Austria as a science and technology nation

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Contents

Foreword

Jens Schneider, Rector, TU Wien and President, TU Austria Alliance
Max Voegler, VP Global Strategic Networks, DACH, Elsevier

Austria is a hidden champion in science and technology. While international attention frequently gravitates toward larger research nations, this report demonstrates that Austria consistently performs significantly better than what may be expected from its size. The high quality of Austria's universities and research institutions, their broad international connections and collaborations including industry and society, and the ability to translate scientific excellence into innovation are central to Austria's strength.

At the same time, the analysis points to the need for further development. Austria's research system has substantial assets, but it also faces distinct challenges that require sharper focus, stronger coordination, and continued strategic development. This report is the result of continuing discussions and conversations about how Austria's science and technology strengths may be benchmarked, understood and positioned in an international context.

One of Austria's distinctive features is the ability to combine complementary capabilities across institutions, disciplines, and regions. TU Austria serves as a role model and example in the national research landscape. The TU Austria Alliance — comprising TU Wien, Graz University of Technology, Montanuniversität Leoben, and its recently associated partners, BOKU University and the technical faculties of the University of Innsbruck and JKU Linz — embodies this strength through deliberate collaboration. TU Austria functions as a scientific and technological ecosystem bundling disciplines over geographic borders and with a coordinated strategy, creating possibilities that go beyond those of a single university.

Austria's position at the centre of Europe has long fostered the exchange of cultures, technologies, and ideas. This continues to shape its research system today. TU Austria reflects this tradition by weaving the complementary strengths of the individual members into broader national capacity for excellence, infrastructure and talent.

Collaborative models are of particular importance at a times when scientific competitiveness requires not only scientific excellence, but critically depends on the ability to connect to create knowledge, to share infrastructure, and to foster talent. Austria has a distinct role within Europe. It is part of the smaller but highly innovative research nations. Its geography enables it to bridge Western, Central, Eastern, and Southeastern Europe, linking research communities, science and industry, discovery and application. This is of particular significance at a time when Europe seeks enhanced resilience, stronger cooperation, and renewed competitiveness in key technologies. Across engineering, digital technologies, advanced manufacturing, materials, sustainability, and the bioeconomy, Austria demonstrates how excellence is strengthened. Institutions maintain and cultivate a clear profiles while contributing to a broader and more coherent ecosystem.

Austria's future will depend on talent. Students, doctoral and postdoctoral researchers, and early–career scientists need to carry ideas from research into application.

They need the conditions to start new businesses, develop technologies, and build partnerships through which scientific capacity becomes of economic and societal value. Austria has strong foundations, especially where research– based entrepreneurship, industrial collaboration, and technological capability intersect. Strengthening these pathways further will be essential to convert scientific excellence into long–term innovation leadership.

This report is part of the Elsevier's Science Nation series, which provides comparative, data–rich analyses of national and regional research and innovation systems.

These reports aim at identifying a country's performance in an international context, assessing strengths and defining areas for further development.

We hope that the following pages will contribute to a reflection and constructive conversation about the future development of Austria as part of the innovation landscape of Europe. We offer an evidence–based view: the data are indicative and highlight where more focus and further progress are needed to unravel the full power of Austria's Universities, industry, funders, and policymakers.

We intend to provide a basis for a common understanding and strategy for Austria as a science and technology nation.

Academic leaders' perspectives

Henrietta Egerth,
Managing Director, Austrian Research Promotion Agency (FFG)

The report, *Austria as a science and technology nation*, presents a research system that achieves a remarkable level of performance relative to its size. With around 0.11% of the global population accounting for roughly 0.8% of scientific output and a citation impact of 1.54, Austria stands out for both productivity and influence.

One of the system's defining characteristics is its strong international orientation. The high share of internationally co-authored publications (67%) reflects close integration into global research networks and sustained openness to collaboration. In this context, the Austrian Research Promotion Agency FFG plays an important role in connecting actors, supporting participation in European programs and facilitating cross-border cooperation.

Austria also shows solid performance in linking research to innovation. The close interaction between academia, industry and policy is visible in co-publications and knowledge transfer indicators, pointing to a system where scientific results are effectively translated into application. Funding institutions such as the FFG contribute to this dynamic by strengthening collaboration and supporting the path from research to market.

At the same time, future competitiveness will depend on the system's ability to further accelerate these processes. In areas such as AI, quantum technologies and biotechnology, Austria delivers strong scientific output but faces challenges in scaling innovation and bringing solutions to market more rapidly. Increasing international competition, technological rivalry and shifting geopolitical conditions add to this pressure.

Against this backdrop, continued success will require not only sustained excellence, but also adaptive and well-coordinated innovation policies. Strengthening commercialization pathways, mobilizing private investment and ensuring flexible funding structures will be key to maintaining Austria's position in a rapidly evolving global landscape.

