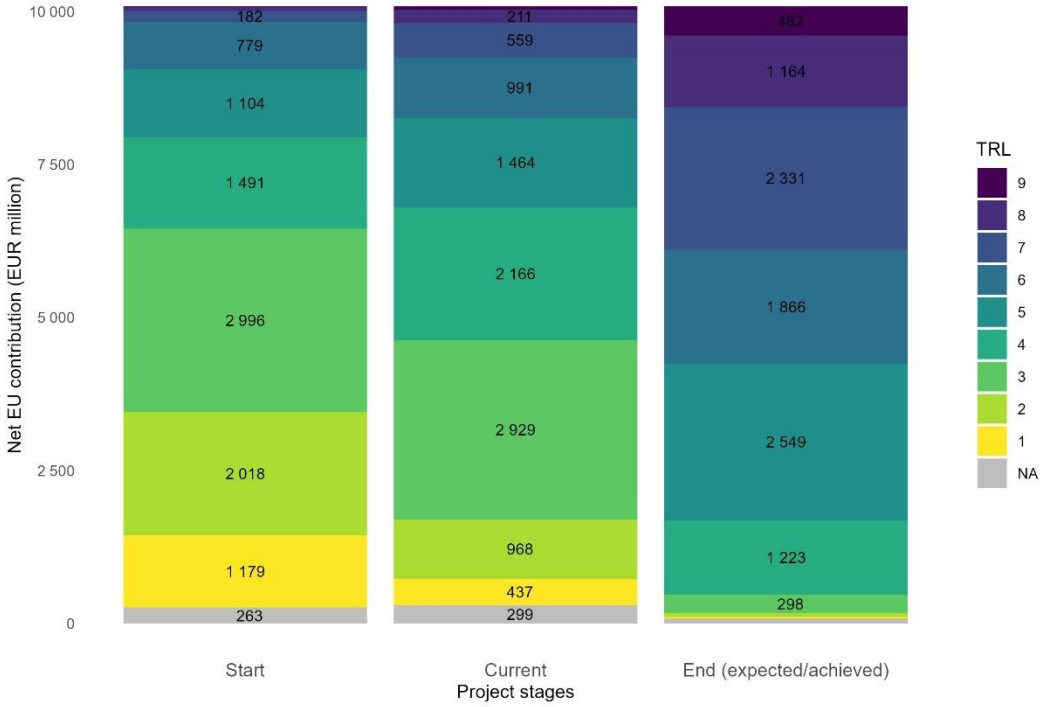


Base: 2 472 projects.

Another way of examining the same data is through the funding granted to each project. In this case, the patterns are overall very similar. As shown in Figure 3, the allocation of funds to projects at various TRLs reveals a notable shift over the project lifecycle. Initially, projects classified as TRL1-TRL3 receive a substantial amount of funding, totalling nearly EUR 6.2 billion. However, by the project's completion, the funding allocated to this TRL group drops to slightly over EUR 389 million.

In contrast, projects at higher TRLs (TRL6-TRL8) experience a significant increase in funding over the project duration. Initially, these projects receive just over EUR 1 billion, but at the end, they account for a substantial EUR 5.3 billion. This marked increase in funding for higher TRL projects suggests that funding is effectively helping projects to reach the later stages of technological development, such as demonstration, testing, and validation.

Figure 3: TRL evolution in Horizon Europe (funding amount)

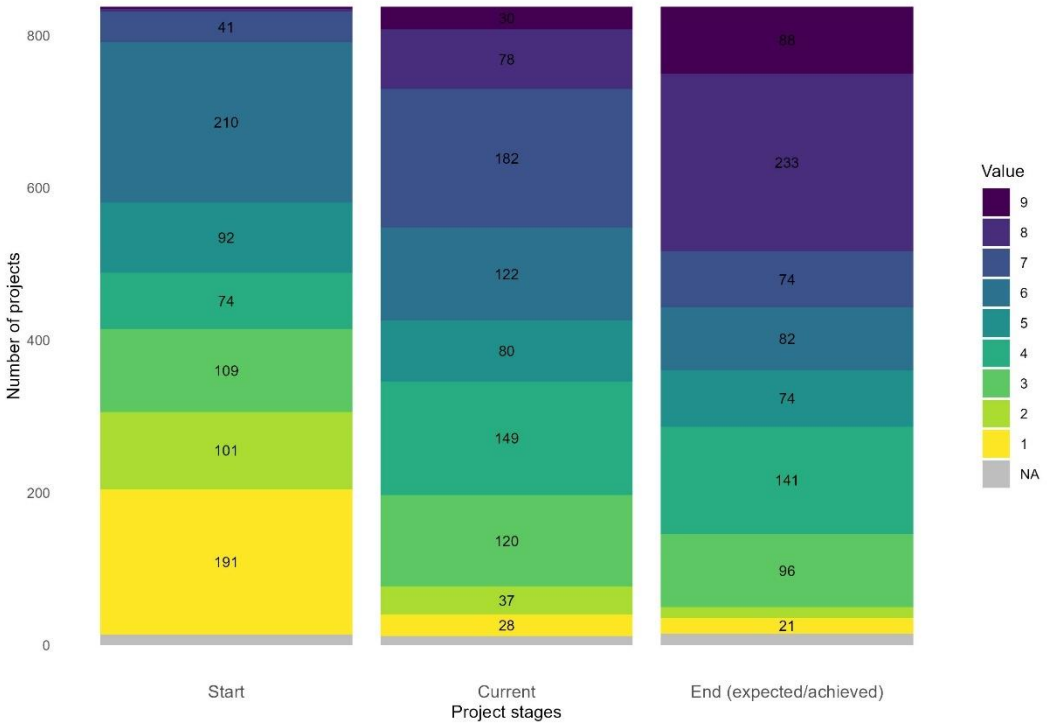


Base: 2 472 projects.

3.2. Mono-beneficiary and collaborative projects

A similar progression towards higher TRLs is observed in both mono-beneficiary and collaborative projects, as illustrated in Figure 4 and Figure 5. While there are some minor differences between the two groups, the overall trend towards higher TRLs remains consistent. Notably, mono-beneficiary projects exhibit a slightly more pronounced progression towards higher TRLs at project completion. This can be attributed to the presence of European Research Council (ERC) Proof of Concept projects (206 projects, accounting for one-quarter of all mono-beneficiary projects) and European Innovation Council (EIC) projects (352 projects, representing 42% of projects). By design, these schemes focus on single participants and target higher TRLs, particularly the Proof of Concept and the EIC Accelerator.

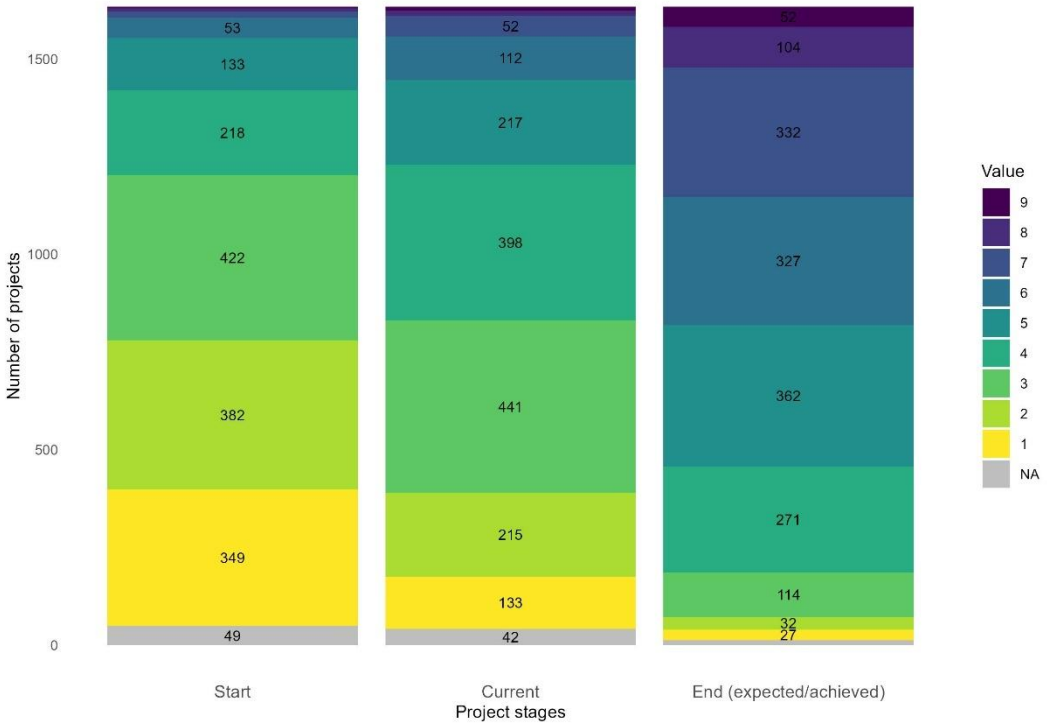
Figure 4: TRL in mono-beneficiary projects



Base: 838 projects.

In contrast, collaborative projects, which are almost double the number of mono-beneficiary projects (1 634 projects, with 1 150 projects originating from Pillar II, approximately 70%), exhibit a slightly different profile. Among these collaborative projects, nearly 60% (960 projects) reach a TRL between TRL4 and TRL6 by the project's end. This tendency may be attributed to the dominant presence of Pillar II projects in the sample, which typically focus on applied research and innovation activities. The fact that a significant proportion of collaborative projects achieve a TRL between TRL4 and TRL6 suggests that these projects are successfully advancing towards the demonstration and testing phases, albeit at a slightly slower pace compared to mono-beneficiary projects.

Figure 5: TRL in collaborative projects



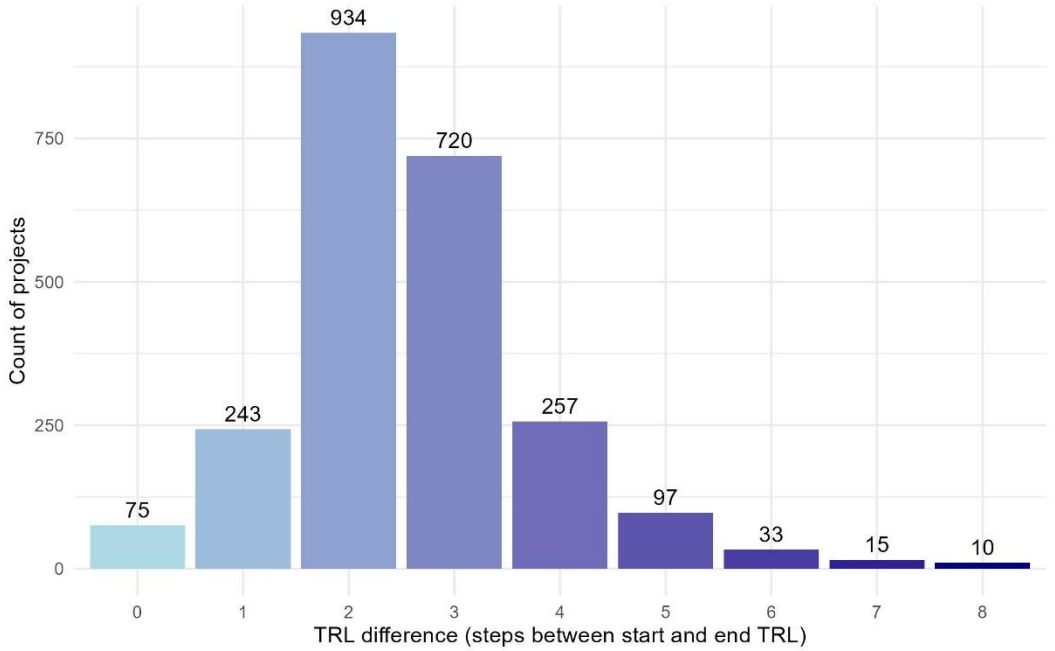
Base: 1 634 projects.

