# EU MUST HELP EUROPEAN COUNTRIES TO INVEST 0.75 % OF GDP IN GOVERNMENT RESEARCH

### Proposal for a *20-year Programme of EU* for the years 2026-2045

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## EXECUTIVE SUMMARY

Spending on research is a highly profitable investment. The U.S. National Academy of Sciences has demonstrated that for every dollar spent on research, society is rewarded with five dollars in the long term, representing a 500% return on investment. Similarly, according to the European Commission every euro invested by Governments in research — subdivided between *basic research* (typically two thirds) and *applied research* — increases, in the long period, the Gross Domestic Product (GDP) by 4-7 euros.

Despite the evidence, the European Union, which stands as a global leader in knowledge and culture, does not invest enough in the development of science, incrementing a potential economic decline.

This document addresses a critical, yet overlooked, problem: the *vast and unacceptable disparity* in public research funding among EU member states. For decades, Europe has failed to close this gap despite the unanimous approval of the Lisbon and Europe strategies.

This failure has created a two-speed Europe: one third of the 27 countries are pushing the boundaries of science, while the majority lack the resources to train their young talents and contribute meaningfully the long-term economic development of the whole Europe. This is not just an injustice—it's an economic and social waste.

This proposal outlines a concrete **20-year program for European public research**, aiming to correct this structural weakness. We propose a co-funded plan to gradually raise the public research investment in the most disadvantaged countries to 0.75% of GDP, which was the 2022 European average, still far from the 1% of the 2000 Lisbon strategy. This initiative is designed to:

- **Promote long-term economic development** by leveraging the proven link between research investment and GDP growth.

- **Stop and invert the "brain drain"** by creating the necessary conditions to retain top scientific talents and attract those who have emigrated, particularly in USA.

- **Strengthen European cohesion and competitiveness** by ensuring all member states can contribute to the continent's scientific and technological present and future.

This program is both necessary and timely. With global competition intensifying and geopolitical shifts affecting the international flow of talent, Europe has a unique window of opportunity to position itself as the undisputed leader in science and innovation.

**An unacceptable disparity: the data**

A key metric is the **Government R&D intensity** $I_k$, defined as the ratio of *Government Budget Allocations for R&D* (GBARD) in the k-th year to the GDP of the same year. Unfortunately, this crucial metric shows a dramatic disparity across the EU. While the average R&D intensity in 2022 was 0.75%, this figure hides a dangerous reality: the two "virtuous" countries (Germany and Finland) averaged 1.0%, while the two most lagging countries (Ireland and Romania) were at a mere 0.165%. This is a **six-fold difference**.

To put this into perspective, in the table this gap is compared to other core government services:

| Field of Government Investment | Ratio of Max to Min Expenditure | Why it Matters |
|---|---|---|
| Education | 2.15 | Understandable differences in national priorities and structures. |
| Health | 2.00 | Understandable differences in national priorities and structures. |
| **Public Research** | **6.10** | **Unacceptable. This gap shows a systemic failure to support science.** |

As shown in the table above, the disparity in research funding is *three times* greater than in Education or Health. This is unacceptable because it means over half of the EU countries:

- Lack the necessary infrastructure and research staff to produce quality science and contribute to the long-term economic development.

- Cannot properly train their young researchers.

- Are unable to compete for European-level funding based on the quality of science, creating a cycle of underinvestment and stagnation.

To correct this imbalance, in this report a **twenty-year Programme for EU Government Research (2026-2045)** is proposed. It is built on a co-funding model where the EU contributes as much as each country does to the yearly budget increase.

**Programme organization, investments and outcomes**

The main points of the proposal are:

1. **Target:** Each of the 20 EU countries currently investing less than 0.75% of its GDP will receive support to increase its R&D intensity.

2. **Annual Commitment:** Each country will define the yearly increase of *its Government R&D Intensity* $I_k$, which however cannot be larger than **3.9% per year** to guarantee that the budget increase can be effectively spent.

3. **EU Contribution:** The European Union will reimburse **50% of this increase** in the following (k + 1) year, providing a powerful incentive for investment.

**In the years 2026-2045** this gradual approach, designed to be manageable and sustainable, requires a total investment of €180 billion, with €90 billion financed by the EU. In euros of 2025, these sums reduce to €150 billion, with **€75 billion financed by the EU**, that corresponds on average to **€3.7 billion per year**.

After 20 years not all the 19 countries, for which $I_{2025}$ is smaller than 0.75%, will have reached the goal because of the 3.9% limitation on the annual increase of the R&D intensity. These countries are part of the so called "Group I" which in the figure is at the left.
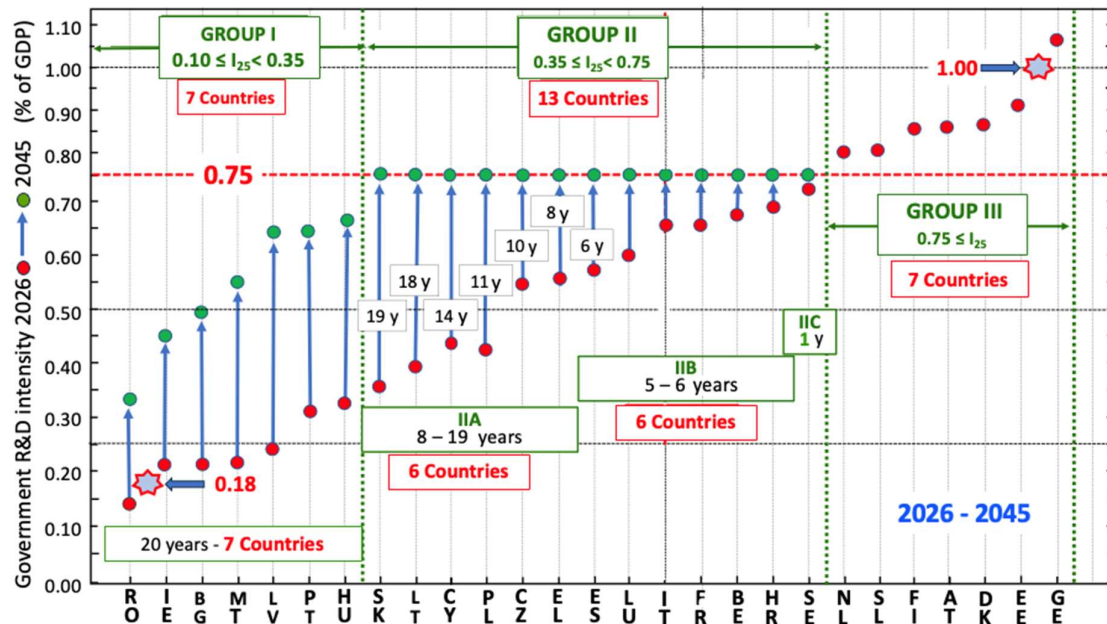


To be more specific

- **Group I (7 countries below 0.35% R&D intensity):** These countries will not reach the 0.75% target within 20 years but will make significant progress, in some cases doubling their R&D intensity; Latvia Portugal and Hungary will reach 0.65%.

- **Group II (12 countries between 0.35% and 0.75%):** These countries will reach the 0.75% target in a timeframe ranging from 5 to 19 years, as clearly shown in the figure; Sweden is so close to the goal that it can arrive in 1 year.

- **Group III (7 countries between above 0.75%):** These countries will certainly increase their Government R&D intensity but without receiving funds from Bruxelles.

It is very important to underline that the benefits of the program are **distributed fairly** and in proportion to need. The most disadvantaged countries (Group I) will be the biggest beneficiaries, receiving EU reimbursements that, over 20 years, are approximately **nine times** their 2025 investment. In contrast, Group II countries closer to the target -like Italy or France - will receive reimbursements equivalent to **about half** of their 2025 investment.

**Governance for ensuring success**

To ensure funds are used effectively, the program requires robust governance. In the Report it is propose establishing a dedicated **European Research Investment Agency** to:

- **Monitor Progress:** Track R&D intensity and spending in each country annually.

- **Enforce Criteria:** Ensure that EU funds are used exclusively for new research hires, infrastructure, and grants, rather than for covering existing expenses.

- **Implement Best Practices:** Promote the modification of the rules and the structures of each Country to improve knowledge transfer from Government research to industry.  Group II countries will

- **Connect the European countries**: Facilitate knowledge sharing among member states on how to effectively scale up research and innovation ecosystems.

- **Evaluate Impact:** Measure the success of the program not just in financial terms, but also through key performance indicators such as the number of new researchers, joint scientific publications, patents filed, knowledge transfer to start-ups, production of novel goods, etc.

This program is more than a financial plan; it is a strategic vision for a more integrated, resilient, and competitive Europe. With a relatively small investment, by fostering knowledge the European Governments can unite the 27 nations, tackle future challenges together, promote the long-term economic growth of Europe, and secure its place among the global leaders of the 21st century[1].

*The "*Overview*" section on page 16 provides further useful information for readers who do not wish to go into the details.*

## INDEX

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[1] On April 12, 2025, *Corriere della Sera* published an appeal – signed by the authors of this Report - denouncing the unacceptable disparity summarized in the table, proposing the twenty-year Programme described in this Report and underlying how this is the only way for all the EU countries to offer good conditions to the scientists who want to come back from USA. See: www.lincei.it/it/notizie/appello-la-ricerca-pubblica-dellunione-europea

### 1. An unacceptable disparity

A Government finances '**public**' research - the combination of '**basic**' and '**applied**' research - by investing an annual sum called **GBARD** = '*Government Budget Allocation for R&D'*. Universities produce mainly basic research while specialised Agencies devote themselves to both basic and applied research. Eq. (1) says that the ratio of **GBARD to nominal GDP** (i.e. GDP at current prices) is the *'Government R&D intensity'* For brevity in this Report the term 'government' is almost always dropped.