Christof Gattringer,
President,
Austrian Science Fund (FWF)

The current report, *Austria as a science and technology Nation*, demonstrates that Austria occupies a leading position in international science despite its comparatively small size. Although Austria accounts for only around 0.11% of the world's population, it contributes approximately 0.8% of global scientific output — and does so at a quality level that stands 54% above the global average. This shows that scientific visibility and influence do not depend on the size of a country, but on scientific excellence and connectivity.

A key factor behind this success is close collaboration across national borders. Around two thirds of all scientific publications are produced through international cooperation, a figure well above the EU average. Cross-institutional collaboration within Austria, such as through the TU Austria, is a major contribution to this success. The Austrian Science Fund (FWF) actively supports such collaborative approaches, for example through larger-scale funding instruments such as *Spezialforschungsgruppen* (Specialized Research Groups), *Emerging Fields*, and major *Clusters of Excellence*. Austria's technical universities play a central role in all these areas, underlining their outstanding importance within the country's research landscape.

Particularly in forward-looking fields such as the key technologies defined by the Federal Government, Austria is exceptionally well positioned internationally thanks to the strength of its technical universities — supported in no small measure by the FWF's sustained investments over many decades. It is notable that a considerable share of these selected areas, including artificial intelligence, quantum technologies, advanced materials, and the life sciences, builds on the established strengths of Austrian basic research and is likewise reflected in the FWF's Excellence Clusters.

None of these achievements are accidental. They are the result of long-term investment and intensive collaboration. To secure and further strengthen this position, Austria must continue to invest in talent, cooperation, and new ideas, thereby making an important contribution to the future of both the country and Europe.

Martin H. Gerzabek,
President, Christian Doppler Research Association (CDG)

The report clearly demonstrates that Austria has succeeded in establishing a strong presence in the European and international scientific community despite its small size. It is particularly encouraging that a large number of publications result from collaborations within Austria, across Europe, and internationally, thereby highlighting the interconnectedness of the Austrian research landscape. Excellence in key technology sectors and significant contributions to sustainability research are further examples of Austria's success.

In its expanded form, TU Austria serves now even more as a multidisciplinary academic hub with significant capabilities. In my own capacity, I am particularly pleased that Austria stands out, especially in the joint research efforts of academic institutions and companies. It didn't come as much of a surprise to me that the research impact of collaborative research (academic–corporate) is greater than that of academic research alone. We had already concluded this from our annual analyses of CDG-funded research. The report thus shows us that collaboration between academic institutions and leading companies in Austria and Europe is a key asset for research and innovation in Austria. The universities of the TU Austria and the medical universities in Austria play a crucial role in this regard — that is, precisely the group of universities that have been particularly successful in utilizing the CDG model in the past and presently.

I view this report as a mandate to consistently continue the way already begun to closely integrate universities and companies within the research and innovation system. It is clear that Austria has developed a particular strength in this area, which should be further expanded.

The report thus shows us that collaboration between academic institutions and leading companies in Austria and Europe is a key asset for research and innovation in Austria.

Brigitte Hütter,
Rector, University of Arts Linz,
and President, uniko

This report is an important contribution for understanding Austria's position as a nation of science and innovation in an international context. It outlines that Austria performs strongly across key areas, characterized by high research quality, strong intersectoral and international connectivity, and clearly defined areas of expertise — scientific excellence being the cornerstone of innovation.

At the same time, a rapidly changing global environment poses new demands. Europe must strengthen its strategic autonomy and resilience, and Austria's contribution will depend on the performance of a comprehensive and well-connected Research, Technology and Innovation (RTI) ecosystem.

The report's findings strongly resonate with key themes emerging from an ongoing national debate on a *Higher Education Strategy 2040*. The importance of international collaboration, institutional differentiation, and stronger coordination across the higher education sector is increasingly emphasized. At the same time, discussions around clearer institutional profiles, new forms of cooperation, and predictable careers highlight both the diversity and the complexity of Austria's higher education system.

This calls for a joint consolidation of instruments aligned with strategic goals, as well as a stronger harmonization of initiatives, in order to bundle expertise effectively and achieve greater overall impact.

It is clear that we must embrace new ways of thinking, with a stronger focus on transdisciplinarity that goes beyond traditional academic and sectoral boundaries. Technological progress alone is not sufficient; lasting impact requires cultural transformation. Sustainable innovation depends on how new technologies are understood, accepted, and integrated into everyday life. In this context, the social sciences and the arts play a pivotal role. They are key drivers of cultural change, shaping societal values, behaviors, and public discourse.