Another way to present the progression through different TRL stages is by considering the number of levels that projects report having advanced over the course of the grant. This is represented in Figure 6.

The distribution of TRL progression between the start and end of projects reveals that most projects advanced by either two steps (934 projects, or 39%) or three steps (720 projects, or 30%) in TRL levels. This finding aligns with feedback from Policy Officers involved in Pillar II and Pillar III, who indicated that most projects typically progress within this range. The fact that nearly 70% of projects fall within this range suggests that the funding period is generally sufficient to support significant technological advancements.

In contrast, only a small proportion of projects (58 projects, or 2%) reported an increase in TRL of six or more levels, indicating a more rapid and substantial progression towards technological maturity. Since there are no exact instructions for beneficiaries and Project Officers on how to report TRL, these projects with relatively high TRL increases mostly include those with limited technological components (e.g., econometric or business models) where the TRL scale has been interpreted more loosely. However, these represent only a small fraction of the entire project sample reviewed in the analysis. Conversely, a small group of projects (75 projects, or 3%) did not report any progress in terms of TRL. This is not surprising, given that innovation, due to its unpredictable nature, may sometimes encounter setbacks or delays.

Figure 6: Distribution of TRL progression

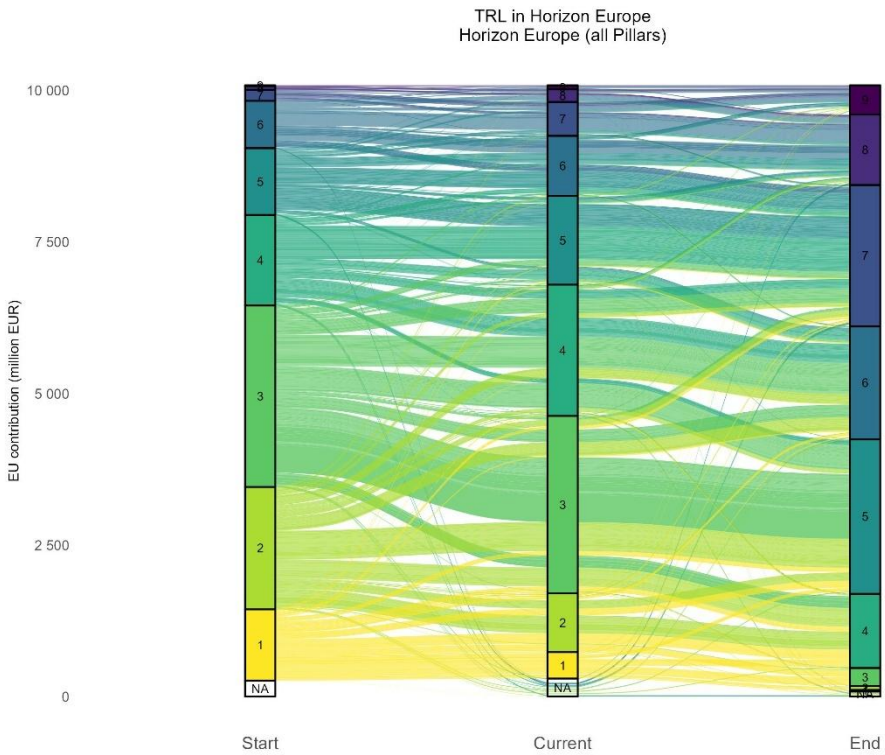


Base: 2 384 projects. One project with negative progression (from TRL9 to TRL8 has been removed).

The underlying assumption behind the previous charts is that projects funded through Horizon Europe progress from lower to higher TRLs over the course of the grant period, albeit at varying speeds. This expectation is rooted in the diversity of topics and technologies covered by these projects, which likely influences their pace of development.

To provide a more comprehensive understanding of this progression, Figure 6 illustrates the “trajectories” of individual projects as they navigate through each stage of the TRL scale. Specifically, this figure captures project flows at the three phases recorded by the Periodic Reporting: (1) at project start, (2) at the time of the latest report submission, and (3) at project end. By visualising these trajectories, Figure 6 offers a dynamic representation of how projects evolve and mature over time, providing insights into the progression of technological readiness across the entire Horizon Europe portfolio.

Figure 7: Evolution of TRL during the project lifetime



Flows are proportional to the amount of funding granted to each project. Base: 2 472 projects.

The most common trajectories of TRL progression are from TRL3 at project start to TRL5 at project end (189 projects), from TRL2 to TRL4 (179 projects), and from TRL6 to TRL9 (178 projects). These three trajectories collectively account for 23% of all projects[19].

4. TRL by Horizon Europe Pillar

The ensuing sections assess TRL progress for projects within each of Pillar I (Excellent Science), Pillar II (Global Challenges and European Industrial Competitiveness) and Pillar III (Innovative Europe).[20]

4.1. Pillar I: Excellent Science

Pillar I comprises three main parts: the European Research Council (ERC), Marie Skłodowska-Curie Actions (MSCA), and Research Infrastructures.

Th ERC primarily supports early-stage research, which often falls outside the conventional application of Technology Readiness Levels (TRLs) and is sometimes referred to as TRL-0 research. At this stage, commercial considerations are not yet a primary focus and have not

[19] Excluding projects where information on one or more of the three stages is not available.
[20] The Programme part “Widening Participation and Strengthening the European Research Area” is not part of this analysis due to the very limited amount of data available.

necessarily been formulated, with the research largely driven by scientific curiosity and discovery.

As confirmed by feedback from the ERC, grant beneficiaries are not required to systematically declare TRLs in their periodic reports. Instead, they are advised to complete the TRL section only if it is deemed suitable for their project, and only at the end of the grant.

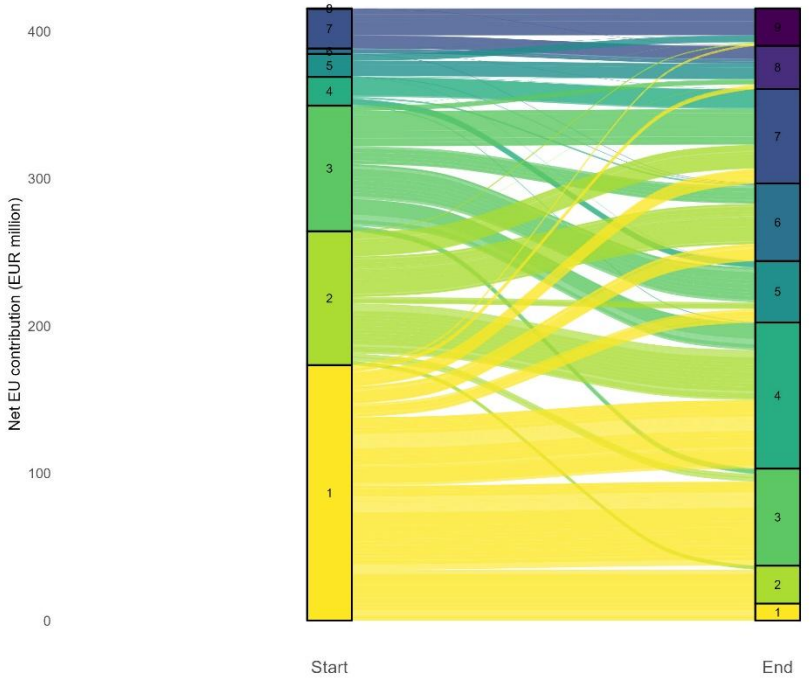
Furthermore, Scientific Officers do not necessarily review the information provided in this section, which means that the data for Pillar I (where the ERC constitutes an important part, with 46% of projects in the sample) should be interpreted with caution.

However, a notable exception within the ERC portfolio is the Proof-of-Concept grants, designed to bridge the gap between early-stage research and more advanced development. These grants typically support projects at the initial idea stage, TRL1 or TRL2, with the goal of advancing them to a more advanced stage of proof of concept, TRL3 or TRL4.

Figure 7 illustrates the TRL evolution among all projects in Pillar I. As expected, given the focus on fundamental research, more than half of the projects (282, or 51%) start at TRL1. By the project's end, however, only 5% of projects (25) remain at TRL1, while the majority have advanced to TRL3 (136 projects, 25%) or TRL4 (179 projects, 32%). This progression suggests that, despite the early-stage focus of Pillar I, many projects make significant progress in terms of technological maturity over the course of the grant.

However, it must be noted that not all reported TRLs are verified by the ERCEA's Scientific Officers, and the reported end TRLs are indications of the expected TRL achievement by the end of the project. Therefore, there may be some variability in the data.

Figure 8: TRL evolution in Pillar I projects



Base: 551 projects.

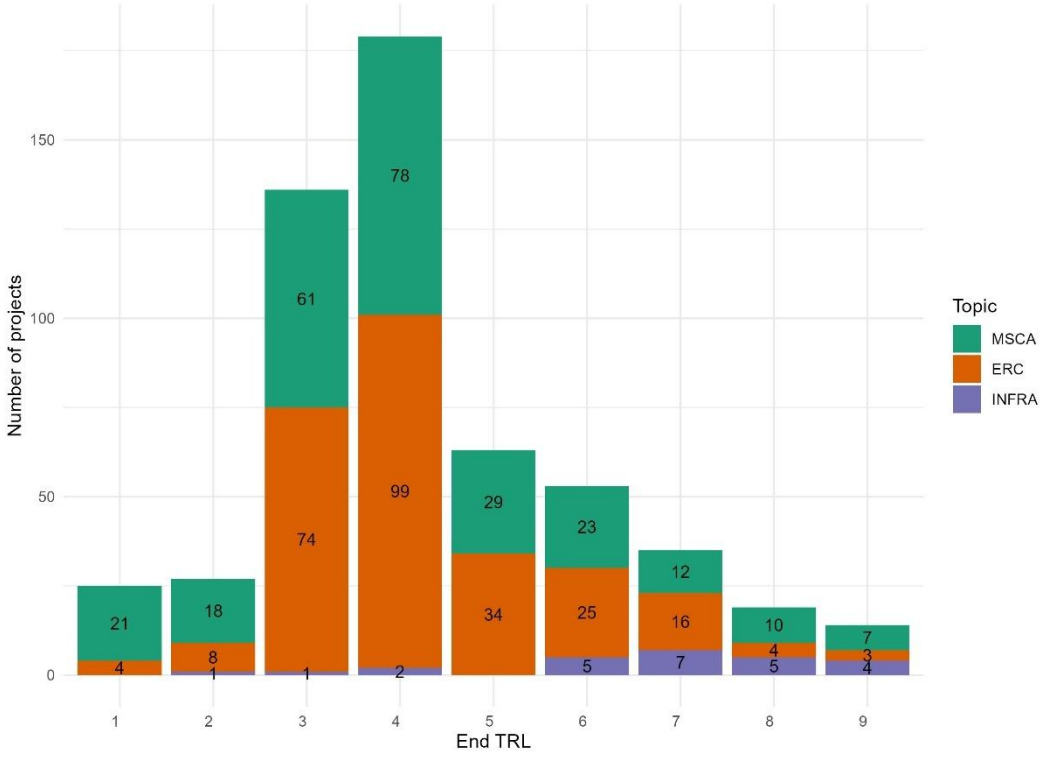
Figure 9 shows the intended or achieved TRLs for projects in Pillar I, which should be interpreted with caution due to the voluntary nature of TRL reporting in the ERC and the lack of verification by Scientific Officers.

Despite these limitations, some notable patterns emerge from the data. MSCA projects are distributed across the entire TRL scale, which may seem unexpected given their primary focus on basic research, experimental proof of concept, and training and career development. However, this spread suggests that **MSCA projects may be more diverse in terms of technological maturity** than initially anticipated.

In contrast, ERC projects appear to be more consistently aligned with the expected focus on **basic research and proof of concept,** with a notable concentration around TRL3. This aligns with the ERC's mission to support early-stage, high-risk **research with the potential to lead to breakthroughs**.