Businesses do both 'applied' research and 'experimental development', with the aim of improving products, and for all these activities they invest resources globally called BERD = *Business Enterprise R&D*. This, divided by nominal GDP, gives the **'Business R&D intensity'**.

$$(\textit{Business R\&D intensity in the k}^{th}\textit{ year}) = \mathbf{J_k} = \text{BERD}_k / \text{GDP}_k. \tag{2}$$

The sum of the two intensities is what is usually called 'R&D intensity':

$$(\text{R\&D intensity in the k}^{th}\text{ year}) = \mathbf{I_k} + \mathbf{J_k}. \tag{3}$$

In 2000, the EU Heads of State and of Government used this economic parameter in launching the 'Lisbon Strategy' with which Europe would "*become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion.*"

Three targets were chosen:

- o an average European employment rate of 70%;
- o an employment rate for women of 60%;
- o **a (total) R&D intensity of EU countries of no less than 3 %.**

In 2002, the Commission published a Communication: *'More Research in Europe – Towards 3% of GDP*'. In 2005, the new Commission published another Communication: *'More Research and Innovation - A Common Approach*'[2]. The seventh guideline[3] stated "*To increase and improve investment in R & D, in particular by private business, the overall objective for 2010 of 3 % of GDP is confirmed with an adequate split between private and public investments*". It should be noted that, although not explicitly stated in official documents, it is generally implied that the 3% target should be met with **one-third from the Government ($I_k$ = 1%) and two-thirds from businesses ($J_k$ = 2%)**."

Five years later, in 2010, the new *'Europe 2020*' strategy still wanted "*to reach the target of investing 3% of GDP in R&D, in particular by improving the conditions for the private sector to invest in R&D*"[4].

In 2020, the final '*Europe 2020*'[5] report recognised that: "*The (total) R&D intensity' reached 2.32%, a 15% improvement on the 2.02% in 2013 but below the overall target of 3%*". An increase of 15% with a target of 50% testifies a complete failure.

Table 1 shows that the 1% has not been reached even 22 years after Lisbon.

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[2] https://ec.europa.eu/invest-in-research/pdf/download_en/mep_en01bat3_051219.pdf
[3] Page 33 of https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:205:0028:0037:EN:PDF
[4] Page 32 of https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF
[5] Pages 58-59 of https://eur-lex.europa.eu/resource.html?uri=cellar:b5a1da8b-be92-11ee-b164-01aa75ed71a1.0001.02/DOC_1&format=PDF

*Table 1:* *After 22 years, the Lisbon target for European government R&D intensity has not been reached while the other two are surpassed.*

| | Total employment | Female employment | R&D government intensity |
|---|---|---|---|
| **Target 2022** | **70%** | **60%** | **1.0%** |
| EU 2000[6] | 63.1% | 53.8% | 0.61% |
| EU 2022[7] | 74.6% | 69.3% | 0.74% |
| **Fraction in 2022** | **106%** | **116%** | **74%** |

In the following years EU has deliberately forgotten the failure to the extent that in the 42-page presentation of the current *'Horizon Europe'* programme[8] - which covers the years 2021-2027 and is depicted on the next page in Fig. 1 - the **3% figure is not mentioned**, not even under *'Reforming and strengthening the European research system'*.
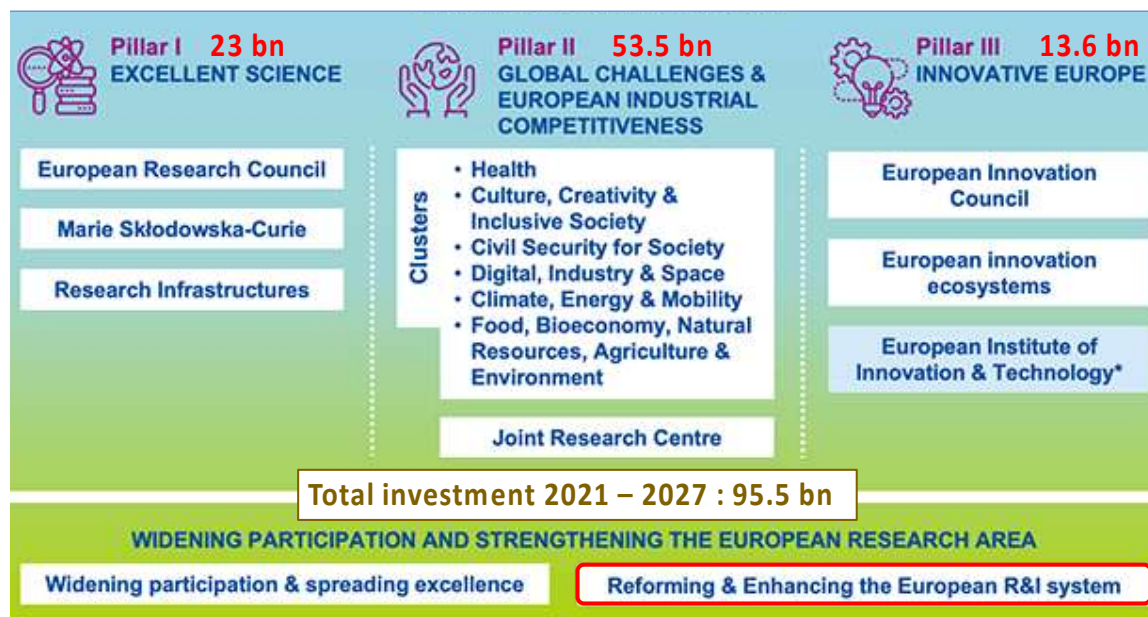


**Figure 1.** *Scheme of the current* 'Horizon Europe' *programme, which consists of three vertical 'pillars' (the first of which includes basic research) and one horizontal 'pillar'.*

This absence is partly justified by the fact that, over the past two decades, it has been realised that R&D intensity is important, but that the transfer of knowledge, from basic and applied research to companies and the resulting development, is determined by many factors[9]:

- o the excellence of research, particularly basic research (Pillar 1 of Fig. 1, p. 4),
- o the focus of government researchers on knowledge transfer,

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[6] https://ec.europa.eu/eurostat/web/products-statistics-in-focus/-/ks-nk-01-008
[7] https://amblav.it/eurostat-i-tassi-di-occupazione-nel-2022-rispetto-agli-obiettivi-ue-per-il-2030/
[8] https://research-and-innovation.ec.europa.eu/system/files/2022-06/rtd-2021-00013-03-00-it-tra-01.pdf
[9] See for example: www.vttresearch.com/sites/default/files/2021-05/OECD-TIP-RD-intensity-case-studies-synthesis-report.pdf

- o the tools and facilities that foster this transfer,
- o the effectiveness of partnerships between universities, public research organisations and companies,
- o the ability of companies to take up and use the knowledge transferred,
- o their investments in applied research and experimental development,
- o the quantity and quality of 'venture capitals',
- o the quality and quantity of private researchers,
- o the facilities granted to companies investing in R&D.

Many of these topics are addressed by the *'Horizon Europe*' Programme (**Fig. 1**, p. 6), which is a very positive thing. However, diverting attention, and for so many years, from the Government R&D intensity has created a seriously unbalanced situation, as is illustrated by **Fig. 2** (p. 8), in which the intensities of the 27 European Countries are *uniformly* distributed between 0.14 and 1.1. In 2022 the weighted average of the EU's (government) R&D intensity **was 0.74% in 20**22, a value obtained by adding the GBARDs of countries with very different intensities: 1.11% of Germany and 0.14% of Romania.

The average values between the two Countries, having maximum and minimum intensities, are reported In column (3) of Table 2. The second row of column (4) shows that **6.1 is the ratio between the $I_{22}^{max}$** value (av. of two countries) and the $I_{22}^{min}$ value (two countries).

***Table 2.** Indices of expenditure variability in three fields of Government intervention[10].*

| | (1) Countries | (2) min max | (3) % of GDP (*) $I_{22}^{average}$ | (4) Ratio $\dfrac{I_{22}^{max}}{I_{22}^{min}}$ | (5) Normalized ratio | (6) σ / aver. (**) | (7) Normalized σ / aver. |
|---|---|---|---|---|---|---|---|
| **R&D intensity.** 11 | Ireland+Romania | min | 0.165% | 6.10 | 3.05 | 0.375 | 3.40 |
| | Finland+Germany | max | 1.005% | | | | |
| **Education** 12 | Ireland+Romania | min | 2.95% | 2.15 | 1.05 | 0.11 | 1.00 |
| | Belgium+Sweden | max | 6.30% | | | | |
| **Health** 13 | Hungary+Latvia | min | 4.60% | 2.00 | 1.00 | 0.18 | 1.65 |
| | Austria+ Czechia | max | 9.20% | | | | |

(*). Average of the countries of column (1).

(**) These three ratios have been computed by excluding the countries of column (1).

The second and third row present the max/min ratios for two important Government activities: **Education** and **Health**, used as a comparison in column (5) by normalising the three figures to the minimum value. One can conclude that, among the 27 Countries, the *disparity in the funds devoted to research* **is three times larger** *than the ones in Education and Health*.

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10 The quantities in columns (5) and (7) do not depend on the purchasing power in the different countries.

11 Table 3, p. 7.

12 - https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_expenditure_on_education