Universities must be empowered to act as hubs of co-creation, supported by improved transfer structures, more flexible career models, and stronger incentives for cross-sector collaboration. In doing so, they will safeguard democratic values and long-term societal prosperity. Taken together, these findings underline that strengthening the contribution of universities within an integrated RTI ecosystem is a central condition for sustaining Austria's competitiveness and capacity to innovate.

Georg Knill,
President, Federation of Austrian Industries (IV)

The report underscores a clear and encouraging message: Austria is a "small but excellent" science and technology nation whose global influence significantly exceeds its size. With only around 0.8 percent of global research output but a markedly higher citation impact, Austria demonstrates that quality, connectivity, and strategic focus can compensate for limited scale.

From an industrial perspective, this is highly relevant. Austria's strength lies not only in scientific excellence but in its ability to translate knowledge into economic and societal value. The strong performance in academic–corporate collaboration, well above European and global benchmarks, highlights a research system that is deeply embedded in industry. This close integration is a core asset for a country whose competitiveness depends on innovation–driven manufacturing and technology leadership. Due to the high impact of excellent science–industry collaborations it is vital that the Austrian universities further strengthen the engagement in long–term, strategic collaborations with our leading industrial companies.

At the same time, the report shows that Austria's research system is strongly internationalized, with a high share of cross–border collaboration.

This openness is essential in a rapidly evolving global research landscape, where technological leadership increasingly depends on networks rather than national scale alone.

For the Federation of Austrian Industries (IV), the implications are clear: Research is not a cost factor, but a strategic investment in future competitiveness. Austria's business sector plays a pivotal role in financing the innovation ecosystem, contributing two thirds of total expenditure on research and development. It enables technological sovereignty, strengthens industrial resilience, and drives innovation in key areas such as AI, biotechnology, and advanced materials. The strong performance of technical universities and applied research institutions in particular illustrates how research excellence can directly feed into industrial value creation.

Going forward, the priority must be to further strengthen framework conditions: stable funding for research, development and innovation for science and business, talent attraction, and stronger incentives for knowledge transfer. Austria already has the foundations of a high–performing innovation ecosystem, now the task is to scale its impact and secure its position in an increasingly competitive global environment.

Introduction

Austria's universities compete internationally, and their strength matters because it underpins the ability to attract and retain global talent, a prerequisite for staying competitive in a rapidly shifting geopolitical and technological environment.

At the same time, as artificial intelligence and digital transformation are reshaping research and higher education, universities are also expected to serve as anchors of evidence-based dialogue, critical thinking and democratic resilience, while providing the excellence, infrastructure and international openness that top talent looks for when choosing where to work and study. This report responds by assessing where Austria's research system demonstrates international visibility and connectivity, and by identifying the institutions and cooperation patterns that sustain excellence and global positioning.

But scientific visibility is only one part of the national value proposition. Equally important is how research strength converts into innovation and societal value. Beyond publication performance, the report highlights knowledge valorisation through multiple pathways: academic-corporate collaboration as a signal of cross-sector engagement; patent citations as evidence of technological transfer; and policy citations as a marker of how academia contributes to political and societal decision-making. It also situates Austria's position in key technologies such as AI, quantum technology, biotechnology and critical materials, using a portfolio lens that combines scale, performance and translation signals. In addition, it integrates the spin-off and startup pathway to reflect how universities help move ideas from lab to market. Taken together, these perspectives present Austria's science system not only as a producer of internationally visible research, but as an engine for technological capability, entrepreneurship and societal impact. And within this national system, the universities within TU Austria represent the core engineering and deep-tech platform through which a large share of Austria's translation, industrial collaboration and technological capability is organized.

Key takeaways

Austria is a **"small but excellent"** science and technology nation. With ~0.11% of the global population, it produces ~0.8% of global scientific output yet has a Field-Weighted Citation Impact (FWCI) of 1.54 (54% above world average), showing that international influence can clearly exceed national scale.

Austria's research model is cross-border co-production. Around **67% of Austrian publications** are internationally co-authored, well above the **EU27 benchmark of 43%**, reflecting a system that is deeply embedded in European and global research networks.

Translation is a measurable comparative advantage. 8.8% of Austrian research output is co-authored with corporate partners, compared with 3.9% in the EU and 2.6% globally. Among TU Austria institutions, the share is even higher at 10.2%, underlining the strength of Austria's technical universities in linking research with industrial application.

Austria's science system works as a **division-of-labor ecosystem**: comprehensive universities provide breadth and scale, medical universities drive high-impact health research, and TU Austria forms the center of Austria's engineering and deep-tech specialization, especially where research, infrastructure, and application come together.

