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Sweden



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ERA Country Report 2023: Sweden

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ERA Country Report 2023 Sweden

Edited by Pär Weström (CARSA)

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ERA COUNTRY REPORT 2023: SWEDEN

Key takeaways:

- Sweden shows strong progress in most areas under ERA Priority 1, for example, open science (1.1), knowledge valorisation (1.5) and global engagement (1.7). Under the ERA Priority 2 some areas are showing progress below the EU average, such as the environmental/green challenges (2.1) and government support to boost innovation ecosystems (2.3).
- Sweden is an innovation leader in Europe, with a research ecosystem benefitting from an innovation-friendly environment, highly skilled workers, attractive research systems and internationally competitive and innovative companies.
- An increasing lack of highly skilled staff in science, technology and engineering is detected as an important challenge to be tackled. Another topic on the political agenda is how to strengthen the Swedish research quality, to maintain global competitiveness and innovation leadership.

1. National context

1.1. Overview of the ERA policy agenda implementation

After a few years as the top innovating country, according to the scores of the European Innovation Scoreboard (EIS), Sweden was overtaken by Denmark in 2023 and moved to second position. Still, the country's overall performance is increasing at a rate higher than that of the EU average (8.5 percentage points).¹ Sweden is committed to the implementation of the European Research Area (ERA) Policy Agenda, officially committed to a total of 11 policy actions: 7 of Priority 1 (ERA Actions 1, 3, 4, 5, 7, 8 and 9) and 4 of Priority 2 (ERA Actions 10, 11, 12 and 14), and with recorded activities² in 5 additional policy actions, covering also Priorities 3 and 4.³

One of the key strategies is the **Research Policy Bill**⁴, presenting the policy orientation for the next four years, whereas budget is allocated in the annual budgeting process and finalised in annual appropriations directives for government agencies. The current Research Policy Bill, presented in 2020, outlines the direction of Sweden's research policy from 2021 to 2024. Another important policy example is the **Updated national approach on open access to publications and research data in the Research Bill (2021-2024)**, coordinated

¹ European innovation scoreboard (Country profile Sweden), European Commission website, available at: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en#european-innovation-scoreboard-2023

² EC-OECD (2023), STIP Compass: International Database on Science, Technology and Innovation Policy (STIP), edition November 6, 2023. Available at: <https://stip.oecd.org>

³ The number of commitments to ERA Actions does not imply any judgment about the country's performance in achieving the ERA priorities.

⁴ The Government of Sweden (Sveriges Regering) (2020), *Forskning, frihet, framtid – kunskap och innovation för Sverige* (Prop. 2020/21:60), available at: <https://www.regeringen.se/rattsliga-dokument/proposition/2020/12/forskning-frihet-framtid--kunskap-och-innovation-for-sverige/>

by the Swedish Research Council.⁵ According to the European Semester Report of 2023, EUR 286 million (ca. 8.7%) of the Swedish Recovery and Resilience Plan (RRP) is dedicated to research and innovation investment to support the green transition.⁶

1.2. Policy context

Research funding structure and allocation, and innovation policies based on research, are governed by research bills presented to parliament every four years. The current goal is “*for Sweden to be one of the world's leading research and innovation countries and a leading knowledge nation, where high-quality research, higher education and innovation development and well-being of society, the competitiveness of the economy competitiveness and respond to the societal challenges we face*”.⁷

The government agencies are independent from the central Government Offices (ministries) and have a high degree of autonomy⁸. Most **universities** in Sweden are government agencies, whose research funds are allocated through block funds.⁹ Additionally, higher Education in Sweden is governed by the **Higher Education Ordinance**.¹⁰

The **Swedish Research Council** (Vetenskapsrådet) is Sweden’s largest public funding body, supporting basic research within all scientific disciplines at universities and higher education institutions, through calls for grant applications in open competition.¹¹ It is a government agency within the **Ministry of Education and Research** with the mandate to advise the government on research policy issues.

Together with the funds disbursed by the **Swedish Research Council** (EUR 664.8 million in 2021), four additional councils and agencies make up the core structure of Swedish research funding:¹² **Formas** (EUR 149.9 million) disbursed funds 2021; the **Research Council for the Environment, Agricultural Sciences and Rural Development** supports the research fields of environment, agricultural sciences and rural development. The **Research Council for Health, Working Life and Welfare** (Forte) (EUR 69.1 million) promotes and supports research in the fields of health, working life and welfare. **Sweden’s Innovation Agency (Vinnova)** aims to strengthen Sweden's innovative capacity and contribute to sustainable growth, by funding needs-driven research and effective innovation systems, involving both public and private actors. The Swedish Energy Agency supports national research on new renewable energy technologies, smart grids, and fuels of the future.

⁵ <https://www.vr.se/english/mandates/open-science/open-access-to-research-data/about-our-work-on-open-access-to-research-data.html>

⁶ European Commission (2023), *2023 Country Report – Sweden*, available at: https://economy-finance.ec.europa.eu/system/files/2023-05/SE_SWD_2023_627_en.pdf, p. 46-47

⁷ The Government of Sweden (Sveriges Regering) (2020) available at: <https://www.regeringen.se/rattsliga-dokument/proposition/2020/12/forskning-frihet-framtid-kunskap-och-innovation-for-sverige/>

⁸ Public agencies and how they are governed, The Government of Sweden website, available at:

<https://www.government.se/how-sweden-is-governed/public-agencies-and-how-they-are-governed/>

⁹ <https://www.uka.se/swedish-higher-education-authority/about-higher-education/governance-of-higher-education>

¹⁰ Higher Education Ordinance 1993:100 (*Högskoleförordning (1993:100)*), 4 February 1993, Swedish Parliament website, available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/hogskoleforordning-1993100_sfs-1993-100/

¹¹ <https://www.vr.se/english/about-us.html>

¹² OECD (2023), *Public research funding in Sweden: Optimising the system in response to multiple demands*, OECD Science, Technology and Industry Policy Papers, No. 148, OECD Publishing, Paris, <https://doi.org/10.1787/9eb9a85b-en>

The efforts of these agencies and institutions, is supported by the **Swedish recovery and resilience plan (RRP)**. The plan aims to allocate EUR 286 million research and innovation investments to support the green transition.⁶ The Swedish government initiated in 2021 *Industriklivet* (Industry Leap) for investments in new technology.¹³ It forms part of the green restart of a climate smart society and forms part of the RRF. In 2023, twenty Swedish universities, funding agencies and stakeholders have joined the Coalition for Advancing Research Assessment, supporting progress in ERA Actions 3 and 14.²

Additionally, the Research Policy Bill¹⁴ for 2021 to 2024 incorporates some of the ERA policy objectives into a national perspective. It focuses on strengthen Sweden’s leading position in the areas of research and development at an international level, while promoting cooperation towards the green transition.

2. Assessment of the Implementation of the ERA Policy Agenda and ERA Priorities

As indicated above, Sweden has officially committed to 11 ERA Actions, falling under the priorities *1: Deepening a truly functional internal market for knowledge*, and *2: Taking up together the challenges posed by the twin green and digital transition and increasing society’s participation in the ERA*. The information presented in this section builds on qualitative information collected through desk research. Key resources are the OECD STIP Survey, European Semester Reports and the European Innovation Scoreboard.

The quantitative information presents the most recent data available for the ERA Scoreboard and ERA Dashboard indicators¹⁵. However, in some cases, the data available pre-dates the ERA Policy Agenda. Therefore, the longer-term trends covering the last ten years are presented. The indicators falling under each ERA priority are presented below, and the general indicators are outlined in Table 1. More detailed information on the data and graphs can be found in Annex 1. This report will serve as a baseline for reporting in the future.

Table 1. General ERA Scoreboard and ERA Dashboard indicators¹⁶

| Indicator | Most recent EU average | Most Recent Metric |
|----------------------------------------------------------------------|------------------------|--------------------|
| Gross Domestic Expenditure on R&D (GERD) as a percentage of GDP | 2.26 (2021) | 3.36 (2021) |
| Government Budget Allocations for R&D (GBARD) as a share of GDP | 0.76 (2021) | 0.78 (2021) |
| Researchers (in full-time equivalent) per million inhabitants | 4,483.4 (2021) | 9,640.3 (2021) |
| Business Enterprise expenditure on R&D (BERD) as a percentage of GDP | 1.49 (2021) | 2.4 (2021) |

Source: compiled by research team based on the ERA Scoreboard and ERA Dashboard indicators

¹³ *Industriklivet*, Swedish Energy Agency website, available at: <https://www.energimyndigheten.se/forskning-och-innovation/forskning/industri/industriklivet/>

¹⁴ *Ibid*

¹⁵ See <https://european-research-area.ec.europa.eu/era-monitoring-reports>.

¹⁶ Further information on the trends can be found in Annex 1

2.1. ERA Priority 1: Deepening a truly functional internal market for knowledge

2.1.1. State of play in the implementation of the ERA Actions

Under **ERA Action 1: Enable Open Science, including through the European Open Science Cloud**, the **Research Bill (2021-2024)**^{Error! Bookmark not defined.} includes an updated national approach on open access to publications and research data, a work coordinated by the Swedish Research Council.¹⁷ In the **Lund Declaration** on Maximising the Benefits of Research Data, the Swedish Presidency of the Council of the European Union calls for reinforcing, accelerating, and maximising the benefits of FAIR and open research data in Europe.¹⁸ **SciLifeLab Data Centre** is a central research data infrastructure with services for Open Science and FAIR data sharing, identified by EOSC as a best practice.¹⁹ ²⁰ The Swedish Association of Swedish Higher Education Institutions (SUHF) adopted in 2021 a national road map for open science including recommendations on how to work on EOSC. The Swedish Research Council (Vetenskapsrådet) is a mandated organisation for EOSC and represents the Swedish R&I system in the EOSC Association. Vetenskapsrådet also gives support to the government in the EOSC Steering Board. Additionally, **NAISS** – National Academic Infrastructure for Supercomputers in Sweden – provides resources for large-scale and high-performance computing and storage in all research areas.