13 https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_expenditure_on_health
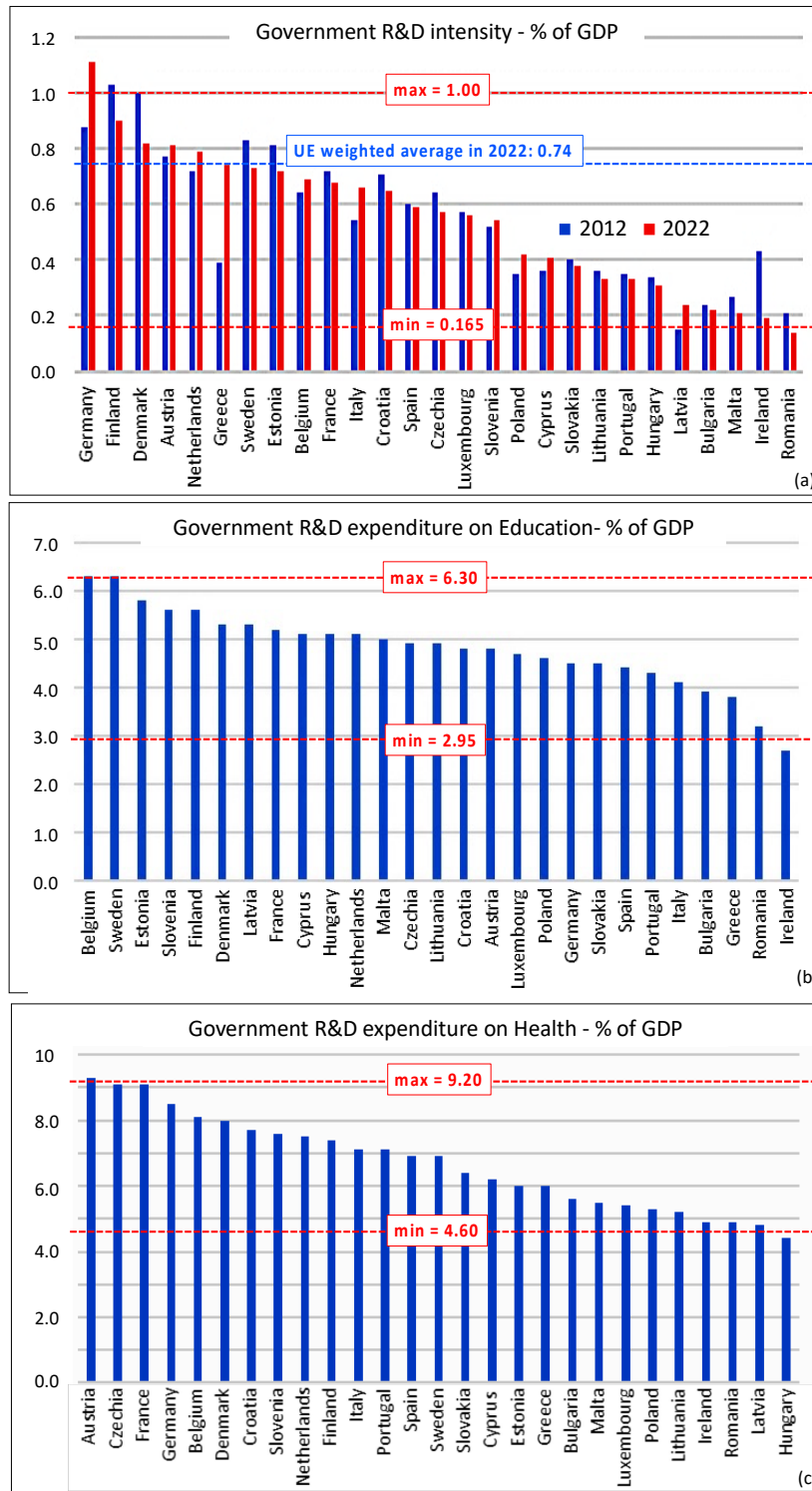
***Figure 2****. (a) Between 2012 and 2022, government R&D intensity increased in 14 countries - including Greece, Germany, and Italy - and decreased in 13 other countries - including Denmark, Finland, Ireland, and Sweden. Ireland and Romania also decreased and are at their lowest. (b) The same two countries are also at a minimum in government Education while for Public Health they are Latvia and Hungary. In Education, Belgium and Sweden are at the maximum. (c) In government Health, Austria and the Czech Republic are at the maximum.*

In Table 2 as second parameter, the ratio of **standard deviation σ** to the **mean** was chosen; the ratio was calculated by discarding the two maximum and minimum intensity values so that the normalized ratios in column (7) are independent of those in column (5). The value 3.40 of the last column says that also funds for Government research *vary from country to country* **three times more** *than those devoted to Education and Health*.

A **three times greater disparity** in Government research between countries than in Education and Health **is unacceptable** because it implies that many European countries

1. do not have the *means* and *research fac*ilities to contribute to Europe's development;

2. cannot train their young researchers while preparing them to compete for *European Research Counci*l grants, which are awarded on the basis of scientific quality alone;

3. are not able to offer their *research teams* the minimum conditions to do good research and to participate in European calls for proposals with a reasonable chance of success.

To remedy this situation– also in view of the return to Europe of many scientists who at present work in the States – in the present Report a **20-year Programme** is proposed in the remainder of this Report, partially financed by the EU, which subsidises the **21 countries** to bring them, in no more than 20 years, **to either 0.75%** or close to this value[14].

### 2. Resources needed for the 20-year Programme

Since the latest GBARD figures published by EUROSTAT are from 2023, in the following the 2023 GBARD values are used for **2025, chosen as reference year**. With this choice, **,** on page 10 lists − for the 27 countries of the Union:

- in column (3): the $Debt_{25}/GDP_{25}$ ratio (**$D_{25}$**) in 2025[15],
- in column (4): the GBARD for 2025 (**$G_{25}$**), expressed in millions of euros[16].

In calculating the values in Table 3, it is assumed that each country's GBARD ($G_{25+k}$) increases, from the previous year, by an amount **$\Delta G_{25+k}$**, obtained by multiplying **$G_{25+k-1}$ by (r − 1) > 0.** The larger r is, the more rapidly the objective will be reached, but if the new resources are too abundant, they cannot be effectively spent. Hence, a **first rule** was adopted:

A. The annual increases **$\Delta G_{25+k}$** of GBARD over the previous year may not exceed **7% per year**:

$$1 + \Delta G_{25+k}/G_{25+k-1} = r \leq 1.07 \qquad (1 \leq k \leq 20) \qquad (4)$$

so that, with the "nominal GDP" growing by 3% per year ($PIL_{25+k} = p^k\, PIL_{25}$ with **p =1.03**) − of which 2% due to inflation and 2,2% to the increase of the 'real GPD' − the "**government R&D intensity**" $I_{25+k} = G_{25+k}/PIL_{25+k}$ does not increase by more than **3.88% per year** (r/p = 1.07/1.03 =1.0388).

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[14] In 2022, Europe's total GBARD amounted to €117.4 billion and total GDP to €15,920 billion, yielding an intensity of public R&D (I2022) of 0.74%. In 2023, the intensity dropped to $I_{2023}$ = 0.70%, with a total GBARD of €123.7 billion and a GDP of €17,720 billion. Thus, in just one year, intensity declined by 5.6% due to a sharp 11% increase in nominal GDP (mostly due to inflation), despite a 5.4% rise in Europe's GBARD.

[15] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_finance_statistics#General_government_gross_debt

[16] https://ec.europa.eu/eurostat/databrowser/view/GBA_FUNDMOD/default/table?lang=en&category=scitech.rd.gba

*Table 3. Duration n of the programme (Column 8), **GBARD** growth rate (Column 8), and **required new resources (Column 9)** at current prices, assuming nominal GDP increases by 3% per year, of which 2.0% is due to inflation and 2.2% to real GDP growth.*

| (1) | (2) Country (No-Euro in brackets) | (3) Debt/ GDP 2025 $D_{25}$ (%) | (4) GBARD 2025 $G_{25}$ (mn) | (5) GDP 2025 $GDP_{25}$ (bn) | (6) R&D Inten. 2025 $I_{25}$ (%) | (7) Years f Eq (5) with r = 1.07 | (8) Years **n** – Growth rate of GBARD from Eq (5) (r-1) | (9) **New resources** Eq. (7) $R_{25-(o+n)}$ (mn) |
|---|---|---|---|---|---|---|---|---|
| 1-RO | (Romania) | 48.9 | 493 | 325.4 | 0.152 | 41.9 | 20 – 7.00% | 11 768 |
| 2-IE | Ireland | 43.3 | 1051 | 510 | 0.206 | 33.9 | 20 – 7.00% | 25 087 |
| 3-BG | (Bulgaria) | 22.9 | 213 | 94.7 | 0.225 | 31.6 | 20 – 7.00% | 5084 |
| 4-MT | Malta | 47.4 | 53 | 21 | 0252 | 28.2 | 20 – 7.00% | 1253 |
| 5-LT | Latvia | 45.0 | 118 | 39.4 | 0.299 | 25.1 | 20 – 7.00% | 2817 |
| 6-PT | Portugal | 97.9 | 802 | 267.9 | 0.299 | 25.1 | 20 – 7.00% | 19 143 |
| 7-HU | (Hungary) | 73.4 | 616 | 198.0 | 0.311 | 23.1 | 20 – 7.00% | 14 704 |
| GRUPPO I: 7 Countries (0,10% ≤ $I_{25}$ < 0,35% | | | | | | | | **79 856** |
| 8-SK | Slovakia | 56.1 | 453 | 122.9 | 0.368 | 18.7 | 19 – 6.93% | 9370 |
| 9-LT | Lithuania | 37.3 | 278 | 71.8 | 0.387 | 17.3 | 18 – 6.86% | 4961 |
| 10-CY | Cyprus | 73.6 | 138.3 | 31.3 | 0.442 | 13.9 | 14 – 6.96% | 1389 |
| 11-PL | (Poland) | 49.7 | 3817 | 749.0 | 0.510 | 10.1 | 11 – 6.67% | 21 164 |
| 12-CZ | (Czechia) | 42.4 | 1626 | 317.4 | 0.512 | 10.0 | 10 – 7.00% | 7778 |
| 13-EL | Greece | 163.9 | 1281 | 225.2 | 0.569 | 7.50 | 8 – 6.62% | 3574 |
| GRUPPO IIA: 6 Countries (0.35% ≤ $I_{25}$ < 0.60%) | | | | | | | | **48 236** |
| 14-ES | Spain | 105.1 | 8997 | 1498 | 0.601 | 5.81 | 6 – 6.88% | 14 596 |
| 15-LU | Luxemb. | 25.5 | 507 | 81.0 | 0.626 | 4.74 | 5 – 6.79% | 565 |
| 16-IT | Italy | 134.8 | 13 461 | 2131 | 0.632 | 4.49 | 5 – 6.59% | 14 535 |
| 17-Fr | France | 109.9 | 18 266 | 2822 | 0.647 | 3.88 | 5 – 6.09% | 18 104 |
| 18-BE | Belgium | 103.1 | 3865 | 596 | 0.648 | 3.84 | 5 – 6.06% | 3810 |
| 19-HR | Croatia | 61.8 | 533 | 78.0 | 0.683 | 2.46 | 5 – 4.95% | 422 |
| GRUPPO IIB: 6 Countries (0.60% ≤ $I_{25}$ < 0.70%) | | | | | | | | **52 032** |
| 20-SE | (Sweden) | 31.5 | 3908 | 541 | 0,722 | 1.00 | 1 – 7.00% | 273 |
| GRUPPO IIC: 1 Country (0.70% ≤ $I_{25}$ < 0.75%) | | | | | | | | **273** |
| 21-NL | Netherl. | 45.1 | 8532 | 1066 | 0.800 | - | - | - |
| 22-SI | Slovenia | 68.4 | 518 | 64.0 | 0.809 | - | - | - |
| 23-FI | Finland | 77.1 | 2349 | 273 | 0.860 | - | - | - |
| 25-AT | Austria | 78.6 | 4095 | 473 | 0.866 | - | - | - |
| 25-DK | (Denmark) | 33.6 | 3277 | 376 | 0.871 | - | - | - |
| 26-EE | Estonia | 20.2 | 337 | 38.2 | 0.882 | - | - | - |
| 27-DE | Germany | 62.9 | 44090 | 4185 | 1.053 | - | - | - |
| GRUPPO III: 7 Countries (0.75% ≤ $I_{25}$) | | | | | | | | |
| | TOTAL | | 20 Countries with $I_{25}$ ≤ 0.75 % | | | | | **180 400** |

The last row of the table shows that the **twenty-year Plan 2026–2045 requires a total investment of €180 billion** at current prices.