TU Austria is Austria's deep-tech engine: Austria holds above-world-average research intensity in key fields:

- In **artificial intelligence**, TU Wien (1,032 papers, FWCI 1.87) and TU Graz (724 papers, FWCI 1.86) anchor Austria's AI output, with TU Austria's corporate partners (Silicon Austria Labs, Infineon Technologies Austria AG, AVL List GmbH) forming the core of Austria's AI industry interface.
- In **quantum technologies**, Austria publishes above the world and EU averages (1.2% of **Austria's** output vs 0.8% **global and EU** benchmark) with citation impact exceeding all G7 comparators; University of Innsbruck is Austria's second most prolific quantum institution (507 papers, FWCI 2.45).
- In **advanced materials and critical materials**, TU Leoben, TU Wien, and TU Graz hold the top three positions and TU Austria institutions collectively account for the highest patent-cited output in this field, with voestalpine AG as the leading industrial partner.

Universities in Austria also strongly contribute to **evidence-based policymaking and democratic resilience**. With 8.9% of Austrian research cited in policy documents, Austria performs above both EU and global benchmarks, showing that its universities support public decision making as well as scientific and technological progress.

This report was developed together with TU Austria and is a data-driven input to the *Hochschulstrategie 2040*, with its eight themes and broad stakeholder participation. The quantitative emphasis is strongest on the themes where bibliometrics can contribute (international visibility, excellence, knowledge transfer, policy uptake) and should be read alongside complementary evidence on teaching/study conditions, inclusion, career paths, governance and financing which the strategy foregrounds.

A note on the data

Except for the section on spin–offs and startups, this report is based on quantitative indicators derived from Elsevier's bibliometric and analytical platforms, including Scopus and SciVal. These platforms use publication metadata and author affiliations to map research output, collaboration patterns and citation impact across institutions and countries. Variations in how researchers report institutional affiliations, as well as changes in organizational structures over time, may affect how institutions are represented in bibliometric databases. As a result, quantitative indicators should be interpreted in context and complemented with qualitative evidence.

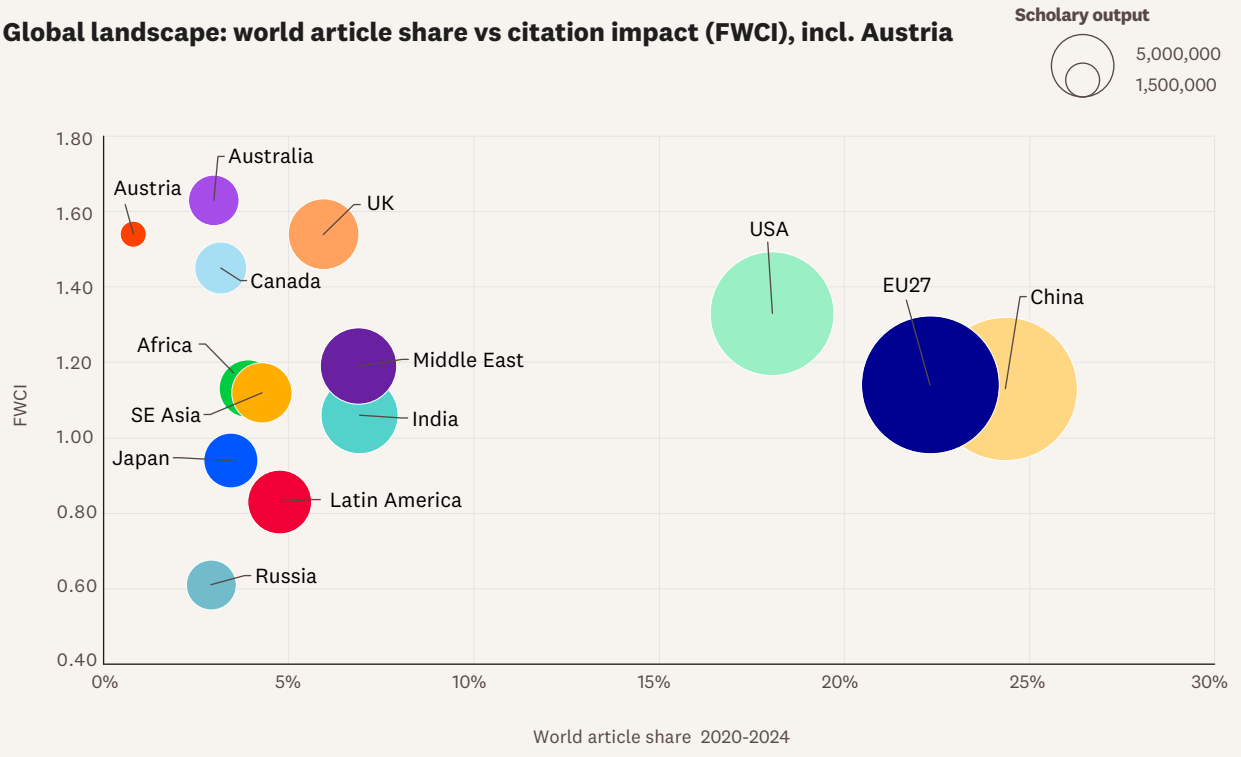
Austria's position in the global research landscape

The global research system is characterized by a growing divergence between scale and impact, with countries and regions occupying very different positions along these two dimensions. When publication volume is considered alongside citation impact, clear structural patterns emerge that contextualize Austria's scientific performance.