Another initiative identified in the OECD STIP Survey² is the public-private programme **Advanced Digitalisation** (Avancerad Digitalisering)²¹, which has as one of its purposes to be a collaboration platform and function as a knowledge hub for other Swedish initiatives in the field of digitalisation. Sweden has also developed national guidelines for open science which is proposed for open consultation.²²

Sweden also committed to **ERA Action 3: Reform the Assessment System for research, researchers and institutions**. As of April 2023, twenty Swedish universities, funding agencies and stakeholders have joined the **Coalition for Advancing Research Assessment** (CoARA), which establishes a common direction for research assessment reform.²

Linked to **ERA Action 4: Promote attractive research careers, talent circulation and mobility**, recently, in 2021, a strategy for Swedish participation in Horizon Europe²³ was launched, and in 2023 the new **National Academic Infrastructure for Supercomputers** in Sweden

¹⁷ Open science, Swedish Research Council website, available at: <https://www.vr.se/english/mandates/open-science.html>; Open access to research data - <https://www.vr.se/english/mandates/open-science/open-access-to-research-data.html>; FAIR research data - <https://www.vr.se/english/mandates/open-science/open-access-to-research-data/fair-research-data.html>; and Open access to publications - <https://www.vr.se/english/mandates/open-science/open-access-to-publications.html>

¹⁸ The Government of Sweden, Ministry of Education and Research, (2023), *Lund Declaration on Maximising the Benefits of Research Data*, available at: <https://www.government.se/information-material/2023/06/lund-declaration-on-maximising-the-benefits-of-research-data/>

¹⁹ A data-centric approach to Life Science, SciLifeLab website, available at: <https://www.scilifelab.se/data>

²⁰ Thomas Neidenmark, Gareth O'Neill, & Istvan Karasz. (2023). EOSC Catalogue of Best Practices. Available at: <https://doi.org/10.5281/zenodo.7574165>

²¹ Ambitioner och resultat (Ambitions and results), Avancerad Digitalisering website, available at: <https://www.avanceraddigitalisering.se/om-avancerad-digitalisering/ambitioner-och-resultat/>

²² National Library of Sweden, 'National guidelines for open science' available at: <https://www.kb.se/download/18.d8a384b18acfe2ed532cb5/1696936867649/Proposal-National-guidelines-for-open-science.pdf>

²³ The Government of Sweden (2021), 'A strategy for Swedish participation in Horizon Europe', available at: <https://www.regeringen.se/informationsmaterial/2021/10/en-nationell-strategi-for-svenskt-deltagande-i-horisont-europa-20212027/>

(NAISS) was presented. Sweden also has a national EURAXESS nod, supporting the careers and mobility of researchers.²⁴ Fourteen Swedish universities have achieved the HR Excellence in Research Award.

Related to **ERA Action 5: Promote gender equality and foster inclusiveness**, the **Swedish Gender Equality Agency** is a government agency under the Ministry of Employment, created in 2018 to contribute to effective implementation of the Swedish gender equality policy.² In the **Research Bill (2021-2024)**^{Error! Bookmark not defined.} among other gender related issues, the government declares that it shares the Equality Authority's assessment and announced in 2020 that universities and colleges will continue to work on the mission for gender equality integration. Several government and non-public research funders have established a joint group to coordinate efforts on gender and equality. The Swedish Gender Equality Agency and the Swedish Secretariat for Gender Research participate in the group.

Although Sweden is not officially committed to **ERA Action 6: Protect academic freedom in Europe**, some previous initiatives were identified in the OECD STIP Survey.² These include bilateral S&T agreements with third countries (started 1999 and 2017) and the establishment of several Foreign Offices for research cooperation in third countries (2017). After proposal in the Research Bill (2021-2024)^{Error! Bookmark not defined.} the Higher Education Act (Högskolelagen) was amended so that academic freedom is promoted and protected in the higher education institution's activities.²⁵

Although Sweden is committed to **ERA Action 7: Upgrade EU guidance for a better knowledge valorisation**, the latest initiative listed in the OECD STIP Survey² is from 2013 referring to Innovation Offices to promote the commercialisation of research results. The innovation initiatives in the Research Bill (2021-2024)^{Error! Bookmark not defined.} shall contribute to improved collaboration between the business world, universities, research institutes, the public sector and other national actors, thereby increasing the conditions for making use of new knowledge and new solutions. The Swedish government has also developed an inquiry into creating a more innovative university sector.²⁶

Under **ERA Action 8: Strengthen research infrastructures** and **ERA Action 9: Promote international cooperation**, key actions are included in the Research Bill (2021-2024)^{Error! Bookmark not defined.} By participating in the **European Strategic Forum for Research Infrastructure (ESFRI)**, the **Swedish Research Council** contributes to the joint development of European research infrastructures.² Sweden also has a Guide to research infrastructure landscape²⁷ and a needs' inventory for research infrastructures.²⁸ Sweden participates in **15 ERICs** and hosts the **European Spallation Source** together with Denmark.

Linked to **ERA Action 9: Promote a positive environment and level playing field for international cooperation based on reciprocity**, the **Swedish Council for Higher Education, the Swedish Research Council and Vinnova** have been mandated to promote the work on responsible internationalisation within higher education, research and innovation at Swedish

²⁴ EURAXESS Sweden, available at: <https://www.euraxess.se/>

²⁵ Swedish Code of Statutes (*Svensk författningssamling*) (2021), 'Act amending the Higher Education Act(1992:1434), available at: <https://svenskforfattningssamling.se/doc/2021317.html>

²⁶ The Government of Sweden (2020), 'Innovation as a driving force – from research to benefit', available at: <https://www.regeringen.se/contentassets/77145fac2a4c4a00bc55fb7ecbf67d4f/innovation-som-drivkraft--fran-forskning-till-nytta-sou-202059.pdf>

²⁷ Swedish Research Council (2023), 'The Swedish Research Council's guide to research infrastructure in 2023' available at: <https://www.vr.se/analys/rapporter/vara-rapporter/2023-05-03-vetenskapsradets-guide-till-forskningsinfrastrukturen-2023.html>

²⁸ Swedish Research Council (2022), 'Results of needs inventory 2021–2022' (*Resultat av behovsinventering 2021–2022*), available at: <https://www.vr.se/analys/rapporter/vara-rapporter/2022-10-13-resultat-av-behovsinventering-2021-2022.html>

higher education institutions, research funding bodies and other public agencies.²⁹ The government research funders coordinate the bilateral and global funding efforts through a joint coordinating mechanism and being able to top-up funding for such activities by EUR 2,5 million.

2.1.2. Progress towards achieving ERA Priorities

With regard to progress towards **Sub-priority 1.1: Open Science**, Figure 5 in Annex 1 indicates that Sweden performs above the EU-27 average related to **open access publications**. According to the Swedish Research Council, coordinating the national efforts in the area, Sweden's goal is to fully implement the transition to open access to research data by 2026.³⁰

Linked to **Sub-priority 1.2: Research infrastructures**, Figure 6 in Annex 1 displays that Sweden participates in 21 **European research infrastructures**, significantly more than the EU-27 average of 16.

With respect to **Sub-priority 1.3: Gender equality, equal opportunities for all and inclusiveness**, Figure 7 and Figure 8 in Annex 1 (**% women in HEIs grade A positions** and **% women among STEM doctoral graduates**) and Figure 9 and 10 (**% of papers with mixed gender authorship 2000–2020**, and **% women authorship of the 10% most cited publications, 2000–2018**) indicate that Sweden performs around the EU-27 average. On the contrary, Figure 11 in Annex 1 shows a performance over EU-27 average for the **Women in Digital Index** in 2022.

Regarding **Sub-priority 1.4: Researchers' careers and mobility and research assessment and reward systems**, Figure 12 in Annex 1 on **share of foreign doctorate students** and Figure 13 in Annex 1 on **proportion of new young (25-34 years) doctorate graduates**, show that data for Sweden are above the EU average. The index of **job-to-job mobility of Human Resources in Science and Technology** is lower in Sweden than the EU average (Figure 14 in Annex 1) and saw a significant drop from 2019 to 2020, increasing the gap with the EU average.

Sweden is progressing well according to various indicators on **Sub-priority 1.5: Knowledge valorisation**. The **share of public-private co-publications** (Figure 15 in Annex 1) is high above EU average and with a tendency of growing faster than EU average. The **number of PCT patent applications in relation to GDP** is also well above the EU average (Figure 16 in Annex 1) and similarly the two indicators related to **business enterprise researchers as a % of national researchers**, presented in Figure 17 in Annex 1. Regarding **business enterprise researchers in full-time equivalent per thousand employees in industry** in Figure 18 in Annex 1, the values for Sweden are noticeably higher than the EU-27, and since 2012 remain around the same value.

Regarding the **share of innovating firms collaborating with higher education institutions or public/private research institutions** (Figure 19 in Annex 1), Sweden's performance is more modest, similar to the EU-27 average. One of three Swedish knowledge

²⁹ <https://www.vr.se/english/just-now/news/news-archive/2023-09-20-national-guidelines-for-responsible-internationalisation-to-be-produced.html>

³⁰ The way towards open access to research data, the Swedish Research Council website, available at: <https://www.vr.se/english/mandates/open-science/open-access-to-research-data/the-way-towards-open-access-to-research-data.html>

valorisation best practice examples presented in the European Commission repository³¹ is taken from the project **REACH2020** (Responsive Engagement of the Elderly Promoting Activity and Customised Healthcare). Standardisation activities within this project supported the dissemination of healthcare solutions for older persons and were employed as an important instrument to use project results at national, European and international standardisation levels.