According to the OECD, Europe's real GDP will grow on average by 1.8% per year between 2015 and 2030[17]. **In Table 3**, a GDP growth rate of **2.2% per year** was adopted—25% higher than the OECD figure—based on the assumption that the investments which are being made by tEU to implement the Draghi and Letta Reports and to strengthen Defence will have a positive impact on the GDPs of the 27 countries.

The Programme—which requires a dedicated management structure as discussed in Section 5, p. 19—is aimed at the 21 countries whose public R&D intensity in 2023 was **below 0.75%.** Since $0.75/(r/p)^{20} = 0.75/1.0388^{20} = 0.35\%$, only countries with $I_{25}$ greater than 0.35% can reach the target in no more than 20 years. For this reason, in T**able 3** the values $I_{25+k} = 0.35\%$ and $I_{25+k} = 0.75\%$ divide the EU countries into **three Groups,** and Group II in **three Subgroups**:

- o **GROUP I**: 7 countries with $I_{25} < 0.35\%$ that will not be able to reach $I_{25+k} = 0.75\%$ within the 20 years of the Programme;
- o **GROUP IIA**: 6 countries with $0.35\% \leq I_{25} < 0.60\%$ that will be able to reach $I_{25+k} = 0.75\%$ within 7 to 20 years;
- o **GROUP IIB**: 6 countries with $0.35\% \leq I_{25} < 0.74\%$ that will be able to reach $I_{25+k} = 0.75\%$ in 5 to 6 years;
- o **GROUP IIC**: 1 country with $I_{25} \geq 0.70\%$ that is very close to the target and will reach it in 1 year;
- o **GROUP III**: 7 countries that, with **0,75%,** $< I_{25}$, have not to invest in the Programme.

Note that the groups would change if the rate of increase was reduced from 7% to 6%, as this would result in $I_{25} < 0.42\%$, instead of $I_{25} < 0.35\%$, as the threshold for achieving 0.75% in 20 years, and Slovakia and Lithuania would move from Group IIA to Group I.

Eq. (A3) in the Appendix 1 (p. 19) – with the GDP factor **p = 1.03** – and its inverse

$$\mathbf{f} = \ln(0.75/\mathbf{I_{25}}) / \ln(\mathbf{r}/1.03) \qquad \mathbf{r} = (0.75/I_{25})^{1/\mathbf{f}} \qquad (5)$$

give one of the infinite pairs of values **(r, f)** that in **f years** (with f being a fractional number) lead from $\mathbf{I_{25}}$ to **0.75%**. The **f** values listed in column (7) of Table 3 were calculated with the value **r= 1.07** established by rule A, and with **p = 1.03** so that $f = 26.25 \ln(0.75/I_{25})$.

The numbers **n** in column (8) are integers **greater than f** and less than or equal to 20. Substituting n for f in the second Eq. (5) gives the **growth rates r** written in red in the same column.

To achieve the results listed above, it will be necessary to invest the new resources $\mathbf{R_{26\text{-}(25+n)}}$ in column (9) on p. 10, which, for each country, are the sums of the $\mathbf{DG_{25+k}}$ **increases over GBARD$_{2025}$**:

$$\mathbf{R_{26\text{-}(25+n)}} = \Sigma_{k=1 \to n} \, \mathbf{DG_{25+k}} \qquad (6)$$

Each $DG_{25+k}$ is the sum of the annual increases $\Delta G_{25+k} = r \, G_{25+k-1}$ of the previous k years[18]:

$$\mathbf{R_{26\text{-}(25+n)}} = \mathbf{G_{25}} \, [\mathbf{H_n(r)} - \mathbf{n}] \quad \text{with} \quad H_n(s) = s \, (s^n - 1)/(s - 1), \quad (n = 1\text{-}20) \qquad (7)$$

as demonstrated in the Appendix 1 on page 19. The factor multiplying $G_{25}$ increases rapidly with the number n of years, as is shown by the **red (green)** curve in Fig. 3, and, for n = 20 and r = 1.07, is **23.87 (17.98)**.

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[17] www.oecd.org/content/dam/oecd/en/publications/reports/2012/02/strategic-transport-infrastructure-needs-to-2030_g1g13d1c/9789264114425-en.pdf?utm_source=chatgpt.com

[18] Example: the annual investments needed, with respect to the reference year 'zero', to pass – in 1 billion steps and in 5 years – from $GBARD_0$ = 10 million to $GBARD_5$ =15 million are: 1 + 2 + 3 + 4 + 5 = 15 billion.
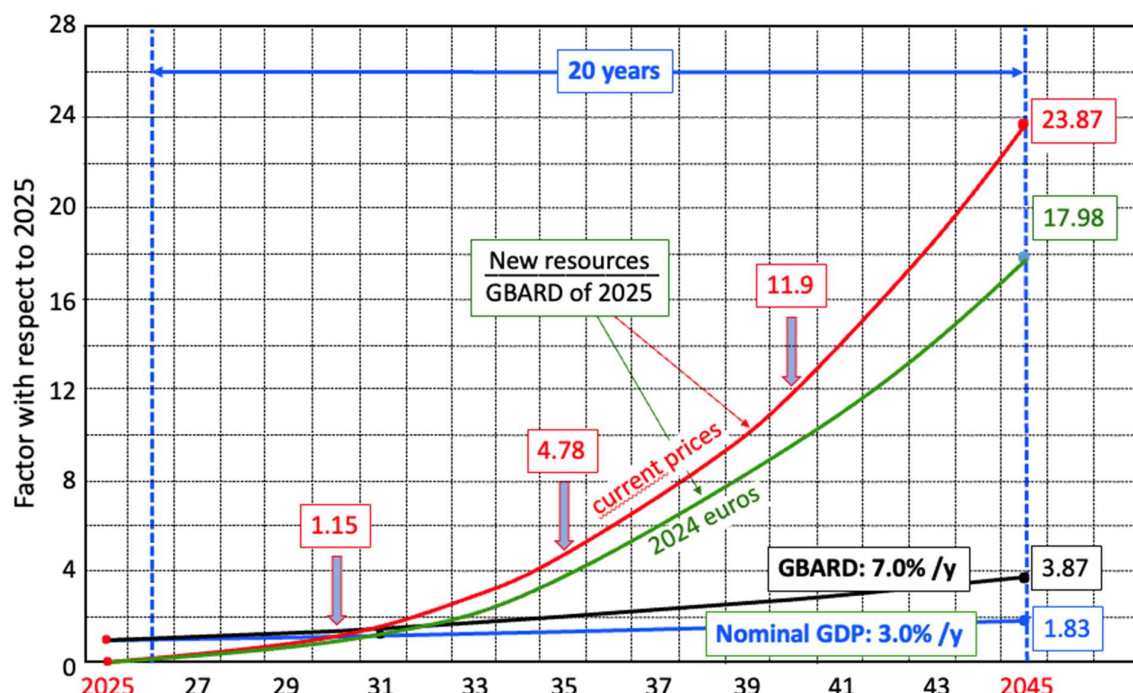
**Figure 3.** *Assumed trends in nominal GDP (blue curve) and GBARD (black curve). The **red curve** represents the ratio $R_{26-(25+n)} / G_{25}$ of Eq. (7). The **green curve** is the factor expressing the new resources in **2025 euro**, as discussed on pages 19-21 of Appendix 1.*

The effects of the investments, listed in column (9) of Table 3 on page 10, are shown in **Figure 4**, which illustrates how many years it takes for the countries in Group I to reach 0.75%. Three of them get close: Latvia, Portugal, and Hungary; Romania, starting from 0.152%, arrives at less than 0.35% reaching half of the target value.
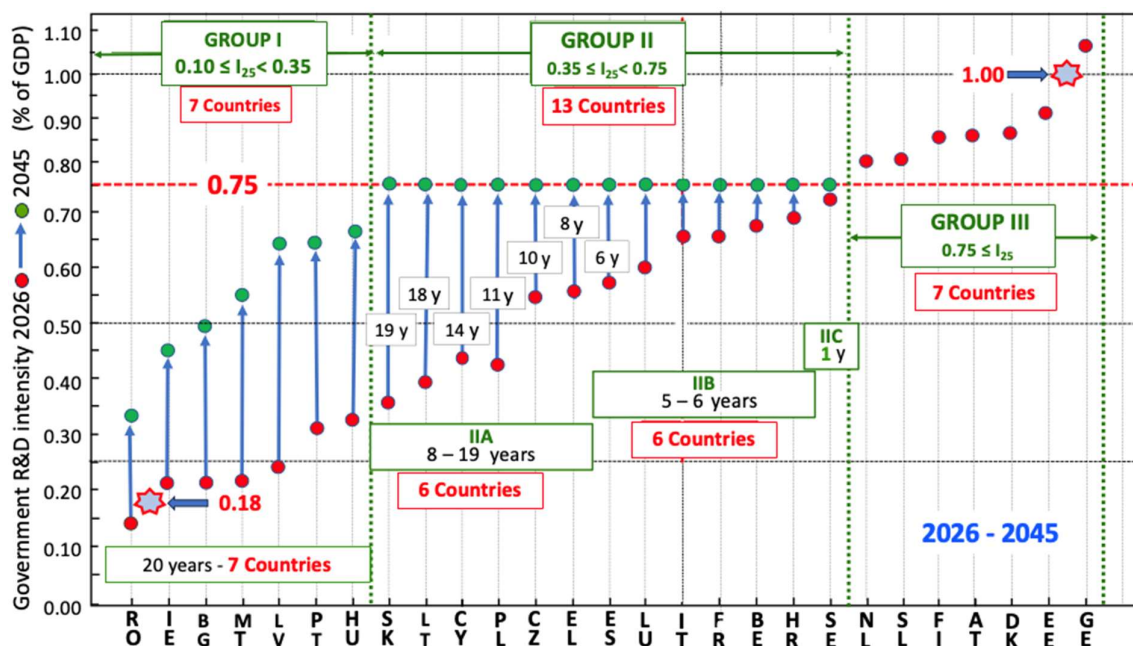


**Figure 4**. *The figure shows that **in 2025** the R&D intensities of the 27 countries were **evenly distributed between 0.18% and 1.00%** (Table 3, p. 7) and that 13 Countries had an intensity larger than 0,35% (Group II) and could arrive to 0,75% in 20 years.*

The model used to calculate the required resources is simplistic because

i. it uses data from 2023 for the reference year 2025,
ii. it assumes a constant **real GDP** increase of **2,2% per year**,
iii. it chooses a maximum GBARD increase of **7% per year** so that the Government R&D intensity increases by a maximum of **3.88% per year**.