At the global level, China has become the largest producer of scholarly output, surpassing both the European Union and the United States in publication volume, Fig. 1. China and the EU now display very similar citation impact levels, both close to the global benchmark, despite their markedly different research trajectories and system sizes. The United States continues to combine a large publication volume with above-average citation impact, maintaining its position as one of the most influential research systems worldwide.

Figure 1

Global landscape: world article share vs citation impact (FWCI), incl. Austria



Against this backdrop, Austria occupies a distinctive niche. While its contribution to global scholarly output is relatively modest, around 0.8% of total world publications, placing it 31st worldwide by volume, its research achieves exceptionally high citation impact. With a FWCI of 1.54, Austria performs well above the EU average (FWCI 1.14)and exceeds the citation levels of much larger research systems, including the United States (FWCI 1.33). Its impact level is comparable to that of the United Kingdom (FWCI 1.55), underlining the international visibility and influence of Austrian research.

In terms of scale, Austria's publication output is similar to that of countries such as South Africa, Mexico, and Hong Kong. Within the European Union, Austria ranks as the 11th most research-productive country, closely followed by the Czech Republic, after which there is a pronounced drop in output. This positioning highlights Austria's role as a mid-sized European research system with outsized impact.

Overall, this comparison illustrates Austria's profile as a "small but excellent" science and technology nation. Despite its limited scale, Austrian research consistently attracts significantly more citations than the global average, reflecting strong research quality, effective international integration, and a high degree of scientific relevance.

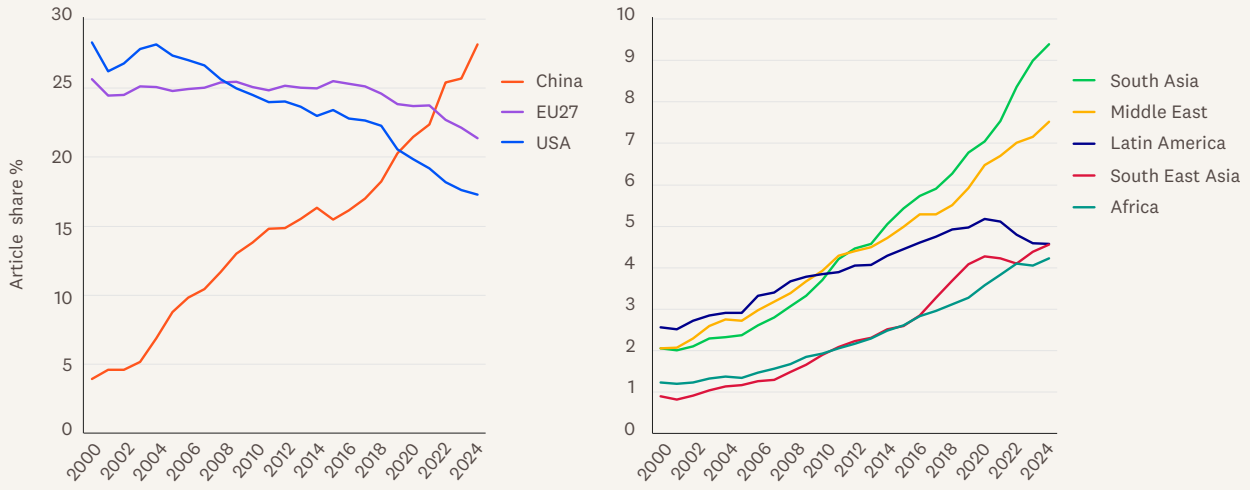
The changing global research landscape

Given Austria's close integration into the international science system, it is useful to first situate the analysis within the global science and technology landscape before turning to the national context. Since the early 2000s, the global research landscape has shifted markedly away from the historical dominance of North America and Europe, Fig. 2, left.

While these regions continue to produce large volumes of research, their relative share of global scholarly output has declined as new actors have expanded rapidly. The most pronounced change is the rise of China, whose research output accelerated sharply over the past two decades, overtaking the United States in 2019 and the European Union in 2021. This growth has been the single most important driver reshaping the global distribution of research production.

Figure 2

Global scholarly output trends by major regions, 2000–2024



Alongside China, other regions have increased their presence in global research, Fig. 2 right. India has shown particularly strong and sustained growth, while the Middle East, Africa, and South-East Asia have more than tripled their share of world scholarly output since the early 2000s. These trends point to a broadening of the global research base beyond a small number of traditional centers.