Considering **Sub-priority 1.6: Scientific leadership**, statistics in Annex 1 shows steady levels of performance for Sweden, slightly above the EU-27 average, both regarding the **share of scientific publications among the top-10% most cited publications worldwide** (Figure 20 in Annex 1), and **regarding the Academic Freedom Index (Afi)** (Figure 21 in Annex 1).

As regards **Sub-priority 1.7: Global engagement**, the curve for **international co-publications with non-EU partners** (Figure 22 of Annex 1) shows a steady progress for Sweden, increasing its significant advantage over the EU-27 average (which is also growing, albeit moderately). Figure 23 in Annex 1 presents the **European and international co-patenting in EPO applications at national and EU level** for which the value for Sweden was higher than the EU-27 average for the period 2010 to 2013.

2.2. ERA Priority 2: Taking up together the challenges posed by the twin green and digital transition and increasing society's participation in the ERA

2.2.1. State of play in the implementation of the ERA Actions

Linked to **ERA Action 10: Make EU research and innovation missions and partnerships key contributors to the ERA**, Sweden actively participates in the EU's five missions, with notable involvement in the EU City Mission through the Strategic Innovation Programme Viable Cities. This initiative utilises significant governance innovations, including City Climate Contracts, to connect city governance to national governance and Net Zero City processes within the EU City Mission.²

In 2022 the **Sweden-US Green Transition Initiative**³² was launched, with the overall objective to accelerate Swedish-American partnerships involving the private sector, academia, innovators, and stakeholders on the federal and state level. The **Innovation Partnership Programme Climate Neutral Industry**, from 2020, aims to contribute to the climate transition in industry.³³ 28 countries have joined **JPIAMR** a global collaborative organisation and platform, coordinated by Sweden, tackling antimicrobial resistance.³⁴ The initiative has been supported by several actions under Horizon 2020 and has created synergies with other Joint Programming Initiatives, fostering national R&I programmes and policy alignment in Sweden.

³¹ Repository of Best Practices, European Commission website, available at: <https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository>

³² Launching the Sweden-US Green Transition Initiative, Atlantic Council website, available at: <https://www.atlanticcouncil.org/event/launching-the-sweden-us-green-transition-initiative/>

³³ The Government of Sweden (2020), *Impact of the innovation partnership programme Climate neutral industry*, available at: <https://www.government.se/articles/2020/12/impact-of-the-innovation-partnership-programme-climate-neutral-industry/>

³⁴ European Commission, Directorate-General for Research and Innovation (2022), *Performance of European Partnerships – Biennial Monitoring Report (BMR) 2022 on partnerships in Horizon Europe*, available at: <https://data.europa.eu/doi/10.2777/144363>

The government research funders coordinate the participation in European partnerships (and previous partnership programmes) through a joint coordinating mechanism and being able to top-up national funding for such activities by EUR 20 million.³⁵ In relation to the missions, Sweden has widened the participation from non-traditional government agencies in the missions' working groups under the strategic programme committee in the framework programme. Sweden also participates in the Trami project³⁶.

Linked to **ERA Action 11: *An ERA for green transformation***, Sweden adopted a climate policy framework³⁷ already in 2017, consisting of a climate act, climate targets and a climate policy council. The **Integrated National Energy and Climate Plan (NECP)**, originally presented to the European Commission in 2018, was updated in 2023.³⁸ The **Innovation Partnership Programme Climate Neutral Industry** and the **Sweden-US Green Transition Initiative**, both mentioned above (ERA Action 10) are also relevant examples of Sweden's commitment to green transformation.

Another example identified by the OECD STIP Survey is the **Green credit guarantees for competitiveness**, an initiative started in 2021, facilitating financing of societally important industrial investments, which increase the opportunities for transition to a more circular economy.

The initiatives linked to **ERA Action 12: *Accelerate the green/digital transition of Europe's key industrial ecosystems***, identified in the OECD STIP Survey started as of 2013. As mentioned above, the Swedish RRP includes research and innovation investment of EUR 286 million to support the green transition, corresponding to ca. 9% of the overall RRP expenditure⁶. The Swedish Research Council has also developed a ten-year programme on the societal consequences of digitalisation which will contribute new knowledge on the cultural and societal impact of digitalisation³⁹.

In 2021, four government agencies published a joint report on a strategic programme to face and lead on the digital transformation of Sweden.⁴⁰ As part of the continued work an EU-coordination mechanism for digitalisation has been established.

As regards **ERA Action 14: *Bring Science closer to citizens***, the most recent initiative refers to Impact Innovation (from 2023), an actor-driven and long-term programme that will accelerate sustainable transition for global competitiveness and societal benefits by driving system innovation towards ambitious transition goals.⁴¹ Moreover, a national platform for

³⁵ Vinnova (2021), Horisont 2020 – årsbok 2021, Vinnova Rapport VR 2022:04, available at: https://www.vinnova.se/contentassets/76659ea101a148ba9a70dee7e4838c66/arsbok-2021_horisont-20202.pdf?cb=20220616143702

³⁶ <https://www.trami5missions.eu/>

³⁷ Sweden's Climate Act and Climate Policy Framework, the Swedish Environmental Protection Agency's (Naturvårdsverket) website, available at: <https://www.naturvardsverket.se/en/topics/climate-transition/sveriges-klimatarbete/swedens-climate-act-and-climate-policy-framework/>

³⁸ Ministry of Climate and Enterprise (2023), *Draft updated National Energy and Climate Plan (NECP) for Sweden*, available at: https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en

³⁹ Swedish Research Council, 'National research programme in the societal consequences of digitalisation' available at: <https://www.vr.se/english/mandates/funding-and-promoting-research/societal-consequences-of-digitalisation.html>

⁴⁰ Vinnova (2020), 'Government assignment to propose a strategic program for digital structural transformation' (*Regeringsuppdrag att föreslå ett strategiskt program för digital strukturomvandling*), available at: <https://www.vinnova.se/publikationer/kraftsamling-for-ett-hallbart-digitaliserat-sverige/>

⁴¹ <https://impactinnovation.se/en/news/impact-innovation-was-inaugurated-swedens-major-innovation-investment-for-the-2030s/>

news and communication about research is being launched in February 2024.⁴² The platform continues to build on the existing website *forskning.se* and is a long-term initiative and an important part of the Swedish Research Council's mandate to coordinate and facilitate science communication in Sweden.⁴³

Although Sweden did not officially commit to **ERA Action 13: Empower Higher Education Institution**, 19 higher education institutions are part of European Universities alliances. There are relevant initiatives such as the **National Academic Infrastructure for Supercomputers in Sweden** (NAISS), that started 2023.

2.2.2. Progress towards achieving ERA Priorities

According to the quantitative analysis, Sweden's performance on **Sub-priority 2.1: Challenge-based ERA actions** is in general similar or slightly below EU-27 average. In the case of the **Government Budget Allocations for R&D (GBARD) by NABS** in transport, and telecommunications and other infrastructure has consistently stayed significantly above EU-27 average, with a positive trend, from the years 2010 to 2021, and with a peak in 2021 (Figure 24 of Annex 1).

The Swedish GBARD curve on energy have been relatively stable since 2010, and from 2019 to 2021 it is below the EU-27 average. Since 2013, **environmentally related government R&D** budget in Sweden is lagging significantly behind the EU-27 average. Increased Swedish budget allocations in 2020 and 2021 have not reduced the gap to EU-27 average, which shows a similar positive tendency. In 2020 (latest figures available) environmentally related government R&D budget made up 1.8% of total Swedish government R&D (Figure 26 in Annex 1), compared to 2.5% in average in the EU-27. As regards **R&I investments allocated to transnational cooperation** (Figure 25 in Annex 1), the curve of Sweden, as well as the EU-27 average, is quite flat, with a small drop in 2020, placing Sweden just below the EU-27 average.

According to data from the **2021 Strategic Energy Technology (SET) Plan Progress Report**, **national public and private investments** have been slightly higher than the EU average from 2012 to 2016, and from 2017 to 2020 following the EU-27 average level, with a sharp dip from 2019 to 2020 observed both for Sweden and for the EU-27 average (Figure 27 in Annex 1). Finally, according to OECD data for 2010 to 2017 (Figure 28 in Annex 1) Sweden's relative **share of filed patents on environment technologies** is similar to the EU-27 average.

With respect to **Sub-priority 2.2: Synergies with education and the European Skills Agenda**, the **share of researchers receiving transferable skills training** (Figure 29 in Annex 1) in Sweden was 48.8% in 2019, slightly above the EU-27 average of 46.3%. The advantage for Sweden was bigger in 2016, with the comparable figures of 64.7% for Sweden versus 49.5% as EU-27 average.

Analysing the indicators for **Sub-priority 2.3: Synergies with sectorial policies and industrial policy, in order to boost innovation ecosystems**, shows that Sweden performs below the EU-27 average in terms of **direct government support and indirect government support**

⁴² Swedish Research Council, 'Science communication' (*Forskningskommunikation*), available at: <https://www.vr.se/english/mandates/science-communication.html>

⁴³ Forskning.se makes science easier to access and understand, Swedish Research Council website, available at: <https://www.vr.se/english/just-now/news/news-archive/2023-12-19-forskning.se-makes-science-easier-to-access-and-understand.html>

through R&D tax incentives, with figures consistently between 0.11% and 0.14% between the years 2013 and 2020 (Figure 30 in Annex 1).

Regarding **Sub-priority 2.4: An active citizen and societal engagement in R&I in all its dimensions**, the indicator **Trust in science** in 2021 (Figure 31 in Annex 1) puts Sweden on equal terms with the EU-27 average. Examination of the **share of research publications on social innovation** (Figure 32 in Annex 1) indicates that Sweden performs over the EU-27 average, the trend from 2020 (with equal scores) to 2021 being that Sweden is increasing its advantage over the EU-27 average.