However, applying these hypotheses results in four interesting pieces of information[19],

- **€180 billion** (at current prices) are required to complete the Programme.
- For the **7 countries in Group I** (Bulgaria, Latvia, Malta, Ireland, Portugal, Romania, and Hungary), the 0.75% target is **not achievable** within the 20-year horizon of the Programme — assuming a maximum annual increase in public R&D intensity of 3.88% — but significant progress will be made: for example, Romania will increase from 0.152% to 1.038820 × 0.14 = **0.325%**, while Latvia, Portugal, and Hungary will reach 0.65% (see **Fig. 4**, p. 12).
- For the **6 countries in Group IIA** (Czechia, Cyprus, Greece, Lithuania, Poland, and Slovakia), reaching the 0.75% target with annual increases of 3.88% **will require between 8 years (Greece) and 19 years (Slovakia).**
- For the **6 countries in Group IIB** (Belgium, Croatia, France, Italy, Luxembourg, and Spain), the annual increases in GBARD needed to reach 0.75% in 5 years range between **5.0% and 6.9%** and are more manageable than the 7.0% required for the countries of Group I.
- **Sweden**, the only country in Group IIC, is already very close to the target, which it can reach in 1 year.

### 3  European Union grants

The disparity among countries — illustrated in **Figure 2a** (p. 8) and **Figure 4** (p. 12) — is the result of the European Union's sustained lack of interest, over the past two decades, in ensuring balanced funding of public research across Member States, despite many declarations to the contrary, beginning with the Lisbon Strategy of 2000.

The more than twenty-year history of this issue leads to the conclusion that motions and recommendations are not sufficient: this disparity will not diminish **without targeted and lasting European interventions.** To this end **a twenty-year plan of financial** support is proposed, quantified according to **Rule B**:

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B.  Countries that in 2025 have a research intensity $I_{(25)}$ **< 0.75%,** and that in year $k$ increase their GBARD by **$DG_{25+k}$** relative to 2025, will receive from the EU — in the following year — a grant **$S_{25+k}$** equal to 50% of that increase:

$$S_{25+k} = 0{,}50 \ DG_{25+k}. \qquad (1 \le k \le 20) \qquad (8)$$

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[19] **In this Report, euro amounts expressed in millions—typically sums of annual values—are either followed by the label "current prices" or left unspecified. Amounts adjusted for inflation, on the other hand, are explicitly indicated as "euro 2025."**

EU grants at current prices, divided by GBARD$_{2025}$, are listed in Column (4) of **Table 4**, which requires a preliminary remark: 50% of each year's additional investment will be reimbursed by the EU in the following year. However, if in any given year the actual investments fall short of those projected in **Table 3**, the corresponding grant will be reduced proportionally.

To calculate the **resources needed**—both at **current prices** (Column 9, Table 3) and in **2025 euros**—for each country (each having its own value of $r$, shown in Column 8, Table 3 on page 10, it is useful to introduce two proportional quantities, **U** and **V**:

$$U = R_{26-(25+n)} / G_{25} \text{ (euro correnti)}; \quad V = T_{26-(25+n)} / G_{25}. \text{ (euro 2025).} \tag{9}$$

The product **Q = 0.50 V** of Column (6) expresses how many times the **total EU subsidies** (in 2025 euros) exceed the GBARD $G_{25}$ invested by each country in the year 2025.

*Table 4. Quantities U, V, Q and R&D intensity at the beginning and at the end of the twenty-year Programme.*

| | (1) | (2) GBARD 2025 $G_{25}$ (bn) | (3) Duration n (years) − **rate of** GBARD (r-1) | (4) U = $R_{26-(25+n)}$/$G_{25}$ (current prices) | (5) V= $T_{26-(25+n)}$/$G_{25}$ (€ 2025) | (6) Q = 0.50 V (€ 2025) | (7) InitialR&D intens. $I_{25}$ (%) | (8) **Final R&D Intens.** $I_{25+n}$ (%) |
|---|---|---|---|---|---|---|---|---|
| **G** | 1-RO | 493 | 20 − 7.00% | **23.87** | **17.98** | **8.99** | 0.152 | **0.325** |
| **R** | 2-IE | 1051 | 20 − 7.00% | **23.87** | **17.98** | **8.99** | 0.206 | **0.441** |
| **o** | 3-BG | 213 | 20 − 7.00% | **23.87** | **17.98** | **8.99** | 0.225 | **0.481** |
| **u** | 4-MT | 52,5 | 20 − 7.00% | **23.87** | **17.98** | **8.99** | 0.252 | **0.539** |
| **p** | 5-LV | 118 | 20 − 7.00% | **23.87** | **17.98** | **8.99** | 0.299 | **0.640** |
| **I** | 6-PT | 802 | 20 − 7.00% | **23.87** | **17.98** | **8.99** | 0.299 | **0.640** |
| | 7-HU | 616 | 20 − 7.00% | **23.87** | **17.98** | **8.99** | 0.311 | **0.665** |
| | 8-SK | 453 | 19 − 6.93% | **20.68** | **15.82** | **7.91** | 0.368 | **0.750** |
| | 9-LT | 278 | 18 − 6.86% | **17.85** | **13.83** | **6.92** | 0.387 | **0.750** |
| **II** | 10-CY | 138.3 | 14 − 6.96% | **10.04** | **8.251** | **4.13** | 0.442 | **0.750** |
| **A** | 11-PL | 3817 | 11 − 6.67% | **5.547** | **4.753** | **2.38** | 0.510 | **0.750** |
| | 12-CZ | 1626 | 10 − 7.00% | **4.784** | **4.153** | **2.08** | 0.512 | **0.750** |
| | 13-EL | 1281 | 8 − 6.62% | **2.790** | **2.492** | **1.25** | 0.569 | **0.750** |
| | 14-ES | 8997 | 6 − 6.88% | **1.622** | **1.488** | **0.744** | 0.601 | **0.750** |
| | 15-LU | 507 | 5 − 6.79% | **1.114** | **1.032** | **0.516** | 0.626 | **0.750** |
| **II** | 16-IT | 13 461 | 5 − 6.59% | **1.080** | **1.005** | **0.503** | 0.632 | **0.750** |
| **B** | 17-Fr | 18 266 | 5 − 6.09% | **0.991** | **0.923** | **0.462** | 0.647 | **0.750** |
| | 18-BE | 3865 | 5 − 6.06% | **0.986** | **0.918** | **0.459** | 0.648 | **0.750** |
| | 19-HR | 533 | 6 − 6.88% | **0.792** | **0.739** | **0.370** | 0.683 | **0.750** |
| **I C** | 20-SE | 3908 | 1 − 7.00% | **0.0699** | **0.0690** | **0.035** | 0.722 | **0.750** |
| | | 60 476 | **Total in mn** | **90 200** | | | | |

**The total amount of the reimbursements is €90 billion—half of the €180 billion appearing in the bottom line of Table 3, as expected**[20].

Which countries are the best funded by the twenty-year Plan?

Taking 50% of the new resources from Column (9) of Table 3 (page 10), the reimbursements in current prices to the countries in Groups I and II amount to €79.9 billion and €100.5 billion, respectively. These figures seem to suggest that countries more advanced in public research investment tend to benefit more, particularly those receiving the largest contributions: Ireland (€12.5 billion, current prices), Poland (€10.6 billion), Portugal (€9.6 billion), France (€9.1 billion), Hungary (€7.4 billion), Spain (€7.3 billion), and Italy (€7.3 billion).

However, **focusing on absolute figures is misleading**, as EU subsidies are proportional to G25, the GBARD in the reference year, and countries with a lower G25 inevitably receive fewer subsidies.

Moreover, different countries have programmes of different durations, and for a fair comparison, inflation must be considered. For this reason, Figure 5 presents the Q ratios—from Column (6) of Table 4—which measure **how many times the reimbursements**, expressed in 2025 euros, **exceed each country's 2025 GBARD**.
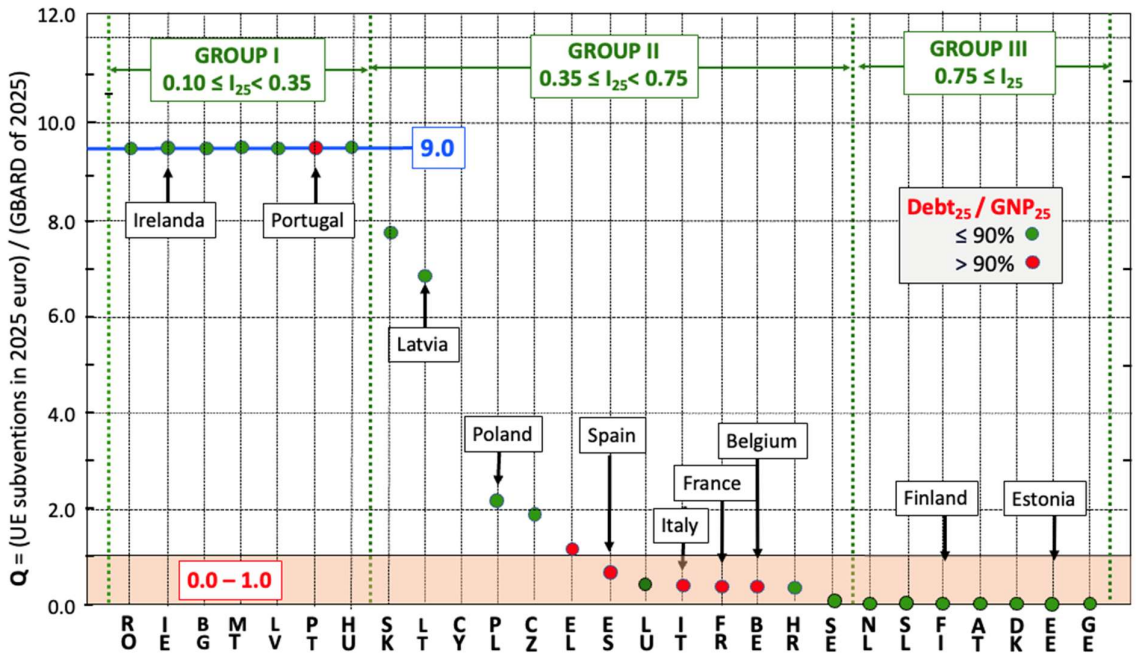


*Figure 5. The Q ratio between total EU contributions and GBARD—both referred to 2025 values—is the parameter that best captures the fairness of the twenty-year Programme.*

The figure clearly shows that the main beneficiaries of the Programme are the **countries in Group I**, which over twenty years receive, in 2025 euros, reimbursements amounting to **nine times their public research investment** of that same year.