By contrast, Europe and the United States have seen a gradual erosion of their global share in recent years, Fig. 2, left. This reflects slower growth relative to emerging regions rather than a decline in absolute research activity, highlighting the increasingly competitive and distributed nature of the global research system.

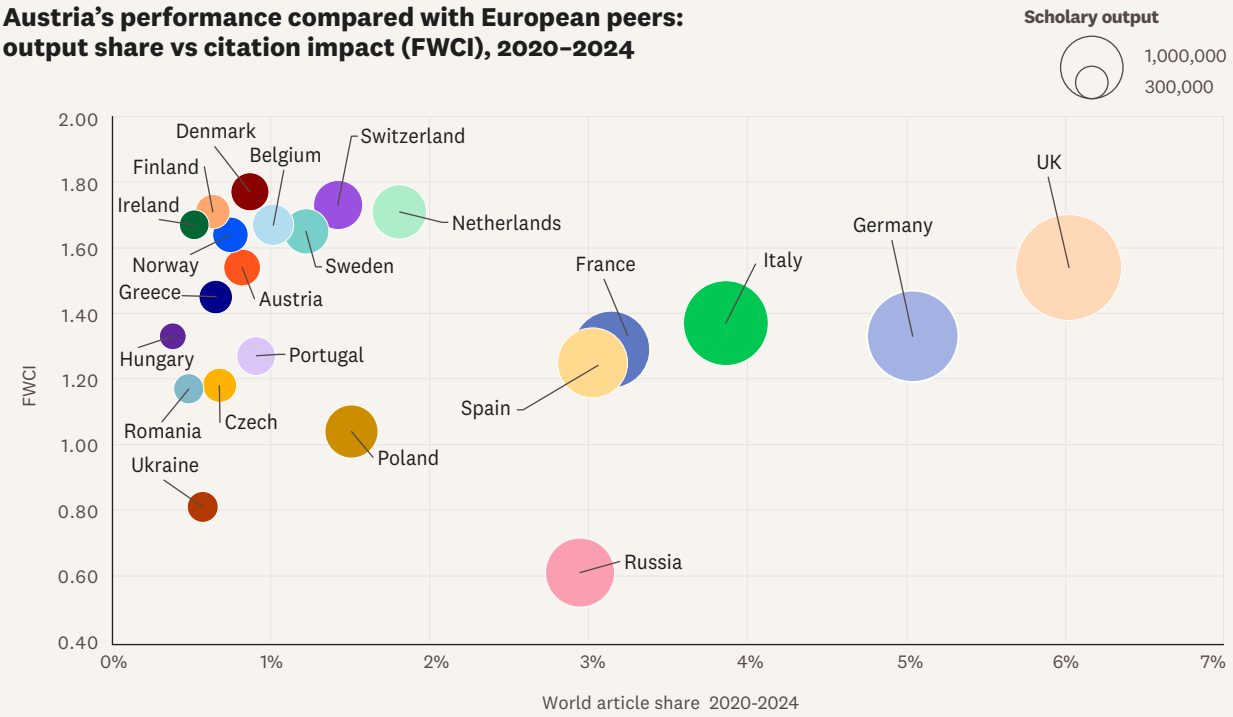

ONTANISTISCHE HOCHSCHULE

Austria in Europe

Within Europe, Austria contributes about 3.6% of the EU27's scientific output. The European comparator view underscores that Austria's impact performance stands out relative to the EU benchmark, Fig. 3.

Figure 3

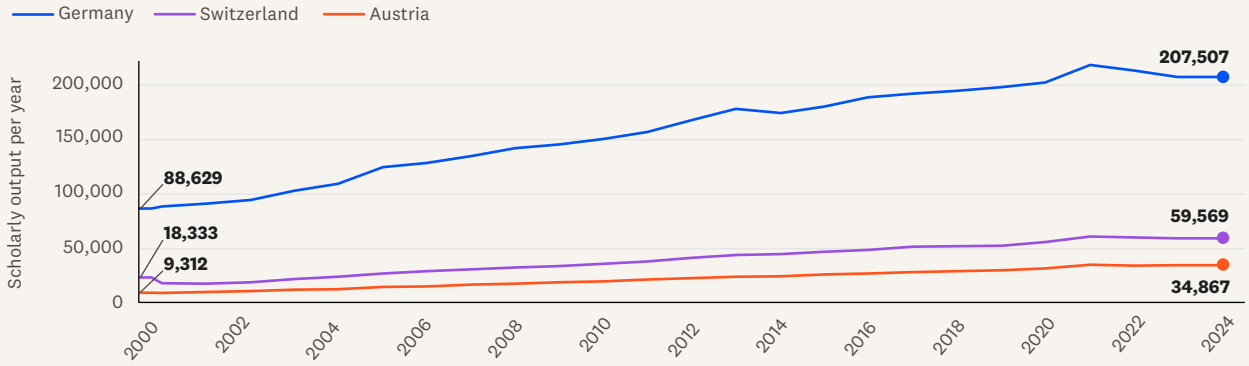
Austria's performance compared with European peers: output share vs citation impact (FWCI), 2020–2024