2.3. ERA Priority 3: Amplifying access to research and innovation investments and reforms.

2.3.1. Progress towards achieving ERA Priorities

Sub-priority 3.1: More investments and reforms in countries and regions with lower R&I performance is measured through the **increase in total R&D expenditure expressed as a percentage of GDP** that for Sweden fluctuates around 0 in the period 2011 to 2021, until reaching a negative value below the EU-27 average (Figure 33 in Annex 1).

2.4. ERA Priority 4: Advancing concerted research and innovation investments and reforms

2.4.1. Progress towards achieving ERA Priorities

Regarding **Sub-priority 4.1: Coordination of R&I investments**, the **share of public R&D expenditures financed by the private sector** remains constant for both Sweden and the EU-27 from 2010 to 2020. In this sense, the Swedish value stayed below the European average during such years (Figure 34 in the Annex).

3. Country-specific drivers and barriers

The European Semester Report on Sweden 2023⁶ highlights an **innovation-friendly environment, highly skilled workers, attractive research systems and internationally competitive and innovative large companies** as core benefits of the national research ecosystem. Sweden is also among the EU top performers in terms of **researchers and scientific publications in relation to population size**.

On the other hand, although Sweden has high indices of scientific publications, the **scientific impact index** has not seen a corresponding increase; the number of **new doctoral graduates** has fallen sharply since 2015. Many Swedish companies report **difficulties to recruit highly skilled staff** in science, technology and engineering, which might hamper future investment in R&D.

Sustaining a high-quality public research base and a sufficient pool of talent is essential to keep the Swedish knowledge economy competitive. Hence, by providing opportunities for individuals to acquire new skills and knowledge, higher education institutions contribute to the overall development and competitiveness of Sweden.

4. Final remarks

Sweden is strongly devoted to the implementation of the ERA Policy Agenda and has officially committed to 11 out of the 17 ERA actions, falling under two core priorities: (1) *Deepening a truly functioning internal market for knowledge* and (2) *Taking up together the challenges posed by the twin green and digital transition, and increasing society's participation in the ERA*.

Additionally, in the last decade important policies have been developed also with reference to the priorities (3) *Amplifying access to research and innovation excellence across the union* and (4) *Advancing concerted research and innovation investments and reforms*. Examples under Priority 3 are the already mentioned initiatives Impact Innovation,⁴¹ Innovation Partnership Programmes (such as the one on Climate Neutral Industry³³) and 'A strategy for Swedish participation in Horizon Europe',²³ as well as the study *Proposal for a new organisation of public, competitive funding of research and innovation*.⁴⁴ In relation to Priority 4, the initiative Swecris could be mentioned, a national database that allows to see how participating research funding bodies have distributed their money to Swedish recipients.⁴⁵

The country shows strong progress regarding most ERA Actions under *Priority 1: Deepening a truly functional internal market for knowledge*. For example, Sweden performs above EU average according to indicators on open science, research infrastructures, knowledge valorisation and global engagement. On the other hand, ERA Action under *Priority 2: Taking up together the challenges posed by the twin green and digital transition and increasing society's participation in the ERA*, are not showing the same level of progress, with several indicators below the EU average.

The indicators related to the environmental challenge and green transformation/transition suggest that Sweden is lagging a bit behind the EU-average. It should be mentioned that the policy debate around government support for innovation in both industry and small businesses has undergone a significant shift in recent years, with an increased focus on the green transition. This transition is generally seen as an opportunity to enhance the long-term competitiveness of Swedish companies. However, some negative tendencies, e.g., linked to the scientific impact index and a decreasing number of new doctoral graduates, have led to policy discussions on a decreasing quality of Swedish research.

A report⁴⁶ from the Swedish Research Council presents possible routes forward to improve conditions for research and to develop and strengthen the Swedish research system. The Council's positions on how to increase Swedish research quality further are presented and justified in four thematic chapters, all seen as a joint concern for higher education institutions, research funding bodies and other actors in the research system.

⁴⁴ The Government of Sweden (2023), 'Proposal for a new organisation of public, competitive funding of research and innovation' (*Ny myndighetsstruktur för finansiering av forskning och innovation*), available at: <https://regeringen.se/rattsliga-dokument/statens-offentliga-utredningar/2023/10/sou-202359/>

⁴⁵ Swecris – search for Swedish research projects, Swedish Research Council website, available at <https://www.vr.se/english/swecris.html#/>

⁴⁶ Swedish Research Council (2023), 'Strengthened Swedish research quality for the benefit of society' (*Stärkt svensk forskningskvalitet till nytta för samhället*). Available at, <https://www.vr.se/analys/rapporter/vara-rapporter/2023-05-31-starkt-svensk-forskningskvalitet-till-nytta-for-samhallet.html>

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6. Annexes

6.1. Annex 1: Graphs

The 2023 ERA Scoreboard and ERA Dashboard indicators used in the country report are presented in this annex. Detailed information on the data sources, description of the indicators, time period for which the data is available, and the necessary calculations can be found in the ERA Scoreboard and ERA Dashboard Methodology Report. The most recent available data for each indicator has been used.