The Research Infrastructures (INFRA in Figure 9) projects, although limited in number (only 25 projects in the sample), are predominantly clustered around TRL6 and above. This suggests these projects are more focused on the development and operation of research infrastructures, which typically require a **higher level of technological maturity for complex systems**.

Figure 9: Pillar I expected or achieved end TRL



Base: 551 projects.

4.2. Pillar II: Global challenges and European industrial competitiveness

The global challenges under Pillar II of the Horizon Europe programme require TRL reporting at the proposal stage and in the final reporting, with optional reporting on TRL progression during

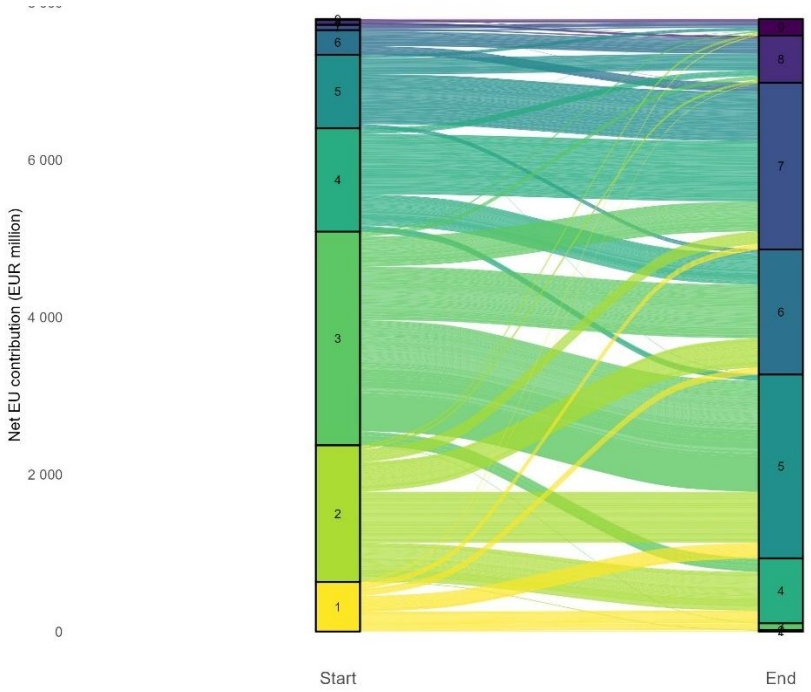
periodic reporting. Within the research infrastructure calls, some specify a defined starting TRL and expected final TRL achievement by the end of the project. A review of the 2021-2025 Work Programmes highlights different practices in different clusters.

- Cluster 1 (Health) rarely defines a starting or expected end TRL, with only one call specifying an expected TRL achievement in the 2023-2025 Work Programme;
- Cluster 2 (Culture, Creativity and Inclusive Society) does not mention TRLs, as expected given its focus on intangibles;
- Cluster 3 (Civil Security for Society) has a large number of calls that define an expected TRL achievement by the end of the project;
- Cluster 4 (Digital, Industry and Space) defines both an expected start and end TRL for many calls in the 2021-2022 and 2023-2025 Work Programmes;
- Cluster 5 (Climate, Energy and Mobility) and Cluster 6 (Food, Bioeconomy, Natural Resources, Agriculture and Environment) have a large number of calls that define an expected TRL achievement by the end of the project. Cluster 5 is also trialling the SRL scale (Section 1.4) in the 2025 Work Programme.

In contrast to the Excellent Science Pillar, which is mostly focused on low TRLs, Pillar II focuses on mid-TRL projects. Additionally, Pillar II aims to foster collaboration among a wide range of innovators, including academia, businesses, and other stakeholders, with 81% of all Horizon Europe funding so far supporting collaborative projects[21].

[21] SWD(2025) 110 final. (2025). Interim Evaluation of the Horizon Europe Framework Programme for Research and Innovation (2021 - 2024). Retrieved from https://research-and-innovation.ec.europa.eu/document/download/a3aa9b90-15c0-4ea7-b25e-9f4e29cfa740_en?filename=ec_rtd_he-evaluation-swd.pdf

Figure 10: TRL evolution in Pillar II projects

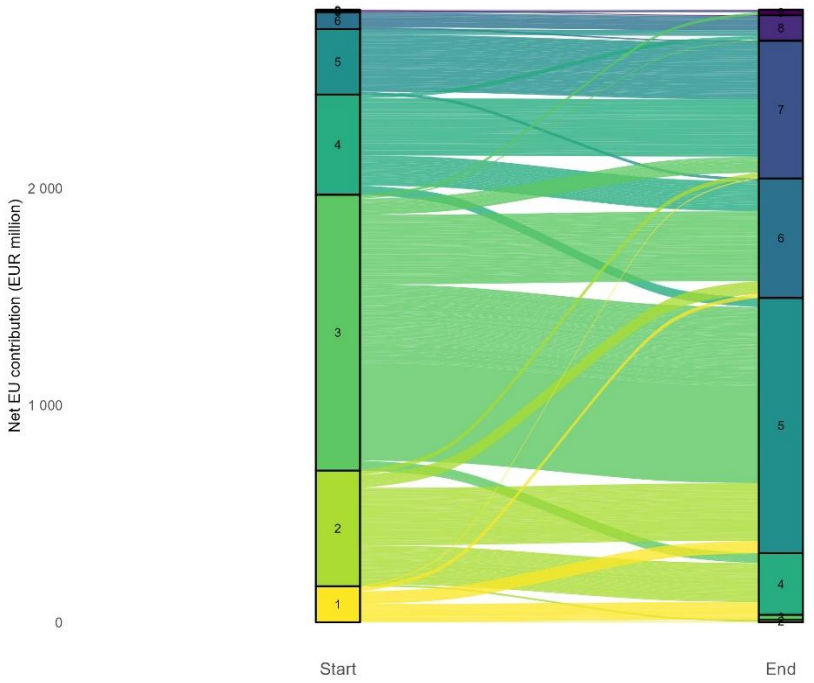


Base: 1 114 projects.

The **focus on mid-TRL technologies** is confirmed by Figure 10, which shows that most projects start around TRL3 (340 projects, 31% of all Pillar II projects) and TRL4 (181 projects, 16%) and end up in the bracket between TRL5 and TRL7 (842 projects, 76%). There are some differences across clusters, although the number of projects with available TRL data varies. TRL is mainly reported by projects in the “Digital, Industry and Space” cluster and the “Climate, Energy, and Mobility” cluster, with 377 and 320 projects respectively, accounting for 63% of all Pillar II projects with TRL data.

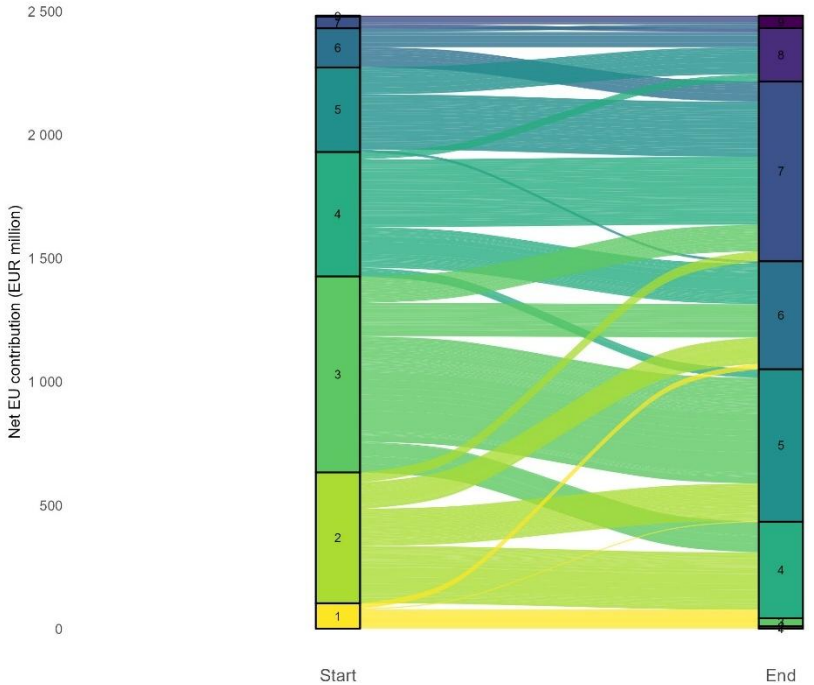
Figure 11 and Figure 12 illustrate the TRL progression in these two clusters. In Figure 11Figure 10, almost two-thirds of projects (63%, 236 projects) start at TRL2 or TRL3, and by the end of the grant period, 294 projects (78%) achieve (or expect to achieve) a TRL between TRL5 and TRL7. Figure 11 shows similar patterns in Cluster 5, with 201 projects (63%) starting at TRL1-TRL3 and 227 projects (71%) ending up at TRL5-TRL7.

Figure 11: Digital, Industry, and Space



Base: 377 projects.

Figure 12: Climate, Energy, and Mobility



Base: 320 projects.

Since TRL measures technological progression, it may not always be the most fitting measure of innovation produced under Pillar II. For example, the "Culture, Creativity and Inclusive Society" cluster has a small number of projects that reported TRLs (40 projects), with most starting at TRL1 (12 projects, or 30% of the projects in this cluster). This is because many projects under this cluster may focus on intangibles and therefore do not necessarily have a strong technological or engineering component. Similarly, the "Civil Security for Society" cluster has only 35 projects with reported TRLs. The evolution of TRL in these clusters is presented in Annex Section 8.

4.3. Pillar III: Innovative Europe

In the sample used for this analysis, most projects in Pillar III belong to the European Innovation Council (EIC), accounting for 574 projects, or 83% of Pillar III projects in the sample. The remainder comprises projects that received funding as part of the European Innovation Ecosystems (EIE).

The EIC has three main types of calls: Pathfinder, Transition and Accelerator. Each type of call has a pre-defined range of TRL within which a project proposal can be funded, namely TRL1-TRL4 for Pathfinder, TRL3/TRL4-TRL5/TRL6 for Transition, and TRL6-TRL8 for Accelerator[22]. As a general rule, Horizon Europe grants fund projects up to and including TRL8[23]. In the case of EIC Accelerator projects that seek to obtain blended finance (i.e. equity investment alongside the grant), the equity component can finance activities beyond TRL8[24] (although the grant may be reduced[25]).

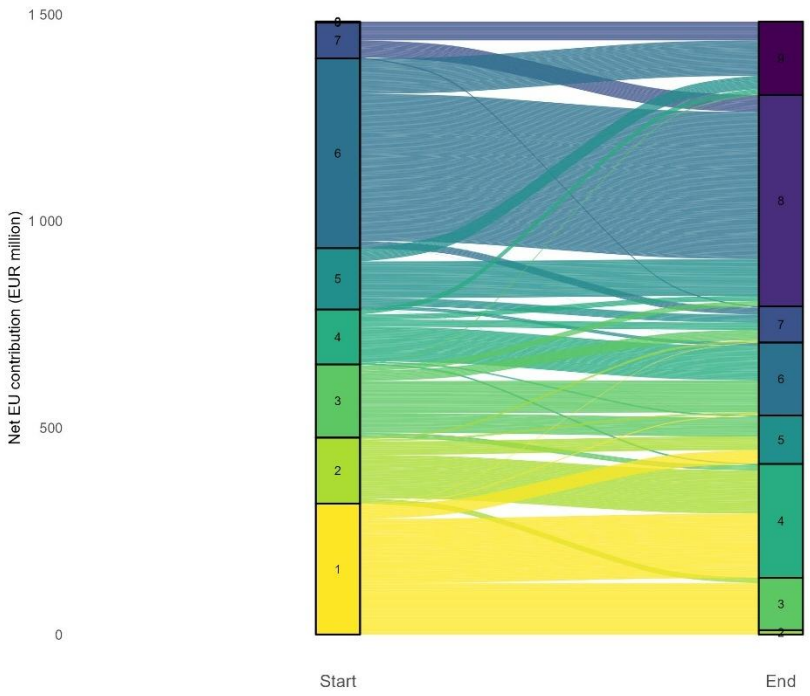
[22] European Commission Decision C(2024)7451 of 28 October 2024 amended by C(2025)4847 of 11 July 2025. (2025). *Annex: European Innovation Council (EIC) Work Programme 2025*. Retrieved from https://eic.ec.europa.eu/document/download/5e1eb75f-e437-477f-9ee9-ef54ff6387fd_en?filename=EIC%20Work%20Programme%202025.pdf (p. 8)

[23] Recital 38, Regulation (EU) 2021/695 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination.