Latvia and Poland receive, respectively, seven times and two and half times, respectively, of what they invested in 2025.

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[20] The formulas for *U* and *V* are provided in the Appendix (page 19), and their numerical values—shown in Columns (4) and (5) of Table 4—are taken from Table A1 (page 20).

The larger and more indebted countries (Belgium, France, Italy[21], and Spain) show values close to Q = 0.5—that is, over 5–6 years, they receive reimbursements equal to about half of what they invested in public research in 2025.

### 4. Reasons for a European Research Investment Agency

Investing over 20 years about 75 million (in 2025 Euro) is not enough to guarantee that all the financed countries will eventually educate better scientists and produce better science so to properly contribute to the EU long term development  To reach its goals the Programme requires robust governance, which must not only ensure – by using objective criteria – that the funds are well spent but has also to help each country to improve the transfer of knowledge, from basic and applied research to companies and the resulting development, by acting of the factors that are listed on the pages 6 and 7.

It is thus proposed establishing a dedicated **European Research Investment Agency** to:

- **Monitor Progress:** Track R&D intensity and spending in each country annually.

- **Enforce Criteria:** Ensure that EU funds are used exclusively for new research hires, infrastructure, and grants, rather than for covering existing expenses.

- **Implement Best Practices:** Promote the modification of the rules and the structures of each Country to improve knowledge transfer from Government research to industry.  Group II countries will

- **Connect the European countries**: Facilitate knowledge sharing among member states on how to effectively scale up research and innovation ecosystems.

- **Evaluate Impact:** Measure the success of the program not just in financial terms, but also through key performance indicators such as the number of new researchers, joint scientific publications, patents filed, knowledge transfer to start-ups, production of novel goods, etc.

### 5. Overview

**Figure 6** was produced using the numerical values of EU reimbursements (in 2025 euros) — year by year — as listed in Tables A2 and A3 (pages 22–25).

The figure shows that across the four five-year periods, the €74.4 billion (in 2025 euros) are distributed as follows: **28.0 – 17.4 – 13.0 – 16.0** billion. The red bars illustrate the year-by-year evolution of EU contributions.

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[21] For Italy the ratio is Q = 0.50, which is eighteen times lower than that of the Group I countries. In the five-year period 2026–2030, the GBARD sequence is: 14.347 – 15.292 – 16.300 – 17.374 – 18.519 billion euros and the annual increases – relative to 2025 – are 0.887 – 1.832 – 2.840 – 3.914 – 5.059 billion euros. It is worth noting that these annual increases are very similar to the proposal published on the front page of *Corriere della Sera* on 1 October 2020, when – in order to reach 0.75% of GDP in five years – 14 scientists (including the authors of this report) called on the Government to increase GBARD in the sequence 1.00 – 2.00 – 3.00 – 4.00 – 5.00 billion euros.
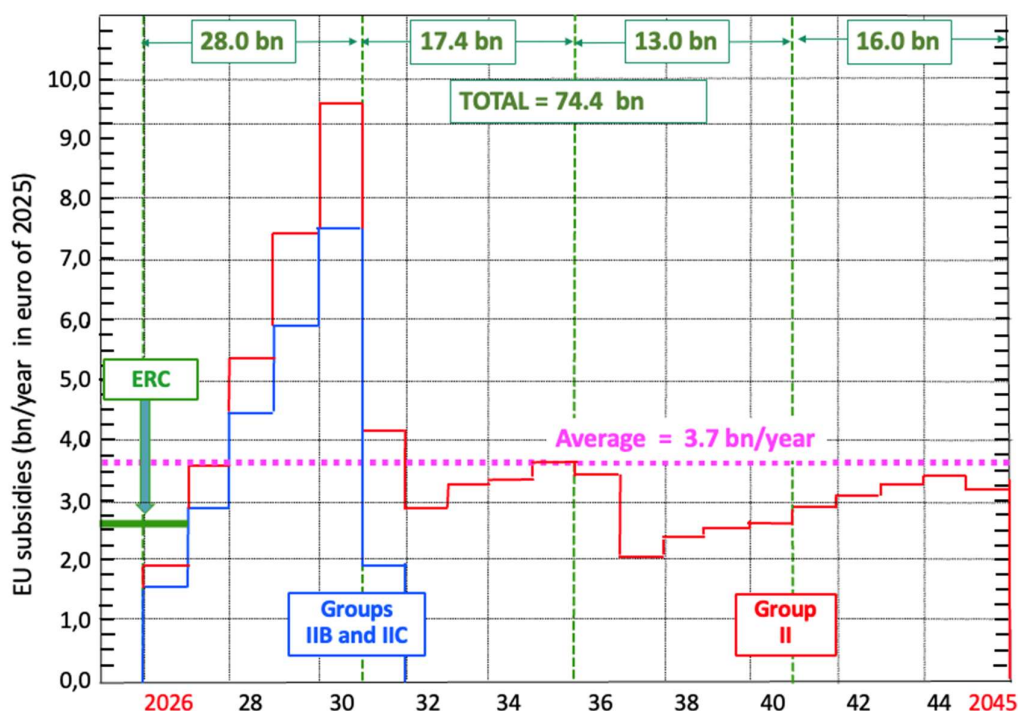
*Figura 6. The annual trend of EU investments, expressed in 2025 euros, is compared with the yearly budget of the European Research Council (green segment*).

In the figure the blue bars refer to Group I countries and, as expected, show a peak at the end of the five-year phase. Because of this peak, in 2030 spending (in 2025 euros) is more than double the average annual expenditure over the twenty years, which stands at **€3.7 billion**— as marked by the magenta dashed line.

It is instructive to compare the magenta line with the green segment, which represents the **entire annual grant budget of the European Research Council (ERC)** awarded solely based on scientific excellence: **€2.5 billion per year**. According to the 2026–2045 Programme, the EU would therefore invest each year one and a half times what it currently invests in Europe's best researchers through the ERC. **This is a more than reasonable amount**, as it would place **all researchers in all EU countries** on equal footing, correcting the disparities among the 27 Member States—a disparity that is unacceptable because, as discussed on page 9, it implies that more than half of European countries:

- **lack the means and research infrastructures** to contribute over the long term to Europe's economic development;

- **are unable to train their young researchers** to compete on equal terms for ERC grants awarded solely on the basis of scientific merit;

- **cannot offer their research groups even the minimum conditions** to conduct high-quality basic science or to apply competitively for European funding.

This is not only an injustice—it is a waste.

A further argument in favour of adopting the twenty-year Programme can also be made: the **€3.7 billion per year** required between 2026 and 2045 represent only a minor adjustment within the broader investment horizon of **€750–800 billion annually** that, according to the

Draghi Report, **Europe must commit each year** to improve productivity, support the green transition, and safeguard sovereignty.

<p style="text-align:center">*   *   *</p>

**Three Concluding Remarks**

First, the **twenty-year Programme is ambitious** because – as shown in Fig. 4 on page 12 – after 5 to 20 years, the R&D intensity of the 21 EU countries currently below 0.75% will reach:

- **0.75% for 13 countries** (Group II): Belgium, Czechia, Cyprus, Croatia, Estonia, France, Italy, Luxembourg, Poland, Slovakia, Slovenia, Spain, and Sweden;

- **around 0.70% for 3 countries** in Group I: Lithuania, Portugal, and Hungary;

- **between 0.40% and 0.50% for 4 countries** in Group I: Bulgaria, Latvia, Malta, and Ireland;

- **0.33% for Romania**, which in 2025 starts from an intensity of just 0.15%.

Second, the **twenty-year Programme is fair** because, under rule B (p. 13), it funds all countries in Groups I and II while **giving preference** – as shown in Fig. 5 on page 15 – to the **Group I countrie**s, which are the furthest from the 0.75% target. The more advanced countries receive, in proportion to their 2025 investment in public research, **eighteen times less** than the countries in Group I.

Third, **the financial commitment required from the EU is reaso**nable. As shown in Fig. 6 (page 16), across the four five-year periods, the EU would need to invest **€28.0 billion, €17.4 billion, €13.0 billion, and €16.0 billio**n respectively – for a total **of €74.4 billion** (all in 2025 euros). Over the 2025–2044 period, the average annual investment – **€3.7 billio**n in 2025 euros – corresponds to **one and a half times** the amount allocated in 2022 (also in 2025 euros) to the **European Research Council**[22]  grants, which support European researchers, especially young ones, solely based on scientific excellence, regardless of nationality. It is, in fact, more than reasonable to invest **an equal amount** in strengthening the public research systems of the Union, thereby creating the necessary conditions for researchers from **all EU countries** – including those **returning from the US** through European and national programmes now being developed – to have access to the means and infrastructure required to **contribute to Europe's long-term development**. This would also allow them to compete on equal footing in excellence-based EU programmes without needing to emigrate again.

To conclude, it should be emphasized that the investments made over the twenty years of the Programme will only be effective for Europe's long-term economic development if, in parallel, **each financed country promotes specific national programmes focused on the themes outlined on page 6 and 7.** Moreover, the **European Research Investment Agency,** introduced in Section 4 (p. 16) and tasked with coordinating the Programme, will need the support of the advanced countries, which are not financed, to push the less virtuous countries to adopt best practices and to remove the many obstacles that currently hinder the transfer of knowledge from basic research to industry.