General Indicators

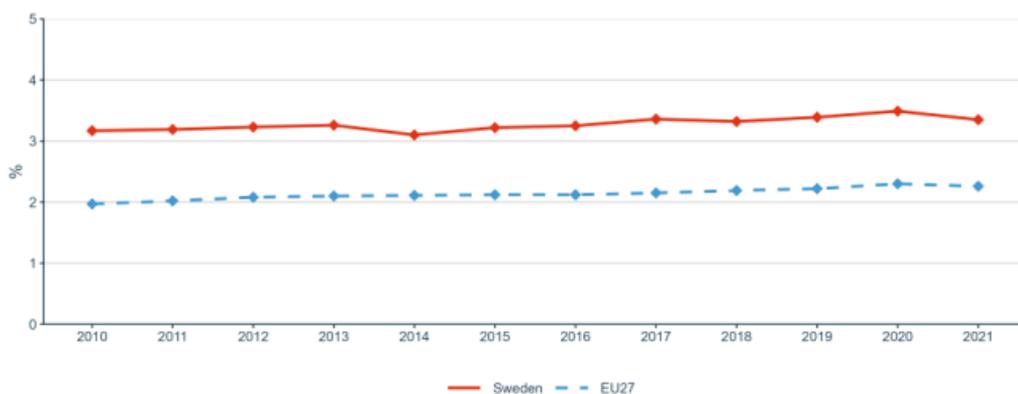


Figure 1: Gross Domestic Expenditure on R&D (GERD) as a percentage of GDP



Figure 2: Government Budget Allocations for R&D (GBARD) as share of GDP

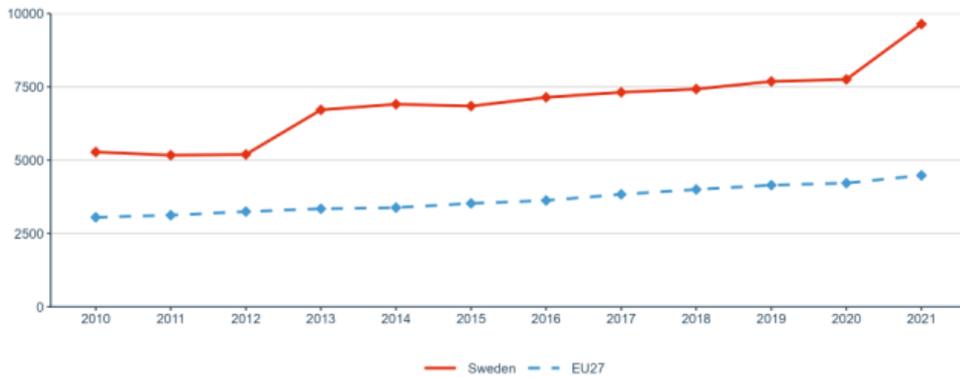


Figure 3: Researchers (in full-time equivalent) per million inhabitants

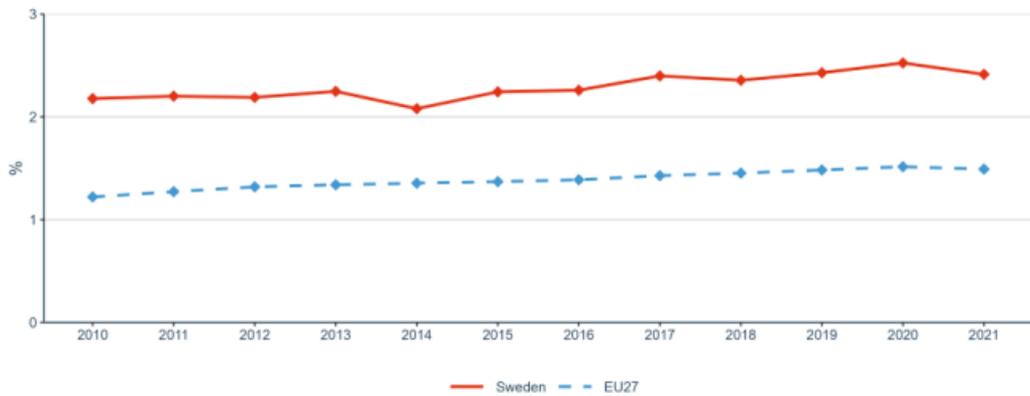


Figure 4: Business Enterprise expenditure on R&D (BERD) as a percentage of GDP

Priority 1: Deepening a truly functioning internal market for knowledge

Sub-priority 1.1: Open Science

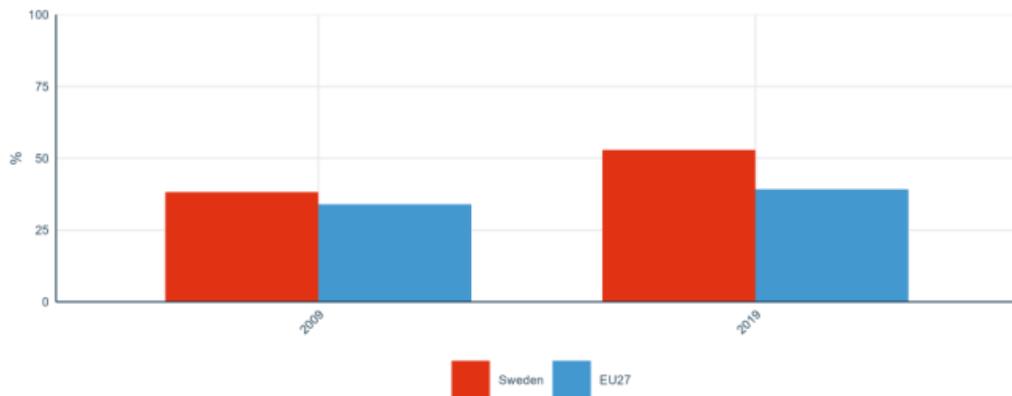


Figure 5: Share of publications available in open access

Sub-priority 1.2: Research infrastructures

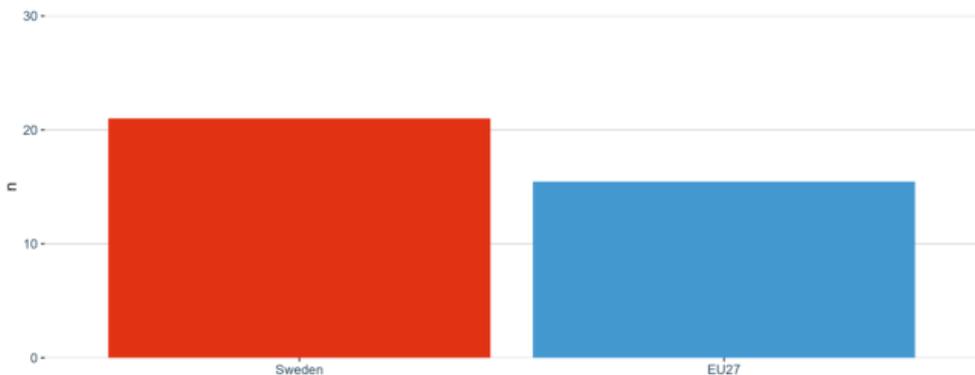


Figure 6: Number of European research infrastructures in which a Member State or an Associated participated (financially contributes to operations) in 2021

Sub-priority 1.3: Gender equality, equal opportunities for all and inclusiveness

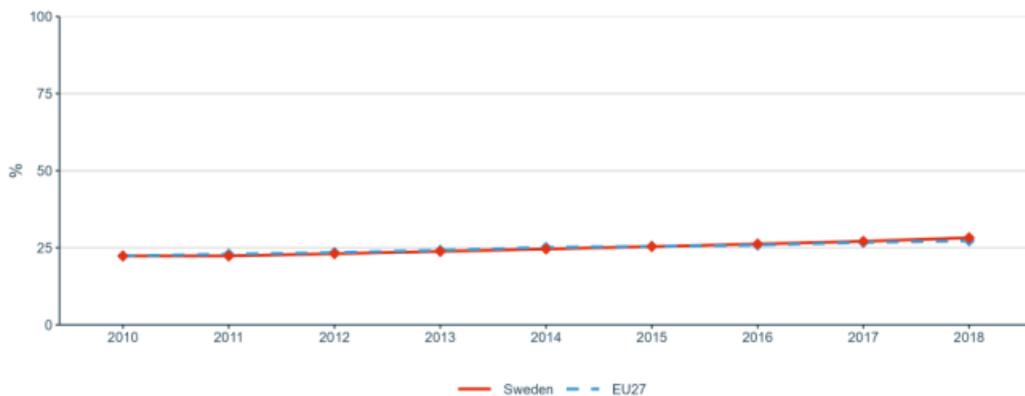


Figure 7: Share of women in grade A positions in HEIs

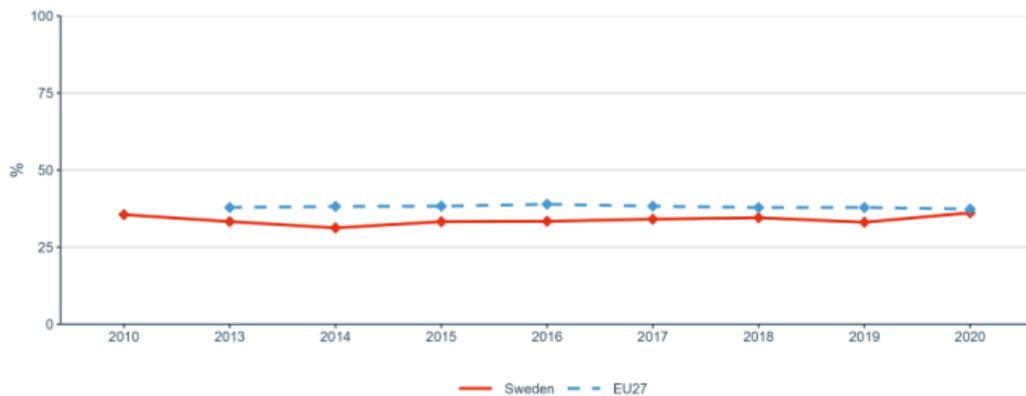


Figure 8: Proportion (%) of women among doctoral graduates by narrow fields of Science, Technology, Engineering and Mathematics (STEM)

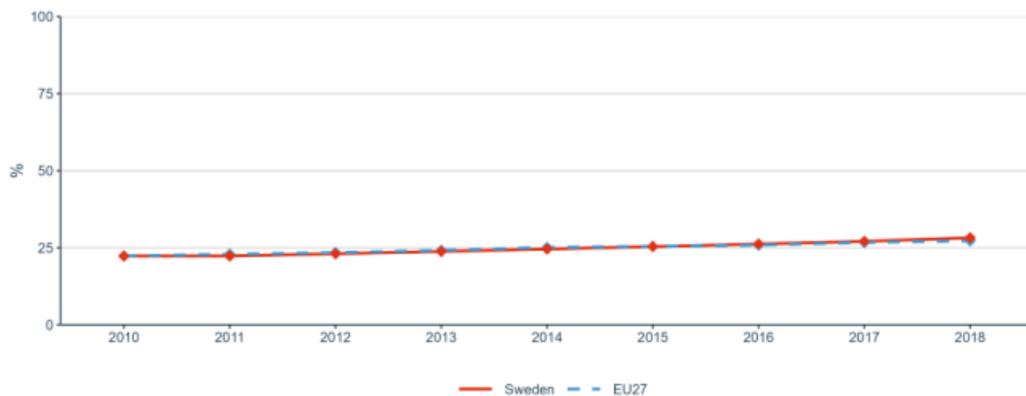


Figure 9: Proportion of papers with mixed gender authorship, 2000–2020

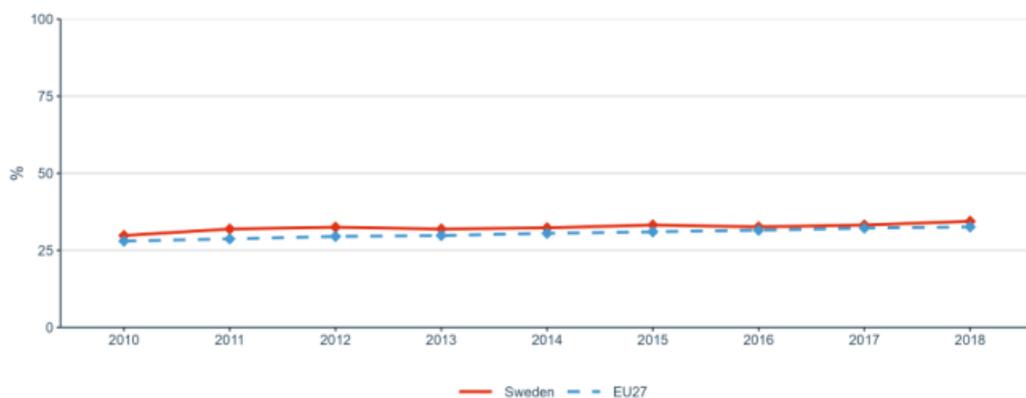


Figure 10: Proportion of women in authorships of the top 10% most cited publications, 2000–2018

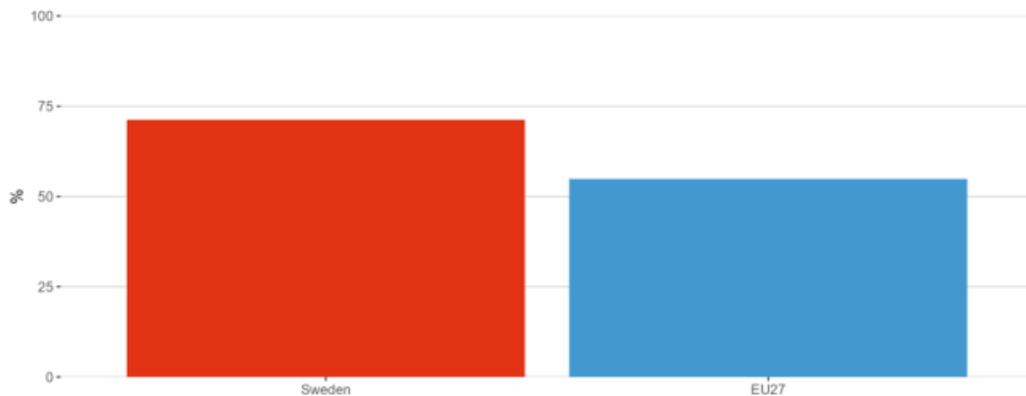


Figure 11: Women in Digital Index in 2022

Sub-priority 1.4: Researchers' careers and mobility and research assessment and reward systems