[24] European Commission. (2025). *What is the EIC Accelerator?* Retrieved from https://eic.ec.europa.eu/eic-accelerator-new-template_en

[25] European Commission. (2025). *Tips for applicants - EIC Accelerator*. Retrieved from https://eic.ec.europa.eu/tips-applicants-eic-accelerator_en

Figure 13: TRL evolution in Pillar III projects



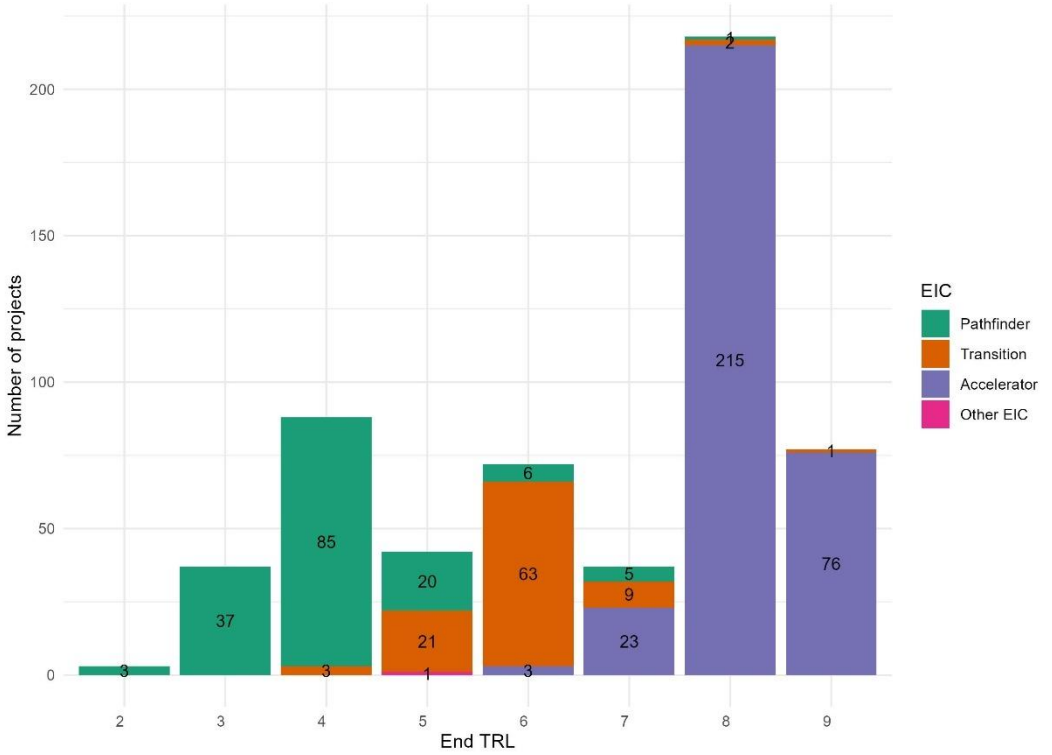
TRL at project start (left) and TRL at project end (right). Base: 694 projects.

Pillar III is the pillar most oriented towards market outcomes. The EIC Accelerator specifically targets the highest portion of the TRL scale by providing support to start-ups and SMEs that have an innovative, game-changing product, service, or business model that could create new markets or disrupt existing ones, and are looking to scale up.

Out of all the Pillar III projects, 32% report their starting level as TRL6 (219 projects). There are also 51 projects above TRL6 (7%). Nevertheless, 424 projects (61%) are at TRL5 or lower when they begin. By the end, 57% of projects have achieved or will achieve TRL6-TRL8 (394 projects), with 91 projects (13%) indicating TRL9 as the endpoint. This is particularly important, because it provides evidence of clear progression towards market outcomes or application in real-world environments.

Figure 14 provides a more detailed view of the TRL progression for EIC projects in the sample. By the end of the grant period, most funded projects are expected to reach TRL8, with 218 projects achieving this level. Additionally, 77 projects, all but one from the Accelerator, anticipate reaching TRL9.

Figure 14: EIC expected or achieved end TRL



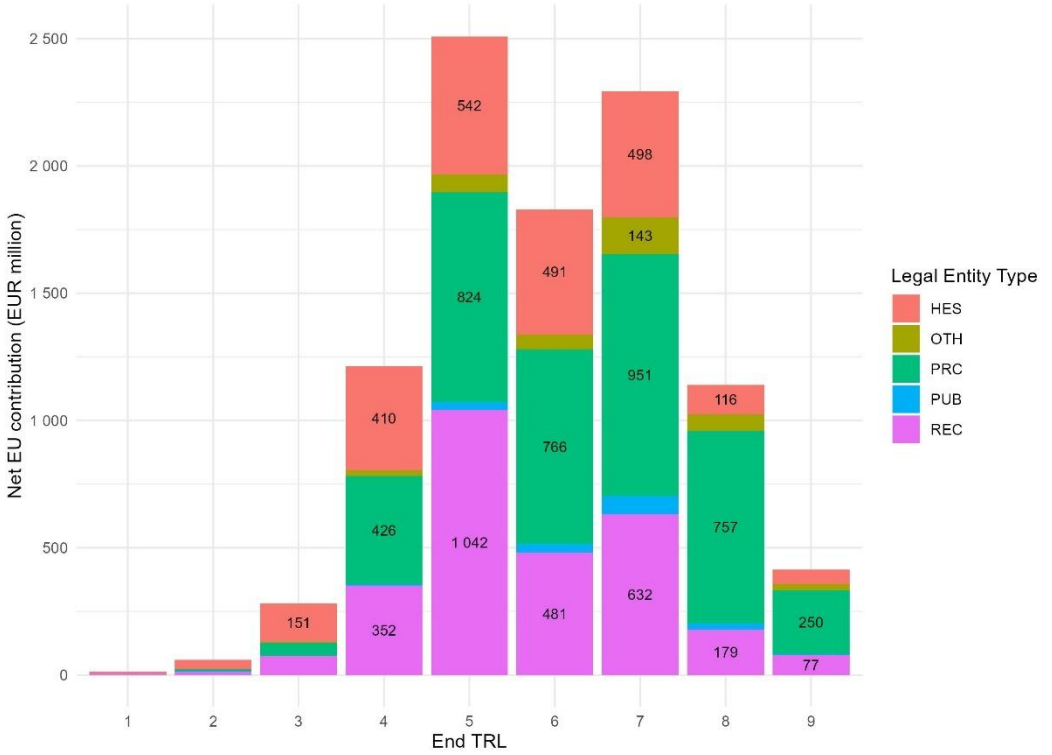
Base: 574

5. Participants and outputs

5.1. Funding by project partner type

Funding is concentrated between TRL5 and TRL7 (Figure 15). In total, projects with an expected or achieved TRL in this group are allocated EUR 6.6 billion, representing 68% of all the funding in the sample. This is consistent with the distribution of the overall sample, which includes a majority of collaborative projects from Pillar II (as discussed in Section 3.2). Meanwhile, the higher end of the TRL scale (TRL8 and, to a smaller extent, TRL9) receives over EUR 1.5 billion in funding, accounting for 16% of all funding in the sample.

Figure 15: Funding by partner type and TRL

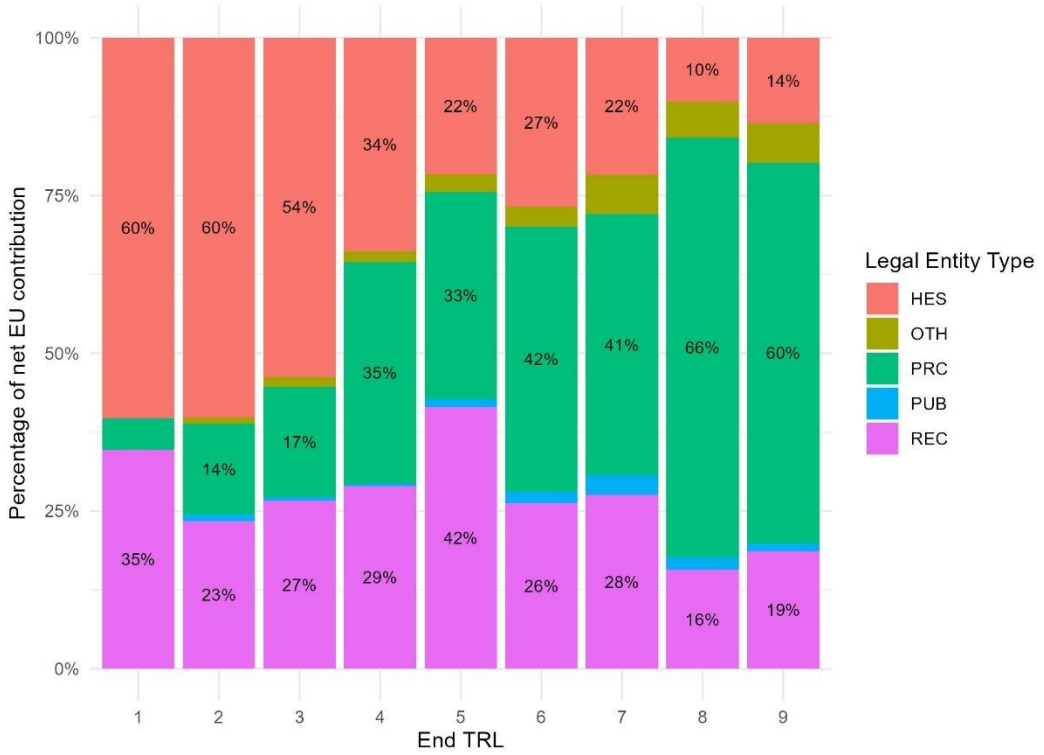


Base: 2 385 projects.

In the sample, when considering the proportion of funding allocated to different organisations within the same TRL, the emerging pattern matches expectations (Figure 16). Overall, higher or secondary education institutions (HES) receive most of the funding in the lower part of the TRL scale, which is closer to fundamental research. For example, in TRL1 and TRL2, HES obtained 60% of the overall funding. Conversely, the share of funding granted to companies and other private for-profit entities (PRC) increases consistently as one moves towards the upper part of the TRL scale. In TRL1, PRCs attract only 5% of all funding, but they receive two-thirds of the funding for projects ending in TRL8 and 60% of the funding for TRL9 projects. This is consistent with expectations for the R&I process**: fundamental research is led by universities, and as innovation gets closer to the market, businesses step in** to provide specialised laboratories, manufacturing equipment, and commercial nous. The specific case of small and medium enterprises (SMEs) is analysed in the ensuing section.

Research organisations (REC), while receiving slightly more funding at the earlier stages of TRL, continue to attract significant shares of funding at higher TRL levels, suggesting that they may operate as a link between industry and academia. By and large, public bodies (PUB) and other organisations (OTH) receive limited funding amounts.

Figure 16: Percentage distribution of funding by type of organisation



Base: 2 385 projects.