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[22] See pag. 21 of di https://opag.europa.eu/en/publication-detail/-/publication/3a11d526-ceab-11ed-a05c-01aa75ed71a1

**Acknowledgments**

# APPENDIX

## New resources to be invested by the EU, expressed — year by year — in current euros and in 2025 euros

### A1. New resources over twenty years in current euros

Using the symbol **f** to denote the (fractional) number of years that are needed to go – with a GBARD grow rate equal to (r-1) – from $I_{25} = G_{25}/PIL_{25}$ (initial government R&D intensity) to $I_{25+f} = G_{25+f} / PIL_{25+f} = $ **0.75%**, with a **3% annual increase** in nominal GDP (**p = 1.03**), one can write

$$r^f G_{25} / (p^f PIL_{25}) = (r/p)^f I_{25} = 0.75\%, \tag{A1}$$

from which one derives

$$r = (0.75/I_{25})^{1/f}, \qquad (I_{25} \text{ in \%; } p = 1.03) \tag{A2}$$

and also

$$f = \ln(0.75/I_{25}) / \ln(r/1.03). \qquad (I_{25} \text{ in \%; } p = 1.03) \tag{A3}$$

Having fixed the intensity $I_{25}$, Eqs. (A2) and (A3) give the infinite number of pairs f - (r -1) leading to 0.75%. In the specific case r = 1.07 and p = 1.03, Eq. (A3) becomes

$$f = 26.25 \ln(0.75/I_{25}) \qquad (r = 1.07; p = 1.03) \tag{A4}$$

<center>*   *   *</center>

To calculate the **new resources $R_{26-(25+j)}$** during the n years of each country's Programme, it is useful to consider the case n = 5 and calculate the sum $\Sigma_{k=1\rightarrow n} DG_{25+k}$ of the increases $DG_{25+k} = (G_{25+k} - G_{25})$ **with respect to 2025**, with k ranging from 1 to 5:

$$\mathbf{R_{26-(25+n)}} = \Sigma_{k=1\rightarrow n} \mathbf{DG_{25+k}} = G_{25} (r^1 - 1) + G_{25} (r^2 - 1) + G_{25} (r^3 - 1) + G_{25}(r^4 - 1) + G_{25} (r^5 - 1) =$$

$$= \mathbf{G_{25} [\, r (r^n - 1)/(r - 1) - n \,]}. \qquad (n = 1, 20; \text{ in the example: } n = 5) \tag{A5}$$

where the sum of a geometric progression $\sum_{k=1}^{n} x^k = x (x^n -1) / (x - 1)$ was used.

It is useful for the following to define the function

$$H_n(s) = s (s^n - 1)/(s - 1) \qquad \text{so that} \qquad R_{26-(25+n)} = G_{25} [H_n(r) - n]. \tag{A6}$$

To obtain the subsidies paid in n years by the EU (the following year), one must multiply Eq. (A6) by the **factor 0.5** of rule B (p. 13):

$$\mathbf{S_{26-(25+n)}} = \mathbf{0.50\ R_{25-(25+n)}} = \mathbf{0.50\ G_{25} [H_n(r) - n]}. \qquad (\,n = 1, 20) \tag{A7}$$

For r = 1.07, n = 20 this equation becomes

$$\mathbf{S_{26-45}} = 23.87/2\ \mathbf{G_{25}} = \mathbf{11{,}94\ G_{25}} \qquad (r = 1.07; n = 20) \tag{A8}$$

To obtain the subsidies in the time interval **from m to n years**, it is sufficient to calculate the difference

$$\mathbf{S_{(25+m)-(25+n)}} = \mathbf{S_{26-(25+n)}} - \mathbf{S_{26-(25+m)}.} \qquad (n > m; m, n = 1, 20) \tag{A9}$$

### A2. Annual allocation of new resources in 2025 euros

In the above formulae the yearly amounts have been summed so that the results are at 'current prices'. To calculate the **new resources $T_{26-(25+n)}$ in '2025 euros'**, each term of Eq. (A5) has to be divided by the inflation factor g (in the model: g = 1.02):

$$\mathbf{T_{26\text{-}(25+n)}} = G_{25}\,(r^1 - 1)/g^1 + G_{25}\,(r^2 - 1)/g^2 + G_{25}\,(r^3 - 1)/g^3 + G_{25}\,(r^4 - 1)/g^4 + G_{25}\,(r^5 - 1)/g^5 + \dots =$$

$$= G_{25}\left\{\left[\left(\tfrac{r}{g}\right)^1 - \left(\tfrac{1}{g}\right)^1\right] + \left[\left(\tfrac{r}{g}\right)^2 - \left(\tfrac{1}{g}\right)^2\right] + \left[\left(\tfrac{r}{g}\right)^3 - \left(\tfrac{1}{g}\right)^3\right] + \left[\left(\tfrac{r}{g}\right)^4 - \left(\tfrac{1}{g}\right)^4\right]\ \left[\left(\tfrac{r}{g}\right)^5 - \left(\tfrac{1}{g}\right)^5\right] + \dots\right\}$$

$$\mathbf{T_{26\text{-}(25+n)}} = G_{25}\left[H_n\!\left(\tfrac{r}{g}\right) - H_n\!\left(\tfrac{1}{g}\right)\right]. \tag{A10}$$

In writing Eq. (A10), the function $H_n(s)$ defined by formula (A6) was used.

It should be noted that – with $1/g = (1 - x)$ and x tending to 0 – the function $H_n(1/g)$ tends to n so that for g = 1, **Eq. (A10) becomes Eq. (A6)**.

To compute – for each value of r – the new resources in current prices and in 2025 euros it is useful to introduce the quantities U and **V**

$$\mathbf{U} = R_{26\text{-}(25+n)}\,/\,G_{25}; \quad \mathbf{V} = T_{26\text{-}(25+n)}\,/\,G_{25}; \quad \mathbf{P = V\,/\,U} \tag{A12}$$

which are given by the formulae

$$\mathbf{U} = R_{26\text{-}(25+n)}\,/\,G_{25} = [\mathbf{H_n(r) - j}] \tag{A13}$$

$$\mathbf{V} = T_{26\text{-}(25+n)}\,/\,G_{25} = \left[\mathbf{H_n\!\left(\tfrac{r}{g}\right) - H_n\!\left(\tfrac{1}{g}\right)}\right] \tag{A14}$$

with the function $H_n(s)$ defined in Eq. (A6).

In columns (5)-(8) of Table A2, the values of the four quantities U, V, P = V/U and Q =0.35xV with g =1.02 are collected for all countries in Groups I and II.

***Table A1*** - *Values of parameters U, V, and R for an inflation factor g = 1.02 (1/g = 0.9804).*

| | (1) | (2) GBARD 2025 $G_{25}$ (mn) | (3) New resources $R_{26\text{-}(25+n)}$ (mn) | (4) Years **n** and rate (r-1) from Table 3 | (5) U = $R_{26\text{-}(25+n)}$ /$G_{25}$ (curr. prices) | (6) V= $T_{26(25+n)}$ /$G_{25}$ Eq. A14 (€ 25) | (7) P = V/U | (8) Q = 0.50 V | (9) R = $PR_{26(25+n)}$ : 180 400 |
|---|---|---|---|---|---|---|---|---|---|
| | **GROUP. I** | **3346** | **79 856** | 20-7.00% | **23865** | **17.987** | 0.753 | **8.990** | **0-3333** |
| G R O U P II A | Slovakia | 453 | 9370 | 19-6.93% | 20.68 | 15.82 | 0.765 | 7.095 | 0.0397 |
| | Lithuania | 278 | 4961 | 18-6.86% | 17.85 | 13.83 | 0.775 | 6.922 | 0.0213 |
| | Cyprus | 138,3 | 1389 | 14-6.96% | 10.04 | 8.51 | 0.822 | 4.125 | 0.0063 |
| | (Poland) | 3817 | 21164 | 11-6.67% | 5.547 | 4.53 | 0.857 | 2.234 | 0.1005 |
| | (Czechia) | 1626 | 7778 | 10-7.00% | 4.784 | 4.53 | 0.868 | 2.076 | 0.0374 |
| | Greece | 1281 | 3574 | 8-6.62% | 2.790 | 2.492 | 0.893 | 1.245 | 0.0177 |
| | | | **48 236** | | | | | | **0.2229** |

| | (1) | (2) GBARD 2025 $G_{25}$ (bn) | (3) New resources $R_{26-(25+n)}$ (bn) | (4) Years $n$ and rate $(r-1)$ from Table 3 | (5) $U = R_{26-(25+n)}/G_{25}$ (curr. prices) | (6) $V= T_{26(25+n)}/G_{25}$ Eq. A14 (€ 25) | (7) $P = V/U$ | (8) $Q = 0.50\ V$ | (9) $R = PR_{26(25+n)}/180\ 400$ |
|---|---|---|---|---|---|---|---|---|---|
| G R U P P O  II B | Spain | 8997 | 14596 | 6-6.88% | 1.622 | 1.488 | 0.917 | 0.7437 | 0.0744 |
| | Luxemb. | 507 | 565 | 5-6.79% | 1.114 | 1.032 | 0.933 | 0.5183 | 0.0029 |
| | Italy | 13461 | 14535 | 5-6.59% | 1.080 | 1.005 | 0.931 | 0.5017 | 0.0750 |
| | France | 18266 | 18104 | 5-6.09% | 0.991 | 0.923 | 0.931 | 0.4606 | 0.0934 |
| | Belgium | 3865 | 3810 | 5-6.06% | 0.986 | 0.918 | 0.931 | 0.4581 | 0.0197 |
| | Croatia | 533 | 422 | 5-4.95% | 0.792 | 0.739 | 0.933 | 0.3687 | 0.0022 |
| | | | 52 032 | | | | | | 0.2676 |
| II C | (Sweden) | 3908 | 273 | 1-7.00% | 0.0699 | 0.0690 | 0.987 | 0.0340 | 0.0015 |
| | TOTALE | | 180.4 bn | | | Inflation factor weighted with the weights $P = V/U$ | | | 0.8253 |

The last row of the table shows that the **weighted average** of the ratios P = V/U

$$R = \Sigma \left(\frac{R\ 26 - (25+k)}{180\ 400\ mn}\right) \left(\frac{V}{U}\right),$$

is 82.5%. This means that the €0.50 × 180.4 billion = €90.2 billion (in current prices), reimbursed by the Union over the 20 years of the Plan, correspond to €0.825 × 90.2 **= €74.4 billion (in 2025 euros).** Consequently, the average annual expenditure over the 20 years, expressed in 2025 euros, amounts to €74.4 / 20 **= €3.7 billion per year**. This is shown graphically in Fig. 6 on page 16.

\* \* \*

The ratio Q of column (8), obtained by multiplying Eq. (A14) by 0.59, measures how much the EU subsidies (expressed in 2025 euros) are greater than G25:

$$\text{Q = (subsidies in 2025 euros) } / \ G_{25} = 0.50\ V. \qquad (A15)$$

The values of Q in column (8) are graphed in **Fig. 5** on p. 15.

It is important to highlight that, moving from the countries in Group I to the three Group II B countries (**France, Italy, and Spain**) that receive the largest subsidies, **the value of Q drops from 9.0 to around 0.5**—an eighteen-fold decrease. This factor offers a *quantitative measure* of how strongly the twenty-year Programme favours countries that are lagging furthest behind in terms of public research funding.