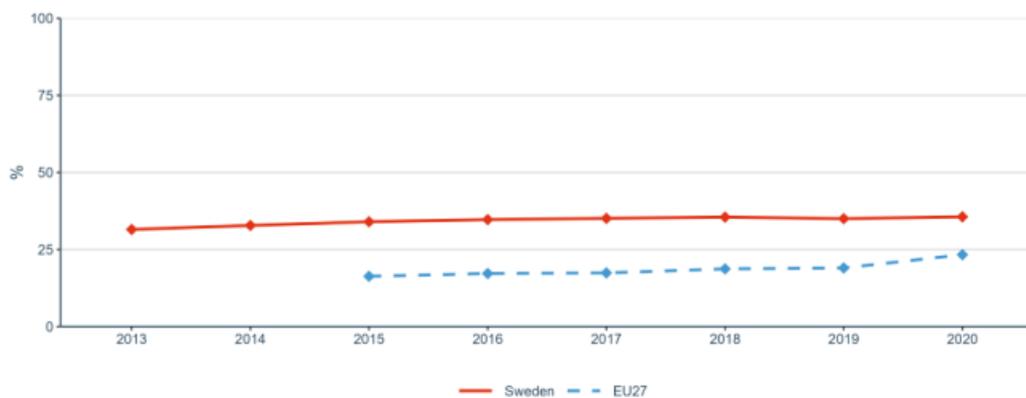


Figure 12: Share of foreign doctorate students as a percentage of all doctorate students

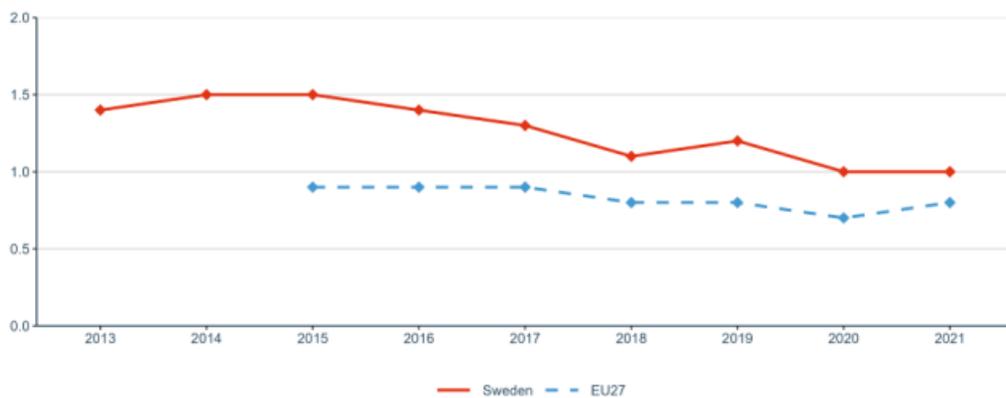


Figure 13: New doctorate graduates per 1,000 inhabitants aged 25-34

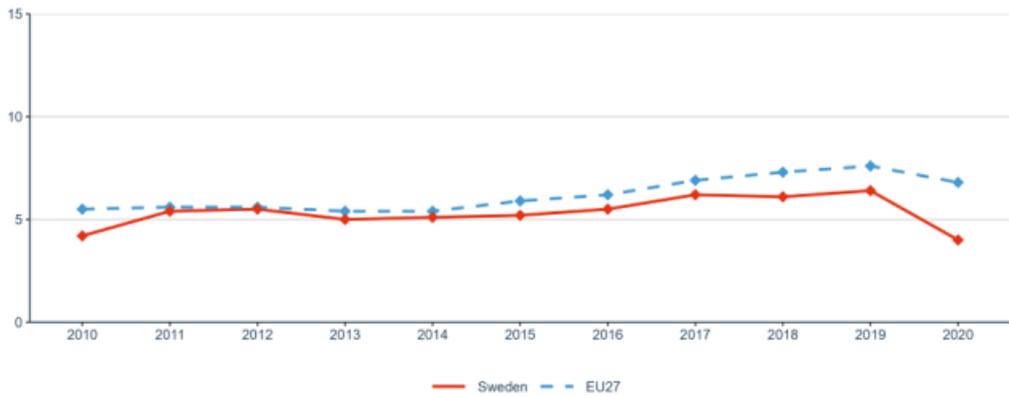


Figure 14: Job-to-job mobility of Human Resources in Science and Technology

Sub-priority 1.5: Knowledge valorisation

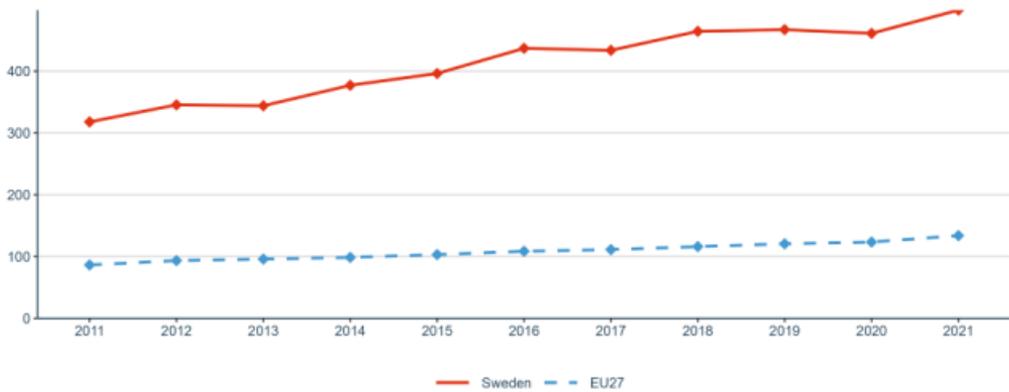


Figure 15: Share of public-private co-publications per 1 mio. inhabitants

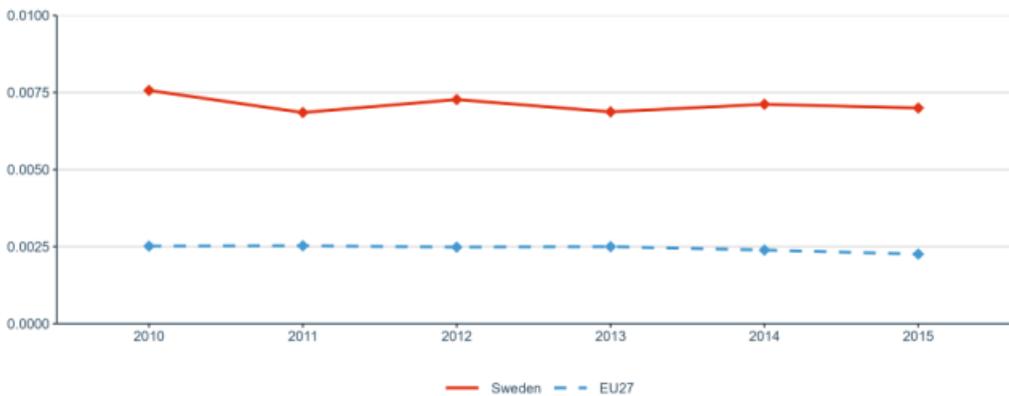


Figure 16: Number of PCT patent applications divided by GDP in million Euros

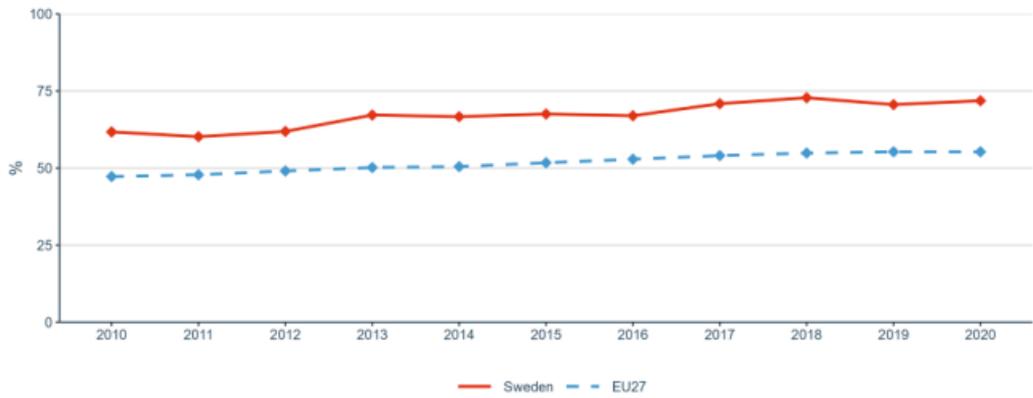


Figure 17: Business enterprise researchers as % of national researchers

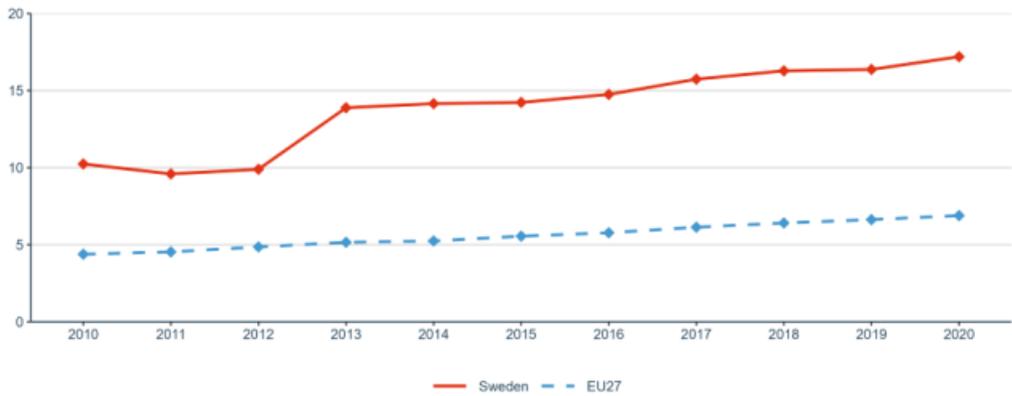


Figure 18: Business enterprise researchers in full-time equivalent per thousand employees in industry