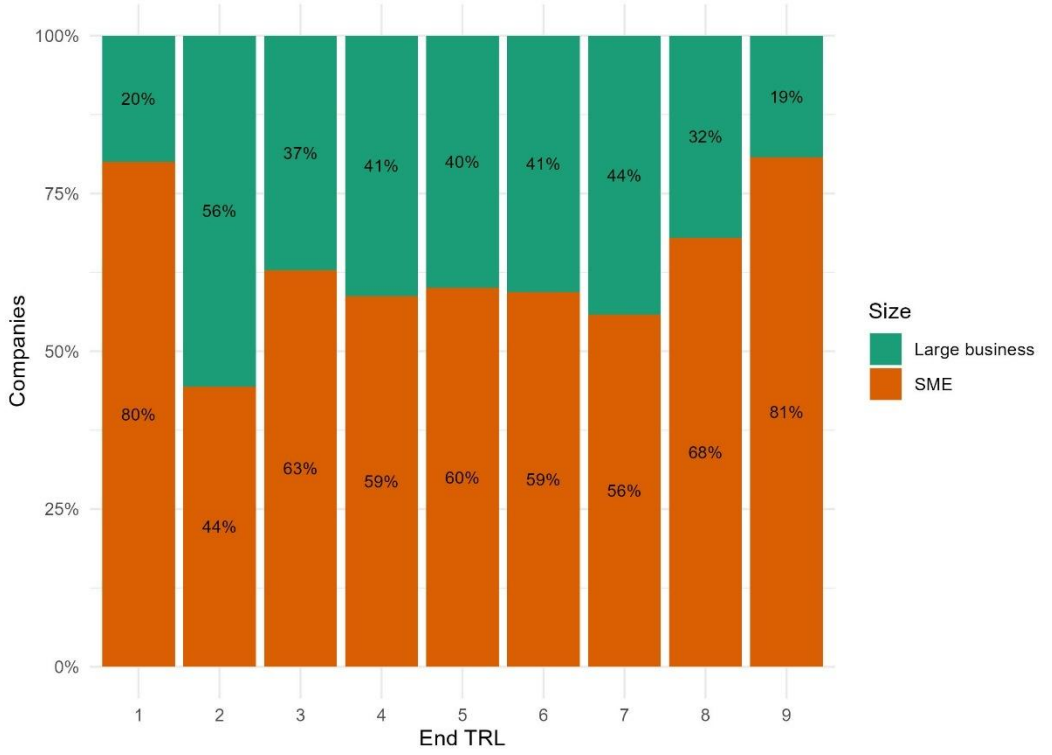
5.1.1. SMEs

SMEs play an important in Horizon Europe, particularly in collaborative projects and within Pillar III[26]. Figure 17 focuses on companies[27] and provides an overview of the split between large companies and SMEs across the different TRLs. Except for TRL2, SMEs comprise the majority of companies involved in projects across the TRL scale, accounting for around 80% of companies at both ends of the scale.

[26] European Commission. (2024). *SME participation in Horizon Europe: Key figures (and key issues) in the first three years*. Publications Office of the European Union. Retrieved from https://data.europa.eu/doi/10.2777/576670

[27] The exact classification of companies in the data repositories of Horizon Europe is "private for-profit entities (excluding Research Organisations and Secondary or Higher Education Establishments". SMEs are flagged in the data, but are not limited to private for-profit entities. However, for simplicity, this analysis only considers SMEs within the subset of for-profit entities.

Figure 17: Percentage of SMEs by TRL



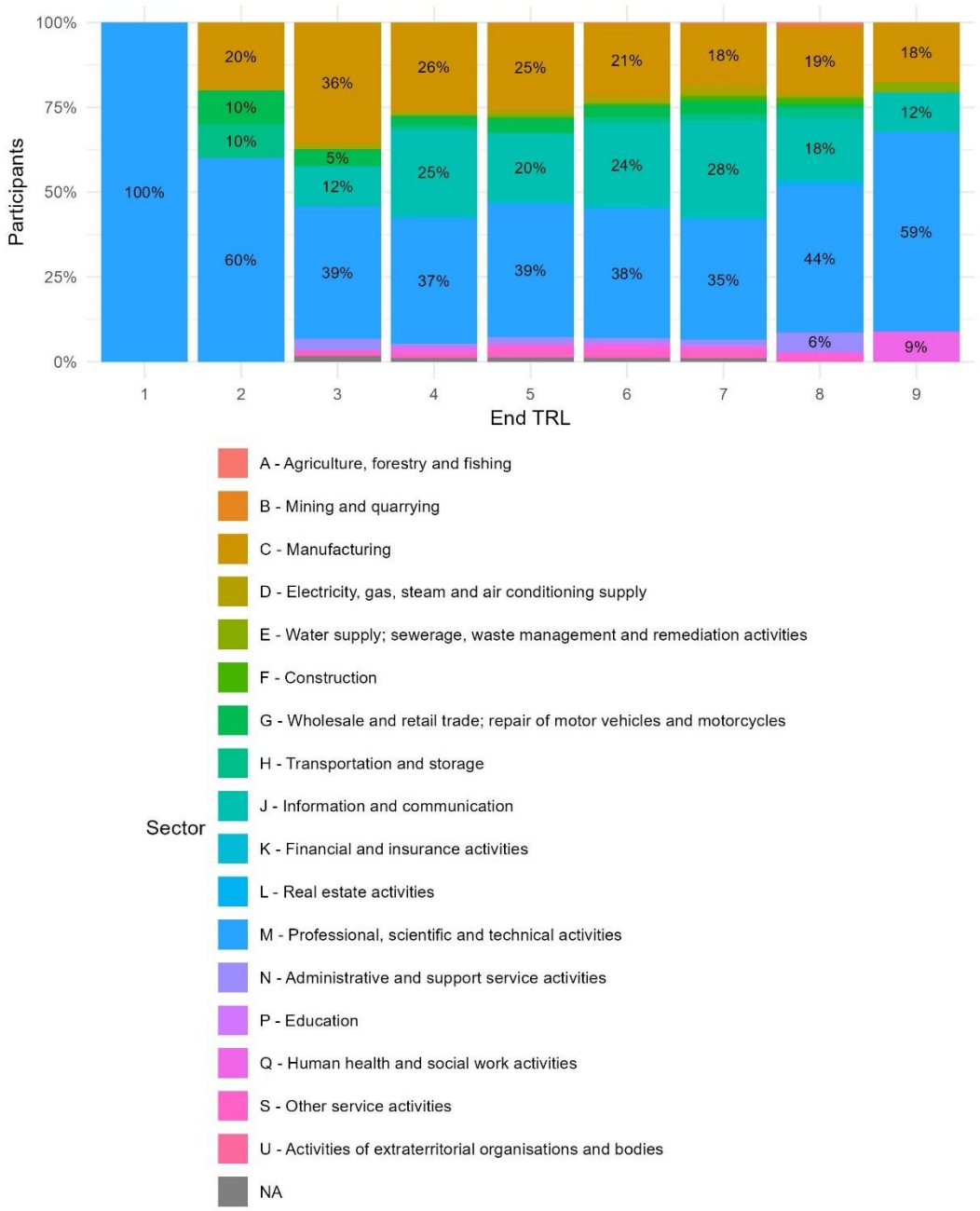
Base: 1 839 projects, 5 136 entities. Sample restricted to PRC. Missing values in size were removed.

5.1.2. TRL by sector

For PRCs, it is also possible to investigate patterns across sectors. The sectors shown Figure 18 represent the 'main' activity sectors as described in the Statistical Classification of Economic Activities (NACE Rev. 2).

In line with expectations, there is a clear prevalence of for-profit entities belonging to the sector of professional, scientific, and technical activities in the lower part of the TRL scale. This broad group comprises several activities closely linked to R&I, including consultancy activities, research and experimental development in the social sciences and humanities (SSH), and scientific research and development. Entities of this NACE category make up 100% of the companies and other for-profit entities involved in projects aiming to achieve TRL1; however, in practice, this represents just two for-profit entities. In TRL2, they account for 60%, which equates to six companies.

Figure 18: Share of participants by sector

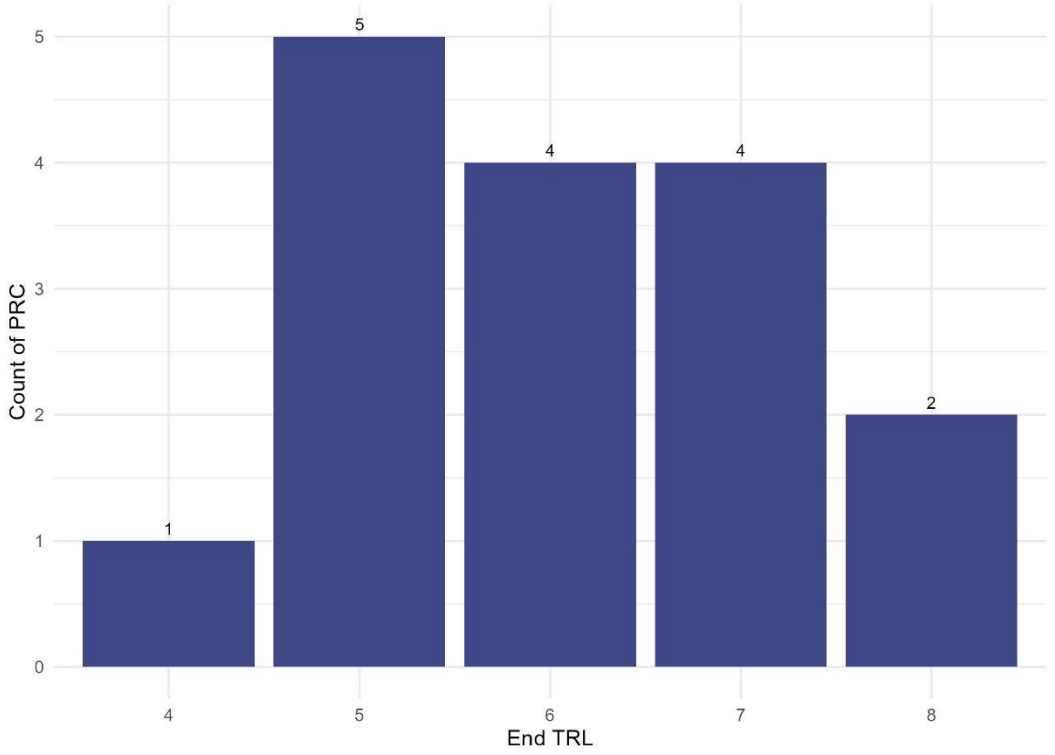


Base: 931 unique projects, 2 058 entities. Data from CORDA combined with data from ORBIS.

The external data used for this sectoral analysis can only be matched to NACE Rev. 2, which is quite outdated since it was published in 2006. This presents some limitations, particularly due to the rapid transformation in economic sectors where R&I is crucial. For example, there is no dedicated section for artificial intelligence (AI). This significantly hinders granularity in the sectoral analysis. Nevertheless, Figure 19 illustrates an attempt to isolate companies operating under the heading ‘Research and experimental development on biotechnology’ (72.11). Only

16 companies have been classified as belonging to this group; however, companies in this sector could also be registered under other, more general sections of Section M – Professional, Scientific, and Technical Activities, which is the largest sector across all TRLs (Figure 17). The 16 companies belonging exclusively to the biotech sector work on projects that are between TRL4 and TRL8.