The above chart shows countries in Europe with at least 100,000 publications in the timeframe. Across the DACH region (Germany, Austria, Switzerland), Austria shows the strongest long-run compounded annual growth rate (CAGR) in scholarly output over 2000–2024, 5.7%, exceeding Switzerland (5.0%) and Germany (3.6%). This supports a narrative of sustained expansion of Austrian research activity, Fig. 4.

Figure 4

Scholarly output trend in DACH, 2000–2024



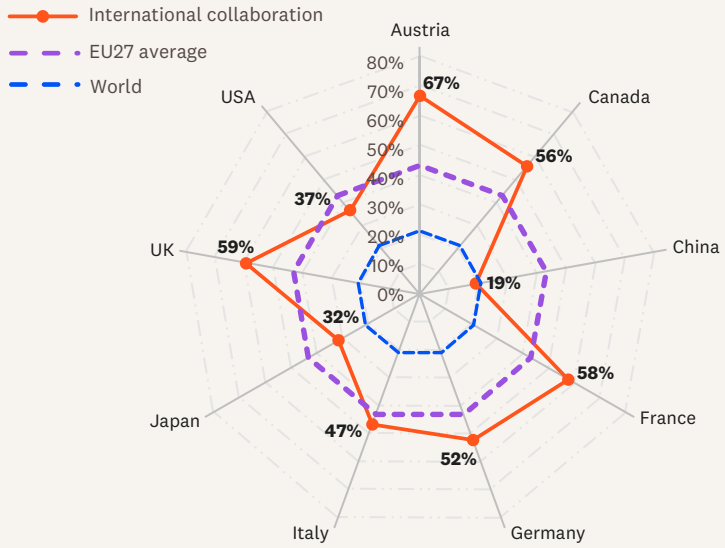
In the most recent period shown, Austria's publication output grew by about 1.7% from 2022 to 2024 despite a decline in the number of publishing authors over the same time period. This differs from broader international patterns where author numbers tend to grow faster than publications. The signal may reflect productivity shifts, collaboration structure, or field-mix changes, but it also warrants attention to talent pipelines and capacity.

International collaboration

International collaboration is a defining characteristic of Austria's research model. Approximately 67% of Austrian output is internationally co-authored, well above the EU27 benchmark (43%) and the global average (21%), Fig. 5.

Figure 5

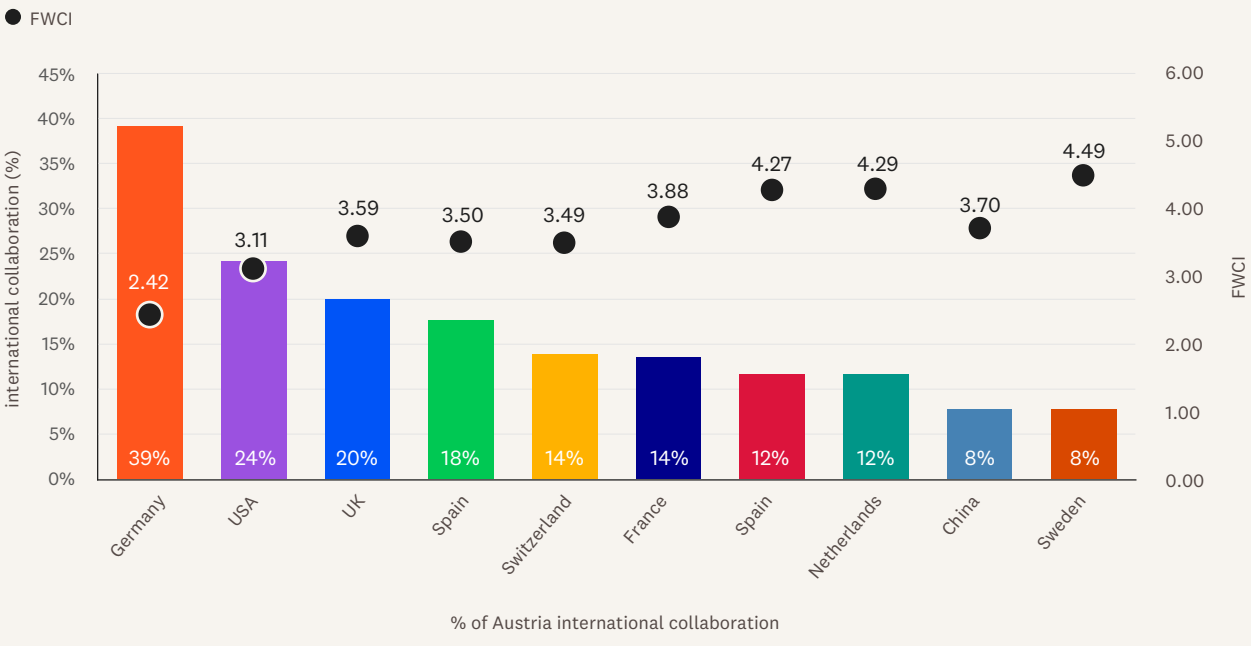
International collaboration level: Austria vs G7/China, EU and world benchmarks, 2020–2024