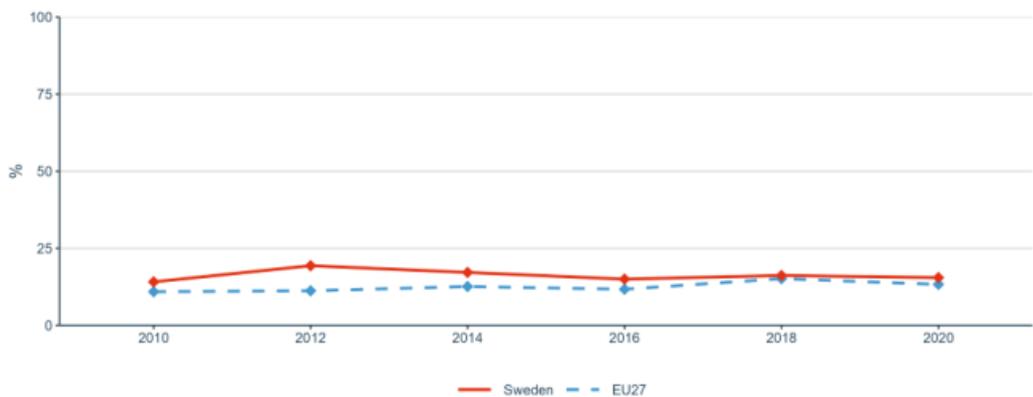


Figure 19: Share of innovating firms collaborating with higher education institutions or public/private research institutions

Sub-priority 1.6: Scientific leadership

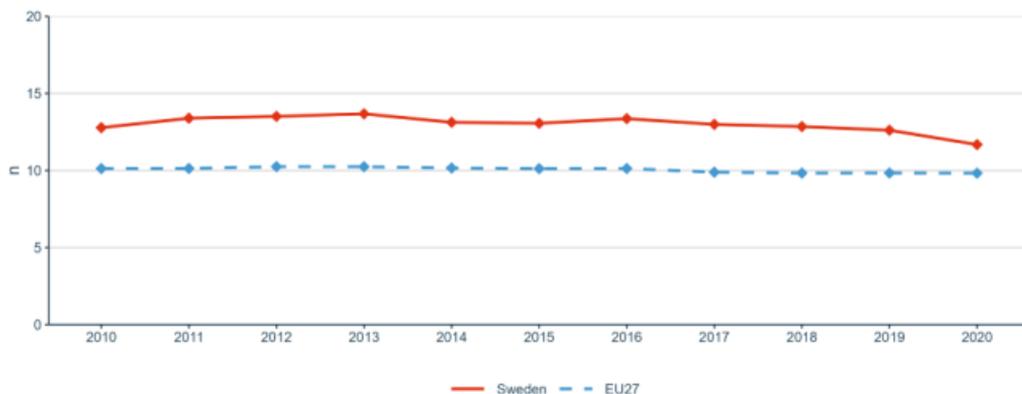


Figure 20: Number of scientific publications among the top-10% most cited publications worldwide as a percentage of all publications

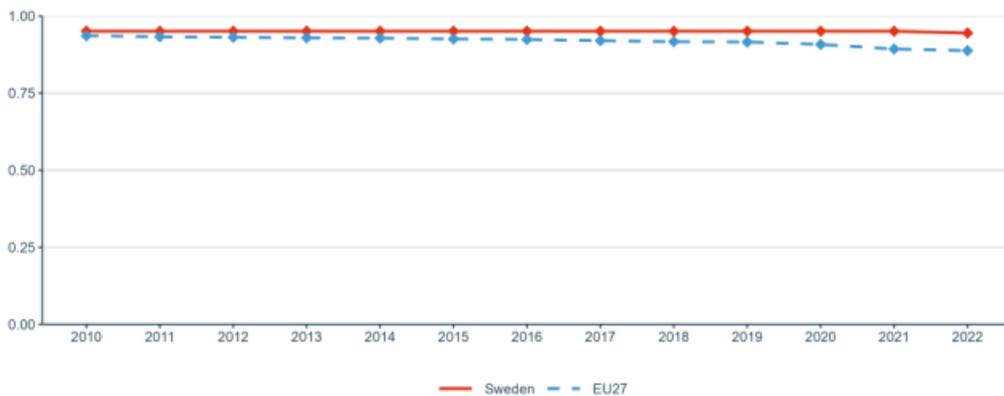


Figure 21: Academic Freedom Index (AFi)

Sub-priority 1.7: Global engagement

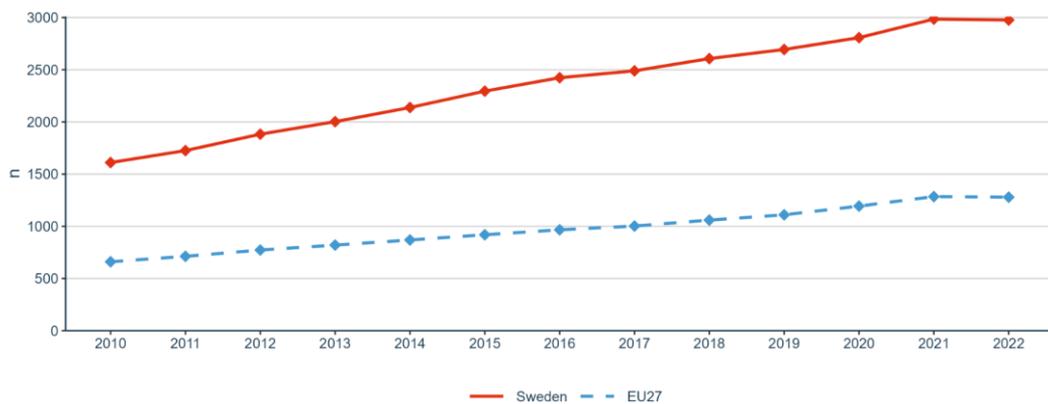


Figure 22: International co-publications with non-EU partners per 1,000 researchers in the public sector

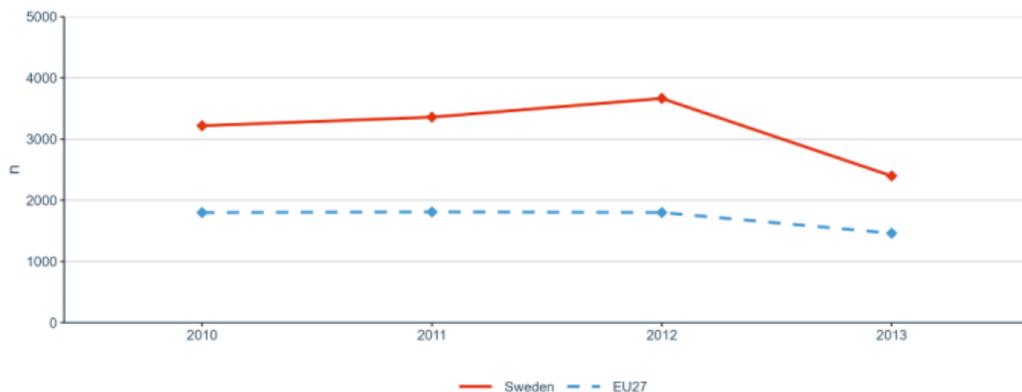


Figure 23: European and international co-patenting in EPO applications at national and EU level

Priority 2: Taking up together the challenges posed by the twin green and digital transition, and increasing society's participation in the ERA

Sub-priority 2.1: Challenge-based ERA actions

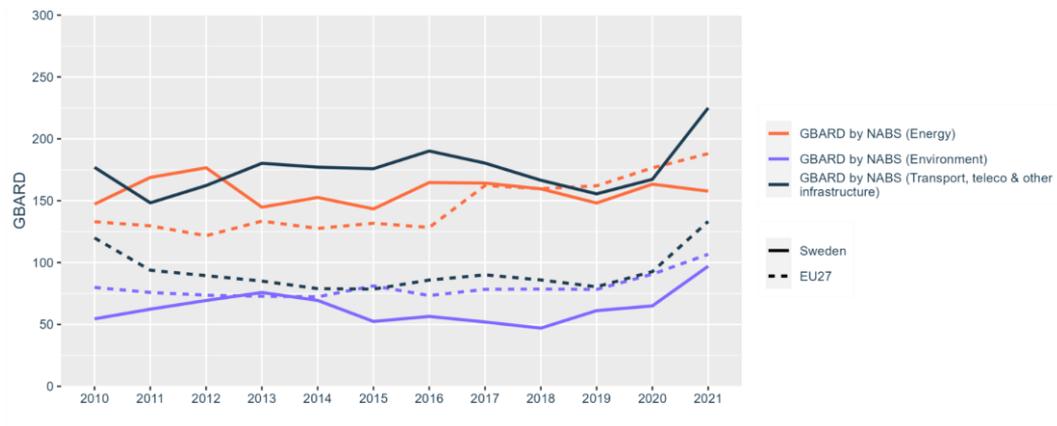


Figure 24: Government budget allocations for R&D (GBARD) by NABS

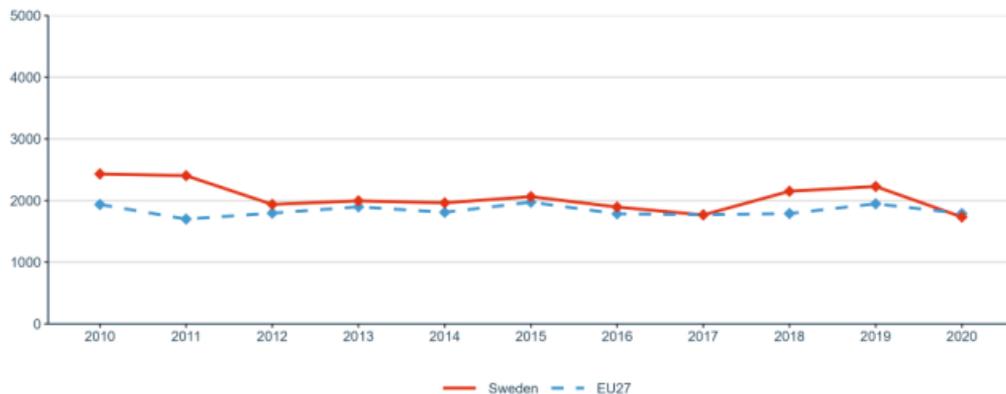


Figure 25: R&I investments (transnational cooperation): GBARD (EUR) allocated to Europewide transnational, bilateral or multilateral, public R&D programmes per FTE researcher in the public sector