Figure 19: Biotech companies



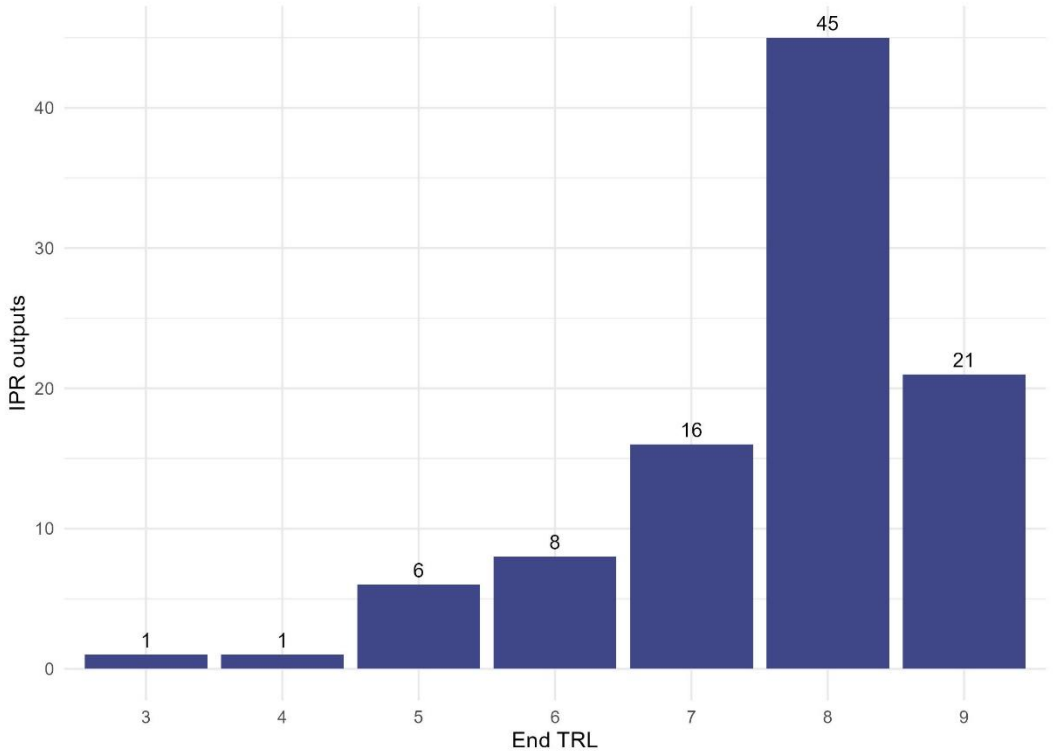
Base: 16 projects, 16 entities. Data from CORDA combined with data from ORBIS. NACE Rev. 2, Class 72.11.

5.2. Intellectual Property Rights (IPR) applications and TRL

Lastly, internal monitoring data suggests that, across this sample, there have been 98 intellectual property rights (IPR) applications[28] from 60 projects (Figure 20). The pattern shown in Figure 20 aligns with expectations: IPRs are predominantly found in the later stages of the TRL scale, where innovation is closer to market readiness. However, some IPR outputs are also associated with early-stage TRLs (TRL3-TRL4). These are presumably IPRs such as trademarks, design rights, or copyrights. There is, however, a lag effect that needs to be considered: it is likely that significantly more data will be available in the coming years, when more projects will reach completion.

[28] IPR applications resulting from Horizon Europe's contributions.

Figure 20: IPR outputs by TRL



Base: 60 projects.

5.3. TRL in European Partnerships

Lastly, the analysis considers the evolution of TRL in European Partnerships. European Partnerships bring together resources from the European Commission and private and/or public partners. These initiatives aim to address some of Europe's most pressing challenges through R&I projects.

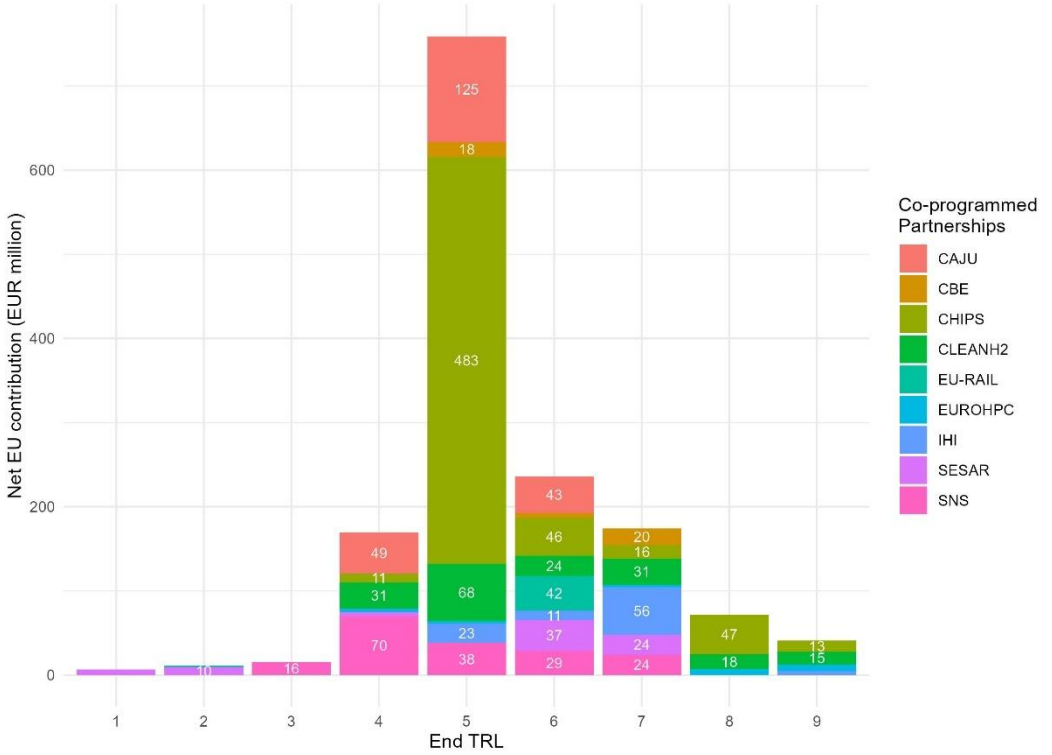
5.3.1. Joint Undertakings

Joint Undertakings are long-term collaborations between private (and sometimes public) partners, requiring a high degree of integration. They are traditionally industry-led, with some exceptions[29].

As the data in Figure 21 shows, most of the funding (as net EU funding) is concentrated in projects expected to achieve TRL5 by the project's end. This is primarily due to the CHIPS Joint Undertaking, which accounts for 63% of all TRL5 funding (EUR 483 million). However, even without this amount, most Joint Undertaking projects are concentrated in the range of TRL4-TRL6, representing 68% of all EU contributions (EUR 681 million). Only 29% of the funding (EUR 287 million) is allocated to projects at TRL7 and above.

[29] Global Health, EDCTP3, EuroHPC, and CHIPS. Of these, only EuroHPC and CHIPS are presented in this analysis due to data availability issues.

Figure 21: TRL in Joint Undertakings



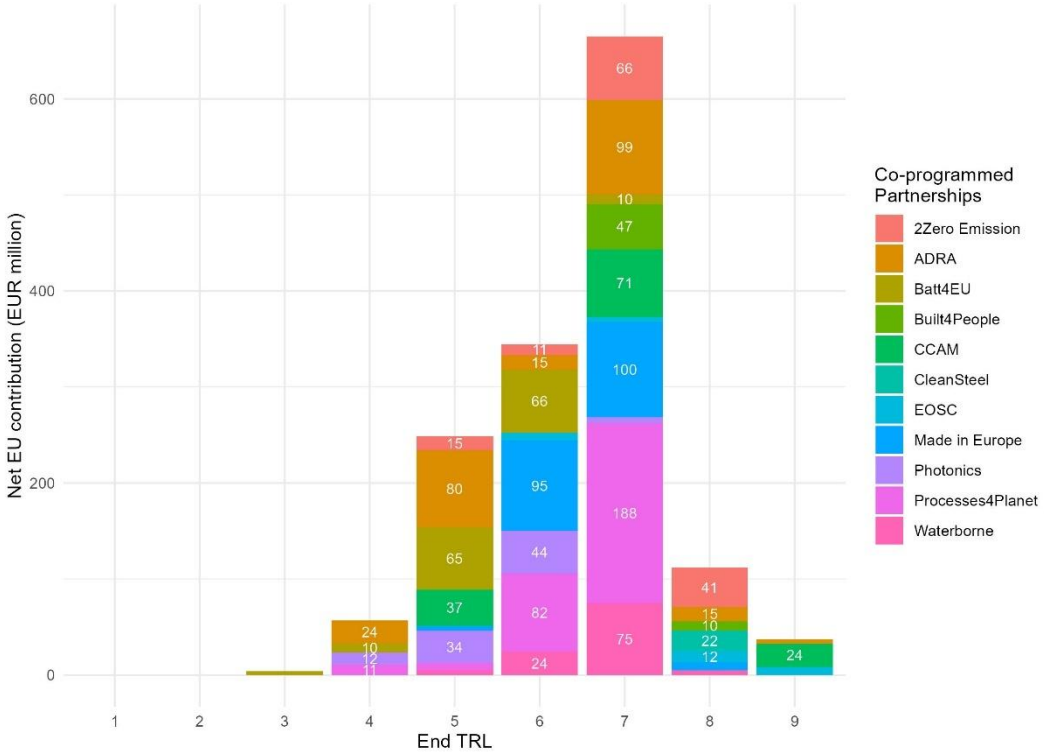
Base: 134 projects.

5.3.2. Co-programmed Partnerships

Another type of European Partnership is the Co-programmed Partnership, which is based on the joint programming of R&I activities and the mobilisation of additional activities by partners in line with the objectives of each Partnership.

As shown in Figure 22, projects under Co-programmed Partnerships appear to be slightly more advanced in their journey towards deployment compared to projects under Joint Undertakings, based on the available data. TRL7 receives the most funding (EUR 665 million, 45% of all EU funding for the Co-programmed Partnerships in the sample). TRL5-TRL7 represent 86% of all funding (over EUR 1 billion), with TRL8 and TRL9 combined accounting for 10% of EU funding (EUR 149 million).

Figure 22: TRL in Co-programmed Partnerships



Base: 214 projects.

6. Conclusions

6.1. Conclusions

This assessment of TRL in Horizon Europe responds primarily to the need of monitoring TRL as per Article 50 of the Horizon Europe Regulation. Yet, this analysis is also important to understand the strengths and weaknesses of Horizon Europe in supporting progress along the innovation journey, at a time when the contours and contents of the next Horizon Europe programme are being decided.

Based on feedback from Project Officers and the findings of the data analysis, the introduction of TRL as a specific field in the topic description and reporting of Horizon Europe provides valuable information for understanding the evolution of the Horizon Europe portfolio. It translates a wide variety of highly technical topics into simple, standardised terms. The TRL framework is a valuable tool for capturing technological progression, but its simplicity inevitably sacrifices some of the complexity behind R&I.

Overall, feedback from Project Officers on the application of the TRL scale is generally positive. Project Officers recognize that the TRL scale is a well-established means of capturing technological progression. However, they acknowledge that there can be discrepancies in how the TRL scale is interpreted and applied in project reporting.

The effective use of TRLs in Horizon Europe is hindered by challenges that Project Officers face in verifying TRL levels, due to limited resources, tools, and expertise. Nevertheless, this is mitigated by the broad knowledge that Project Officers typically have of the domains they oversee, which helps them understand the nature of the projects and their novelty compared to the existing landscape. Additionally, experts involved in proposal evaluation and reviews provide further assurance regarding the TRL.

Analysis of Periodic Reporting data from Horizon Europe projects reveals a consistent progression from lower to higher TRLs over the project lifecycle, with most projects advancing by 2-3 TRL steps. This aligns with the expectations that Project Officers have for project advancements within a typical timeframe of 36-48 months. Furthermore, the budget allocation among different types of project participants seems to reflect the natural progression from fundamental research at lower TRLs – where the input of universities is most valuable – to higher TRLs, where business partners contribute resources for testing in real-life environments and prepare innovations for manufacturing and commercialisation.

Our sample of projects reveals that funding in Horizon Europe is currently concentrated between TRL5 and TRL7 (68%), with a notable portion also allocated to TRL8 and TRL9 (16%). The distribution of funding across organisation types and sectors shows distinct patterns, with higher or secondary education institutions more present at lower TRLs and companies and other for-profit entities receiving more funding as the TRL scale progresses. Research organisations are funded across the TRL scale, suggesting they may bridge industry and academia, while SMEs remain an important component of the programme throughout. Furthermore, for-profit entities in the professional, scientific, and technical activities sector are prevalent at lower TRLs, while companies in the biotechnology sector are primarily involved in projects between TRL4 and TRL5. Lastly, the analysis highlights that most IPR outputs are associated with later-stage TRLs (TRL8-9), although some are linked to early-stage TRLs (TRL3-4), such as trademarks, design rights, or copyrights.