**A3. Annual distribution of new resources in 2025 euros**

To calculate the annual allocation of **new resources—expressed in 2025 euros**—we return to the first of Eqs. (A10), in which the factors $1/g^k$ (with g = 1.02) account for inflation:

$$T_{25-(25+n)} = G_{25}\ (r^1 - 1)/g^1 + G_{25}\ (r^2 - 1)/g^2 + G_{25}\ (r^3 - 1)/g^3 + G_{25}\ (r^4 - 1)/g^4 + G_{25}\ (r^5 - 1)/g^5 +.....$$

The new resources (in 2025 euros) are simply the terms of this progression. Thus, for the k-th year:

$$\text{(new resources needed in the k-th year – 2025 euros)} = G_{25}\ \left[\left(\tfrac{r}{g}\right)^k - \left(\tfrac{1}{g}\right)^k\right]. \qquad \text{(A16)}$$

This is the formula used to compute the values listed in Table A2, which is divided into three sections.

**Table A2.** *The new resources required in year k, expressed in* **2025 euros**, *are calculated using Eq. (A16) (with g = 1.02 and p = 1.03). The values of* **(r/g – 1)** *are shown in red in Column (2) and those of* **(1/g)$^k$** *are also in red in the top Row, Column (4)-(23) for the years k = 1-20.*

| (1) Country | (2) Year – percent. with inflation | (3) G$_{25}$ (mn) | (4) Year k =1 (mn) | (5) Year 2 (mn) | (6) Year 3 (mn) | (7) Year 4 (mn) | (8) Year 5 (mn) | (9) Year 6 (mn) | (10) Year k =7 (mn) |
|---|---|---|---|---|---|---|---|---|---|
| | n-(r/g-1) | 1/g$^k$ | 0.980 | 0.961 | 0.942 | 0.924 | 0.906 | 0.888 | 0.871 |
| **Group I** | 20-4.90% | 3346 | **230** | **466** | **709** | **961** | **1220** | **1487** | **1764** |
| Slovakia | 19-4.83% | 453 | 30.8 | 62.4 | 95.0 | 126 | 163 | 199 | 236 |
| Lithuania | 18-4.76% | 278 | 18.7 | 37.9 | 57.7 | 78 | 99 | 121 | 143 |
| Cyprus | 14-4.86% | 138.3 | 9.43 | 19.1 | 29.1 | 39.4 | 50.1 | 61.0 | 72.4 |
| (Poland) | 11-4.58% | 3817 | 250 | 506 | 769 | 1040 | 1317 | 1604 | 1899 |
| (Czechia) | 10-4.90% | 1626 | 112 | 226 | 345 | 467 | 593 | 723 | 857 |
| Greece | 8-4.53% | 1281 | 83.1 | 168 | 256 | 346 | 438 | 534 | 632 |
| **Group IIA** | | | **504** | **1019** | **1552** | **2096** | **2660** | **3242** | **3839** |
| Spain | 6-4.78% | 8997 | 606 | 1230 | 1872 | 2533 | 3214 | 3917 | - |
| Luxemb. | 5-4.70% | 507 | 33.8 | 68.4 | 104 | 141 | 179 | - | - |
| Italy | 5-4.50% | 13461 | 870 | 1761 | 2677 | 3617 | 4583 | - | - |
| France | 5-4.01% | 18266 | 1090 | 2203 | 3341 | 4503 | 5691 | - | - |
| Belgium | 5-3.98% | 3865 | 239 | 464 | 703 | 948 | 1197 | - | - |
| Croatia | 5-2.89% | 533 | 25.9 | 51.9 | 78.3 | 105 | 132 | - | - |
| (Sweden) | 1-4.90% | 3908 | 268 | | | | | - | - |
| **Groups IIB + IIC** | | | **3133** | **5778** | **8775** | **11 847** | **14 996** | **3917** | **-** |
| **Totals in mn** | | 8640 | 3867 | 7263 | 11036 | 14 904 | 18 876 | 8646 | 5603 |
| | | | **1$^{st}$ five-year period: 55 946 mn** | | | | | | |

| (1) Country | (2) Year – percent. with inflation | (3) G$_{25}$ (mn) | (11) Year 8 (mn) | (12) Year 9 (mn) | (13) Year 10 (mn) | (14) Year 11 (mn) | (15) Year 12 (mn) | (16) Year 13 (mn) | (17) Year k =14 (mn) |
|---|---|---|---|---|---|---|---|---|---|
| | n-(r/g-1) | 1/g$^k$ | 0.854 | 0.837 | 0.820 | 0.804 | 0.789 | 0.773 | 0.758 |
| **Group I** | 20-4.90% | 3346 | **2050** | **2346** | **2654** | **2972** | **3302** | **3645** | **4001** |
| Slovakia | 19-4.83% | 453 | 274 | 314 | 354 | 397 | 441 | 486 | 533 |
| Lithuania | 18-4.76% | 278 | 166 | 190 | 214 | 240 | 267 | 294 | 322 |
| Cyprus | 14-4.86% | 138,3 | 84.1 | 96.3 | 109 | 122 | 135 | 149 | 164 |
| (Poland) | 11-4.58% | 3817 | 2204 | 2518 | 2842 | 3176 | - | - | - |
| (Czechia) | 10-4.90% | 1626 | 996 | 1140 | 1290 | - | - | - | - |
| Greece | 8-4.53% | 1281 | 733 | - | - | - | - | - | - |
| **Group IIA** | | | **4457** | **4258** | **4809** | **3935** | **843** | **929** | **1019** |
| Spain | 6-4.78% | 8997 | - | - | - | - | - | - | - |
| Luxemb. | 5-4.70% | 507 | - | - | - | - | - | - | - |
| Italy | 5-4.50% | 13461 | - | - | - | - | - | - | - |
| France | 5-4.01% | 18266 | - | - | - | - | - | - | - |
| Belgium | 5-3.98% | 3865 | - | - | - | - | - | - | - |
| Croatia | 5-2.89% | 533 | - | - | - | - | - | - | - |
| (Sweden) | 1-4.90% | 3908 | - | - | - | - | - | - | - |
| **Groups IIB + IIC** | | | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| | **Totals in mn** | | 6507 | 6604 | 7463 | 6907 | 4145 | 4574 | 5020 |
| | **2nd five-year period: 34 823 mn** | | | | | **3rd five-year period: 25 951 mn** | | | |

| (1) Country | (2) Year – percent. with inflation n-(r/g-1) | (3) $G_{25}$ (mn) $1/g^k$ | (18) Year 15 (mn) 0.743 | (19) Year 16 (mn) 0.728 | (20) Year 17 (mn) 0.714 | (21) Year 18 (mn) 0.700 | (22) Year 19 (mn) 0.686 | (23) Year 20 (mn) 0.673 | (30) TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| **Group I** | 20-4.90% | 3346 | **4371** | **4756** | **5156** | **5573** | **6007** | **6458** | **60 128** |
| Slovakia | 19-4.83% | 453 | 583 | 634 | 687 | 742 | 799 | - | 7156 |
| Lithuania | 18-4.76% | 278 | 351 | 383 | 414 | 447 | - | - | 3838 |
| Cyprus | 14-4.86% | 138.3 | - | - | - | - | - | - | 1140 |
| (Poland) | 11-4.58% | 3817 | - | - | - | - | - | - | 18 125 |
| (Czechia) | 10-4.90% | 1626 | - | - | - | - | - | - | 6749 |
| Greece | 8-4.53% | 1281 | - | - | - | - | - | - | 3190 |
| **Group IIA** | | | **934** | **1017** | **1101** | **1189** | **799** | **-** | **40 198** |
| Spain | 6-4.78% | 8997 | - | - | - | - | - | - | 13 372 |
| Luxemb. | 5-4.70% | 507 | - | - | - | - | - | - | 526 |
| Italy | 5-4.50% | 13461 | - | - | - | - | - | - | 13 508 |
| France | 5-4.01% | 18266 | - | - | - | - | - | - | 16 828 |
| Belgium | 5-3.98% | 3865 | - | - | - | - | - | - | 3551 |
| Croatia | 5-2.89% | 533 | - | - | - | - | - | - | 393 |
| (Sweden) | 1-4.90% | 3908 | - | - | - | - | - | - | 268 |
| **Group IIB + IIC** | | | **-** | **-** | **-** | **-** | **-** | **-** | **48 446** |
| | **Totals in mn** | | **5305** | **5773** | **6257** | **6562** | **6806** | **6458** | **148 722** |
| | | | **4th five-year period: 31 856 mn** | | | | | | |

The last rows of the three sections of the table indicate that the resources needed—expressed in 2025 euros—for the four five-year periods amount to: **56.0 + 34.8 + 26.0 + 31.9 = 148.7** billion euros. These correspond to a total of 50% reimbursements from the EU over twenty years amounting to **74.4 billion euros**, which—as already stated—corresponds to an average of **3.7 billion euros per year.**

For clarity, Table A3 lists—year by year—the new resources required to implement the twenty-year Plan (in blue), along with the EU grants (in red), which are obtained by dividing the new resources by two.

*Table A3. The new resources needed—listed year by year in **millions of 2025 euros**)—appear (in blue) in the first and third rows. When multiplied by 0.50, they yield the corresponding EU grants (in red). The five-year totals of the EU contributions are shown in the penultimate row.*

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Resources | 3867 | 7263 | 11036 | 14 904 | 18 876 | 8646 | 5603 | 6507 | 6604 | 7463 |
| Subsidies | 1934 | 3631 | 5518 | 7452 | 9438 | 4323 | 2801 | 3254 | 3302 | 3731 |
| **Anno** | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Resources | 6907 | 4145 | 4574 | 5020 | 5305 | 5773 | 6257 | 6562 | 6806 | 6458 |
| Subsidies | 3454 | 2072 | 2287 | 2510 | 2652 | 2886 | 3129 | 3281 | 3403 | 3229 |

| 1st five-years period<br>**Subs. – 28,0 Mrd** | 2nd five-years period<br>**Subs,– 17,4 Mrd** | 3rd five-years period<br>**Subs. – 13,0 Mrd** | 4th five-years period<br>**Subs. – 16,0 Mrd** |
|---|---|---|---|
| **UE subsidies on 20 years: 74,4 mn** (euro2025) (*) | | | |

(*) To maintain the achieved R&D intensity, each country—after the n years indicated in column (2) —must increase its GBARD at its own expense by 3% per year, to keep pace with the growth of nominal GDP.

Using the red figures in the last rows of the second line of Table A4, the **histogram in Figure 6** was constructed. Its content is discussed on page 16.