Figure 26: Environmentally related government R&D budget as percentage of total government R&D

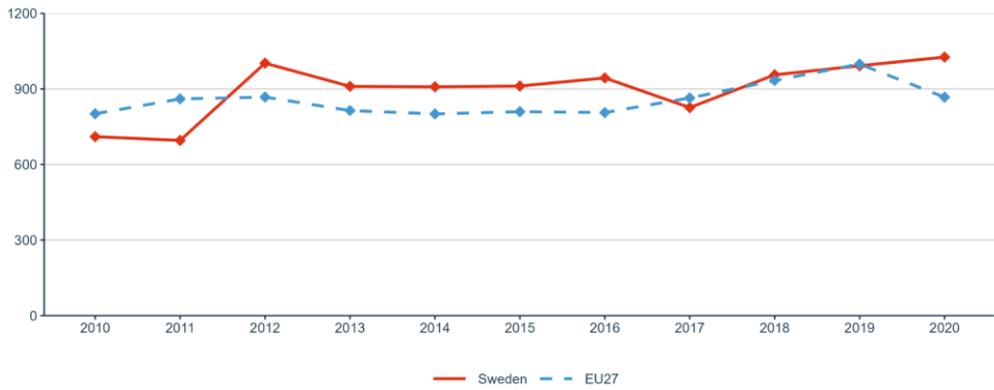


Figure 27: National public and private investments (in mio. EUR) as suggested in the SET Plan progress report 2021

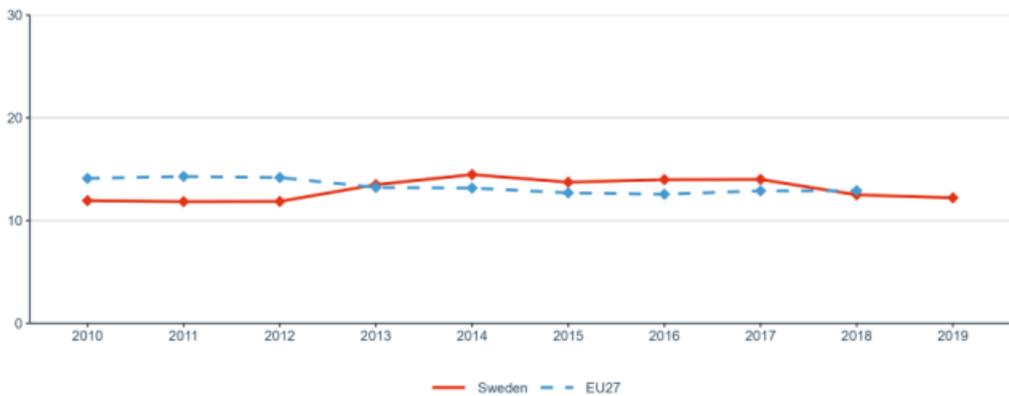


Figure 28: OECD Patents on environment technologies

Sub-priority 2.2: Synergies with education and the European Skills Agenda

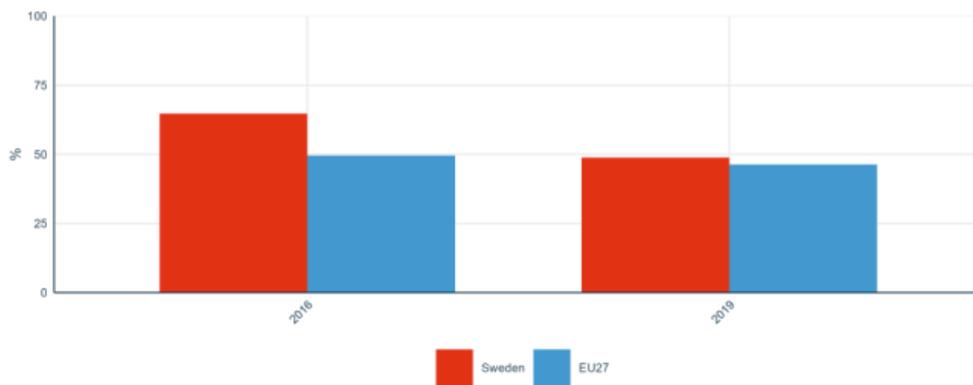


Figure 29: Share of researchers receiving transferable skills training

Sub-priority 2.3: Synergies with sectorial policies and industrial policy, in order to boost innovation ecosystems



Figure 30: Direct government support and Indirect government support through R&D tax incentives as a percentage of GDP

Sub-priority 2.4: An active citizen and societal engagement in R&I in all its dimensions

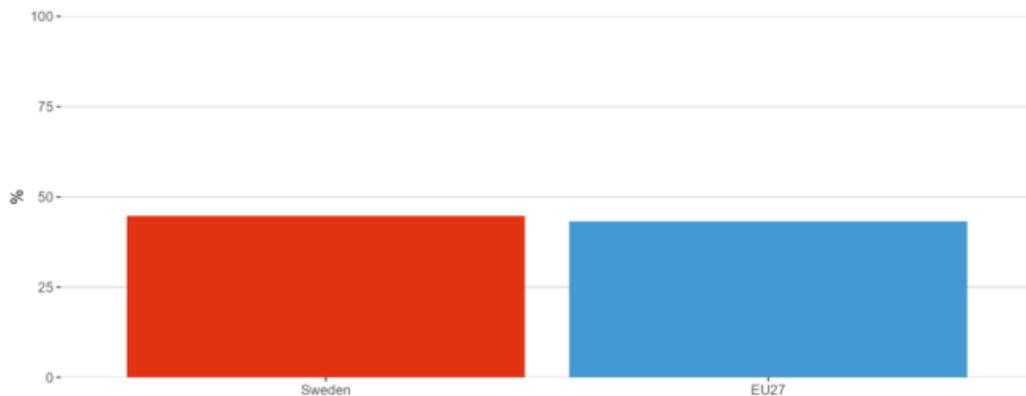


Figure 31: Trust in science in 2021

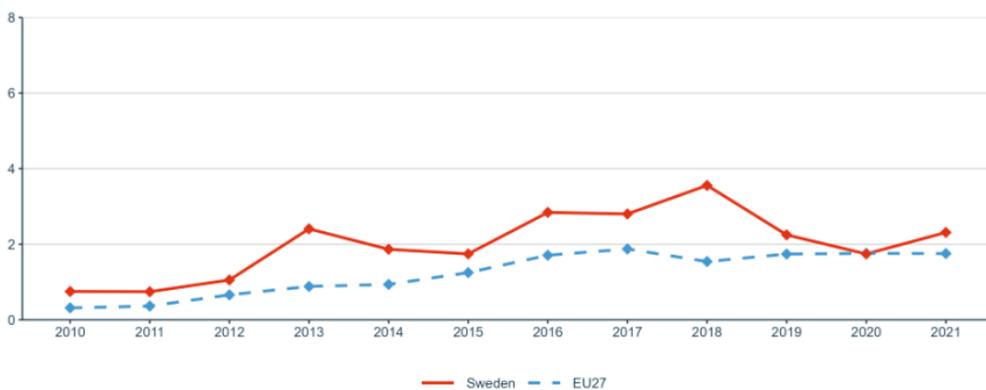


Figure 32: Research on social innovation (publications on 'social innovation' or 'social entrepreneurship') per million population

Priority 3: Amplifying access to research and innovation excellence across the Union

Sub-priority 3.1: More investments and reforms in countries and regions with lower R&I performance



Figure 33: Increase (in percentage points) of total R&D expenditure expressed as a percentage of GDP

Priority 4: Advancing concerted research and innovation investments and reforms

Sub-priority 4.1: Coordination of R&I investments

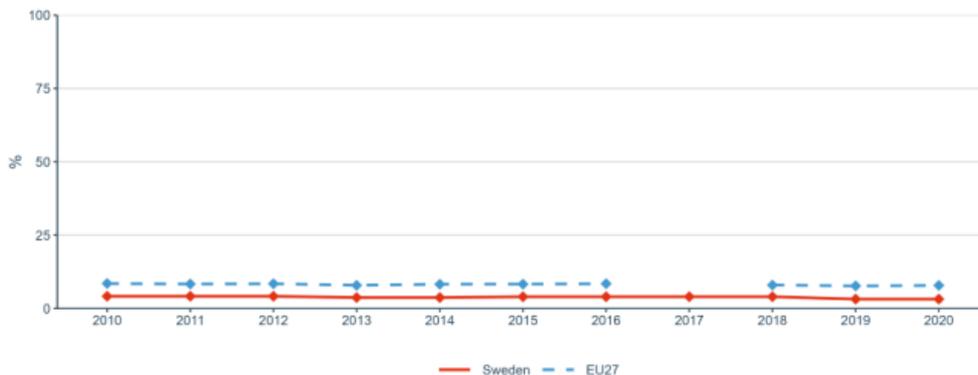


Figure 34: Share of public R&D expenditures financed by the private sector

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Research and Innovation policy

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