Overall, while TRLs provide a useful framework for assessing technological maturity, their limitations should be acknowledged. TRLs may not always be the most suitable measure of innovation produced under Pillar II, particularly in areas such as social sciences and humanities. Therefore, a nuanced understanding of the strengths and limitations of TRLs is essential for effective evaluation and monitoring of Horizon Europe projects.

Further analysis into detailed IPR outputs, EIC Accelerator performance, and sector-specific performance can illuminate how Horizon Europe stimulates the scaling of innovation towards market readiness. For example, TRL analysis can be combined with Horizon Results Booster/Portal data, Innovation Radar data, and Feedback to Policy analyses to build a robust portfolio of market-ready innovations that could be funded in the future European Competitiveness Fund, including links between European Partnerships and IPCEIs. Additionally, TRL analysis can contribute to scanning emerging technologies that could create or disrupt future markets, determining where these technologies are in the development cycle, and where European funding could be used to support and scale them up.

As more projects reach completion, Key Impact Pathways (KIPs) – such as on IPR data, innovative products, full-time employment opportunities created, and co-investment amounts – can provide valuable insights into the research and innovation outputs of the Horizon Europe project portfolio. By correlating KIPs with TRL performance, we can identify which initiatives at specific TRLs create the most employment and attract the most follow-up funding, thereby enhancing our understanding of their broader economic impact and market potential.

6.2. Lessons learned

This analysis leads to two main considerations: the first is linked to the reporting requirements in Horizon Europe, and the second relates to the future FP10.

Feedback from Project Officers shows that while TRL is generally considered a good measure of technological advancement, it can sometimes be subject to interpretation. Comments from Policy Officers indicate the need for tools and guidance to correctly interpret and assess the TRL scale. Currently, there is no specific guidance material available aside from the TRL scale included in the Work Programmes, which does not provide details on suggested interpretations or applications for specific scientific and technical domains.

Improving the way TRL is reported is particularly relevant as the European Commission seeks to simplify reporting for beneficiaries[30]. In this respect, it is crucial to ensure that the data collected from beneficiaries is of the highest quality so that its value can be maximized to extract useful insights about the programme. In turn, this will help to monitor the programme's performance more precisely and capture its impact. In the future, it might also be possible to expand the analysis of the links between TRL and other aspects of R&I dissemination and exploitation, such as IPRs, or evolution across scientific and technical fields.

For this reason, it will be important to engage with Project Officers to provide them with the guidance documents and tools they might need to assess TRL – and potentially offer similar support to beneficiaries when they fill out the Periodic Reporting.

Having high-quality data is essential to make monitoring truly useful. The report on competitiveness by Mario Draghi[31] highlighted how the European Union struggles to translate research into innovation and market outcomes. Based on the data available for this analysis, it appears that Horizon Europe has so far invested significantly in low- and mid-TRL R&I. However, although some projects reach relatively high TRLs, these are a minority and benefit from a relatively smaller share of the overall funding. This also affects some European Partnerships, which are investing in projects concentrated around the middle of the TRL scale, even though the presence of industrial partners in the partnerships should ensure an easier transition towards market outcomes.

Supporting higher-TRL innovation along with research is something that the next Framework Programme can do, with its proposed EUR 175 billion budget[32]. As the European Commission's Competitiveness Compass[33] and the Start-up and Scale-up Strategy[34] underline, initiatives like the EIC can support start-ups in turning ideas into commercial products and services – thus contributing to solving one of the "valleys of death" that hold back innovation in Europe.

The TRL scale helps to summarise, visualise, and narrate the story of innovation, from ideas to products, services, and applications. Yet, most importantly, in the case of the EU, it also shows that R&I support should be coherent across the entire innovation journey to ensure that excellent, groundbreaking ideas find their way into the real world to solve challenges and improve collective well-being.

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[30] COM(2025) 189 final. (2025). *Horizon Europe: Research and Innovation at the heart of competitiveness*. Retrieved from https://research-and-innovation.ec.europa.eu/document/download/1a80e2e1-df28-4f1a-8a52-a0e1b47a1860_en

[31] Draghi, M. (2024). The future of European Competitiveness Part A: A competitiveness strategy for Europe. Retrieved from https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en?filename=The%20future%20of%20European%20competitiveness%20_%20A%20competitiveness%20strategy%20for%20Europe.pdf

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7. Annex

7.1. Data sources

The data sources used in this analysis are listed in the table below, along with their cut-off dates.

Table 3: Data sources

Source	Description	Cut-off date
Project Dashboard (Horizon Dashboard)	European Commission internal repository of project data. This provides the main list of projects included in the analysis. The dashboard on Key Impact Pathways Dashboard was used for IPR data.	6 January 2025 (11 July 2025 for the Key Impact Pathways dashboard)
Common Research Data Warehouse (CORDA)	European Commission internal repository of raw project data. This was used to identify the relevant Policy Officers to be consulted and to obtain other project-level data, including TRL data.	23 June 2025
Call Passport System (CPS)	European Commission internal register of calls and topics.	2 June 2025
Orbis	External dataset. Company information.	2 July 2025

7.2. Consultation of Project Officers

As part of the data validation process, a survey of Horizon Europe Project Officers was conducted. These were Project Officers whose projects had reported TRL information in the dedicated TRL field in the Periodic Reporting of Horizon Europe. A unique survey link was shared with 441 Project Officers, and 113 responded, resulting in a 26% response rate.

The questionnaire was prepared with the support of colleagues from the Directorate-General for Research and Innovation involved in the 'Feedback to Policy' mechanism. An initial draft was shared with several colleagues, who had the opportunity to provide feedback and make suggestions, leading to several changes. For the ERC, this process resulted in the decision to exclude the ERC from the survey, as TRL is not systematically reviewed by Scientific Officers.

Where Project Officers agreed, follow-up interviews were organised to inquire about specific observations made in the survey responses. In total, 11 Project Officers were consulted via interviews.

7.2.1. Main findings from the survey and interviews of Project Officers

- General TRL suitability: 79% of Project Officers believe the TRL scale is a suitable method for capturing progression. However, this is not necessarily related to the suitability of TRLs for their specific project portfolios. Notably, TRLs are considered most relevant and influential during the project proposal stage and in the final report.
- Risk in TRL reporting: 89% of Project Officers indicate there is a risk of beneficiaries voluntarily over- or underestimating TRL reporting.
- Interpretation of TRL “at the end of the project”: Most Project Officers agree that this question in the Periodic Reporting is interpreted as TRL "at the closure date of the grant" (86%)
- Positive feedback on the use of TRL in Horizon Europe:
  - TRL is an internationally widely recognised standardised method, suitable for fields with strong technical and engineering components.
- Potential downsides of TRL use in Horizon Europe:
  - The TRL scale could be unsuitable for projects focussing primarily on research and not on market-ready innovation. It is not applicable to specific areas of research, such as social sciences and the digital space, due to the nature of the work
  - Oversimplification is a risk. The TRL scale does not capture well the non-linear nature of innovation.
  - Projects with different workstreams have components at different TRLs, which cannot easily be captured in one single TRL.
  - Limited tools are available to POs to verify reported TRLs, although significant discrepancies between the reported TRL and the project results would likely be noticed during the review.

7.2.2. General feedback from Project Officers

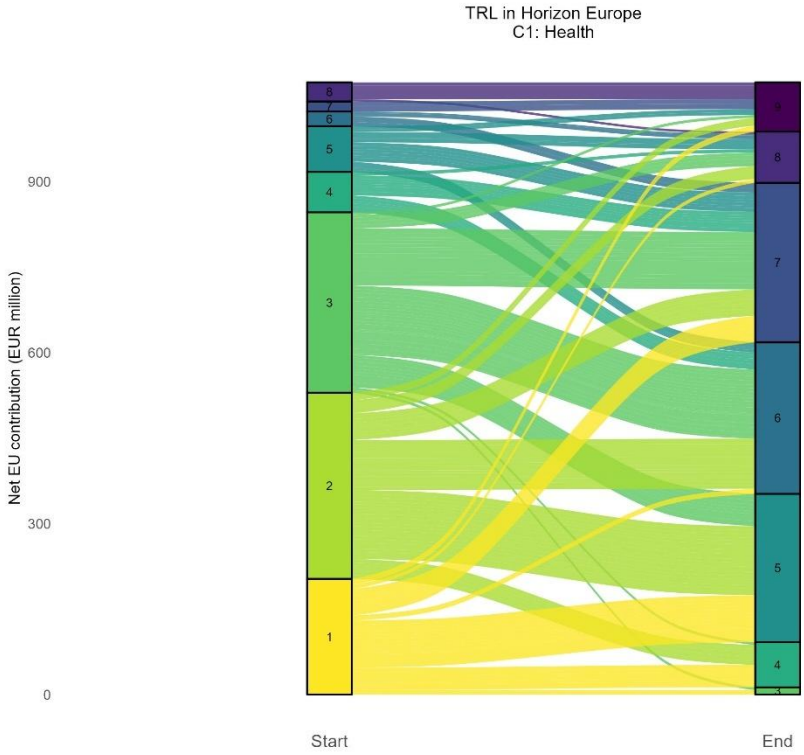
- Improvement of TRL reporting in proposals and in Periodic Reports: The reporting of TRL could be enhanced through interactive tools that help beneficiaries determine their TRL stage, possibly integrated into the reporting workflow. Better utilisation and communication of the Horizon Booster and Innovation Radar were also mentioned as possible areas for improvement.
- Insufficient resources for TRL assessment: Project Officers indicated challenges in verifying TRL levels due to limited resources, tools, and expertise. A dedicated course on TRL assessment, availability of guidance materials, and sharing of available TRL tools (both internal and external) could address this issue. Project Officers within the same cluster responded differently regarding awareness of TRL assessment resources, indicating an intra-cluster difference in resource availability awareness.
- Sector-specific TRL definitions: Complex projects with multiple components at different TRL levels pose additional challenges. The TRL system can oversimplify the non-linear nature of innovation, necessitating more field-specific definitions and evaluation criteria. Moreover, enhancing TRL definitions with more detailed descriptions and examples can improve their applicability across diverse fields. This would assist beneficiaries, evaluators, and Project Officers in better assessing and reporting technological progress, ensuring that TRLs remain a valuable tool.

- TRL validation requirement: Currently, validation of TRL reporting is not a mandatory requirement for all Project Officers, as it is not on the assessment checklist for Project Officers in some clusters. There has also been no official instruction to systematically check TRL reporting or clear guidelines on how to do this.

8. TRL by Pillar II clusters: additional charts

8.1. Cluster 1

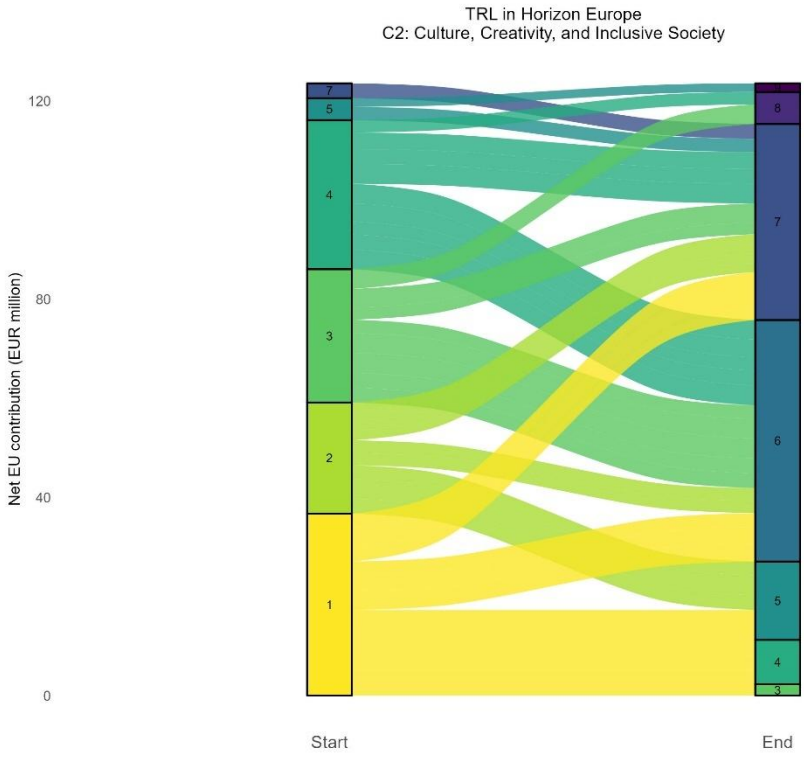
Figure 23: TRL in Cluster 1



Base: 154 projects.

8.2. Cluster 2

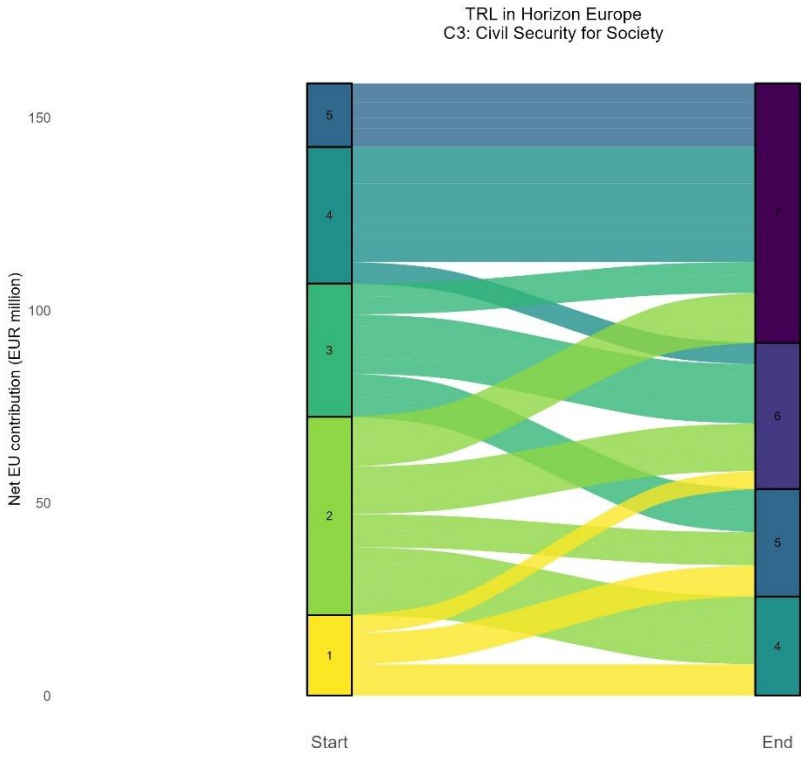
Figure 24: TRL in Cluster 2



Base: 40 projects.

8.3. Cluster 3

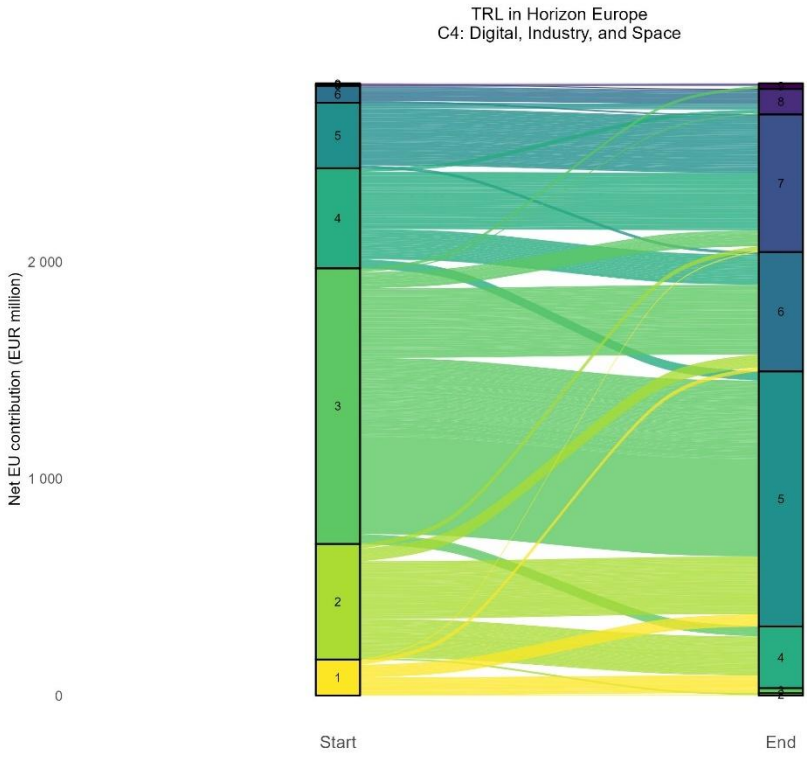
Figure 25: TRL in Cluster 3



Base: 35 projects.

8.4. Cluster 4

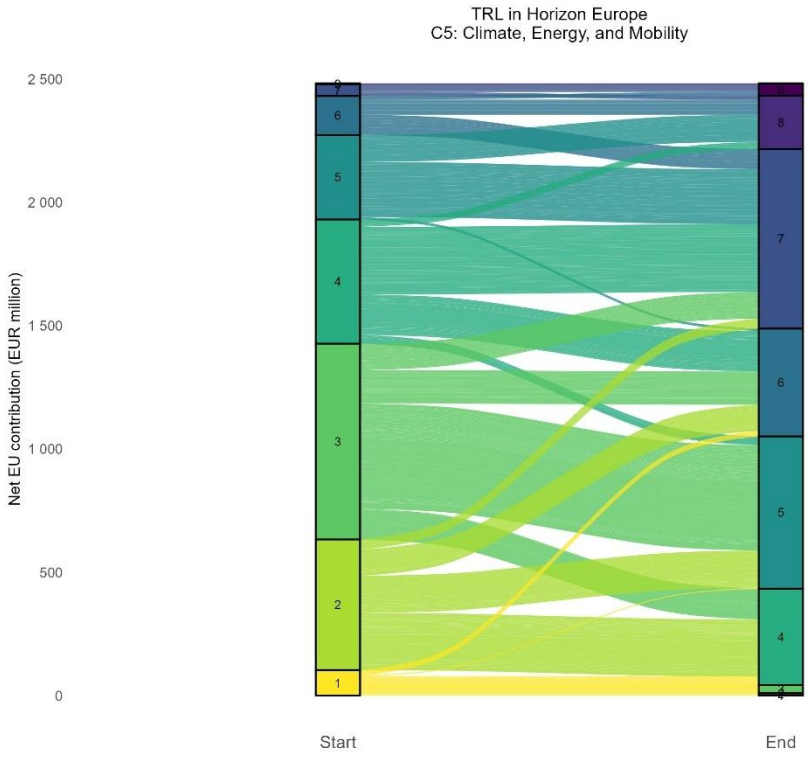
Figure 26: TRL in Cluster 4



Base: 377 projects.

8.5. Cluster 5

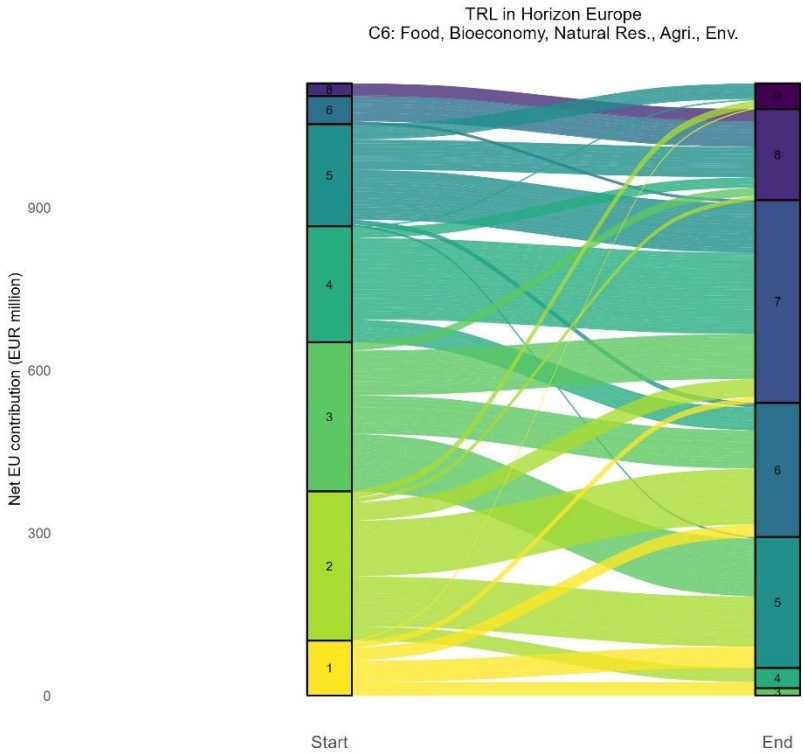
Figure 27: TRL in Cluster 5



Base: 320 projects.

8.6. Cluster 6

Figure 28: TRL in Cluster 6



Base: 188 projects.

9. Note on methodology

The projects included in this analysis are those available as of January 2025 (see Annex 7.1 for the exact cut-off dates). This approach ensures consistency with other publications. Nevertheless, it is unlikely to affect data availability since the entire analysis is based on Periodic Reporting, which is only available at least 12 months after the project start.

In Horizon Europe, there are two types of reporting for beneficiaries: Continuous Reporting and Periodic Reporting. Continuous Reporting is available from the beginning of a project, allowing beneficiaries to complete and amend it at any point. Periodic Reporting, on the other hand, is available only at the end of Reporting Periods, which divide the project into regular periods for technical reporting and monitoring. These Reporting Periods are usually linked to a payment.

In Horizon Europe, the “Impact” section of reporting includes a question on TRL at the start of the project, at the time of report submission, and at the end of the project. Since this data is not mandatory, beneficiaries can choose not to complete the question or only fill it in partially. Additionally, they may indicate that TRL is “not applicable.” These cases, as well as instances where all three TRL measures were left blank, have been excluded from the analysis.

This analysis relies solely on data from Periodic Reporting. In other words, data included in Continuous Reporting is not considered. There is a trade-off between data availability and

reliability: Continuous Reporting likely offers more data points (e.g., projects that have not reached the end of a Reporting Period can already include TRL data), yet it is subject to changes and, unlike Periodic Reporting, has not been validated by the Project Officer (and sometimes by external experts). It was deemed that this analysis could work with a smaller data set but provide more reliable results.

Similarly, more granular or up-to-date information on TRL may be available in other sections of the Periodic Reporting in an unstructured format. For instance, a discussion of the project's overall technological progression might be included in sections addressing the dissemination and exploitation of research results. This type of information has not been considered in the analysis. The rationale for this decision is that the Periodic Reporting includes a specific question on TRL, and the effort required to extract unstructured data from other parts of the project document would not be proportional to the analysis's objective.

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Technology Readiness Levels (TRLs) are a metric used to communicate the maturity of a particular technology. This analysis uses data collected from ongoing and closed Horizon Europe projects to provide an initial overview of the level of technological maturity that projects have achieved or expect to achieve. It looks at TRL from different angles, including by programme part, type of organisations receiving funding, and sector. Findings show that there is a clear progression from lower TRLs towards testing and commercialisation. They also make a case for R&I support throughout the entire innovation journey, to ensure that excellent, groundbreaking ideas find their way into the real world to solve challenges and improve collective well-being.

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