Austria's collaboration footprint is primarily European (more than half of collaborations), followed by North America and Asia Pacific, Fig. 6. At the country level, Germany is the most frequent partner (~40%), followed by the United States (24%) and the United Kingdom (13%). Fig. 6, below also highlights the especially high-impact collaborations that can be found in publications that Austrian researchers have worked on together with colleagues from Spain, the Netherlands and Sweden (FWCI > 4.0).

Figure 6

Austria's collaborators: main partner countries and associated impact (FWCI), 2020–2024

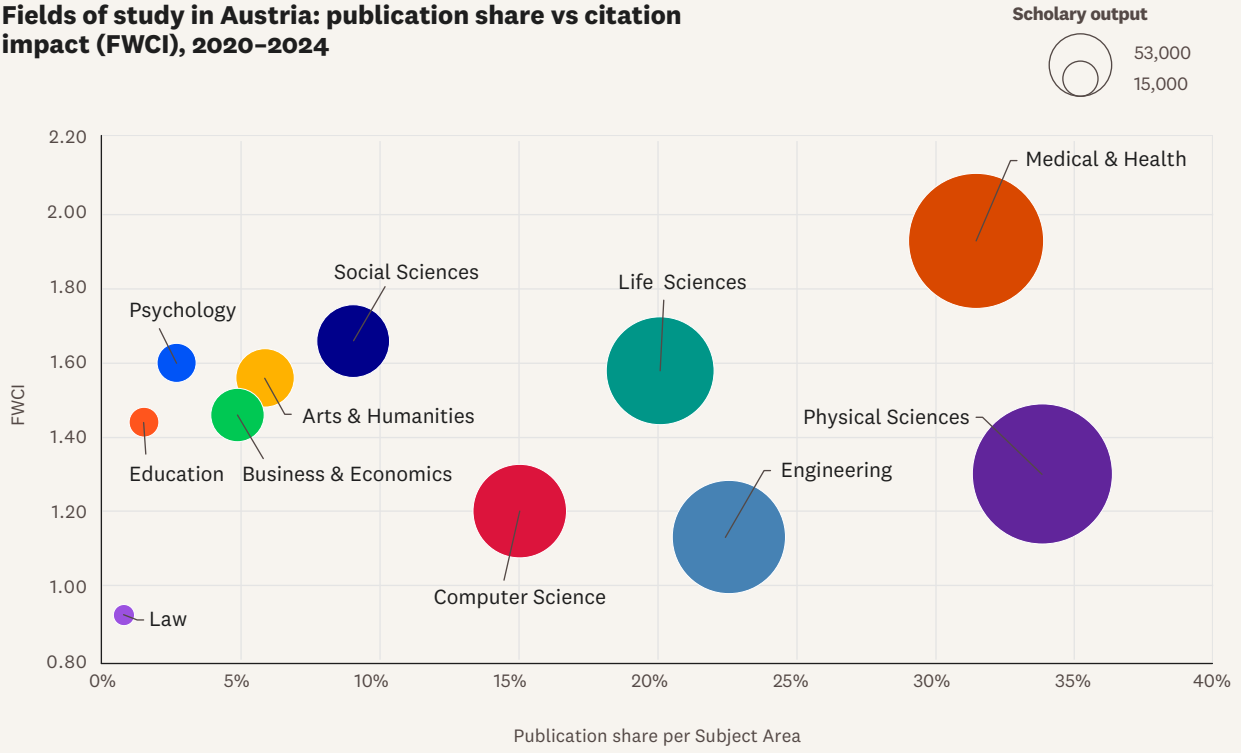


Excellence in research

Austria's high overall citation impact is supported by both a distinctive disciplinary mix and strong field-level performance. Clinical & Health research is the largest discipline and the most impactful (FWCI 1.93), making it a primary driver of Austria's national FWCI, Fig. 7. Social Sciences (FWCI 1.66) and Life Sciences (FWCI 1.58) further lift impact. Engineering and Computer Science contribute high volumes with citation impact still above global averages (FWCI 1.0).

Figure 7

Fields of study in Austria: publication share vs citation impact (FWCI), 2020–2024

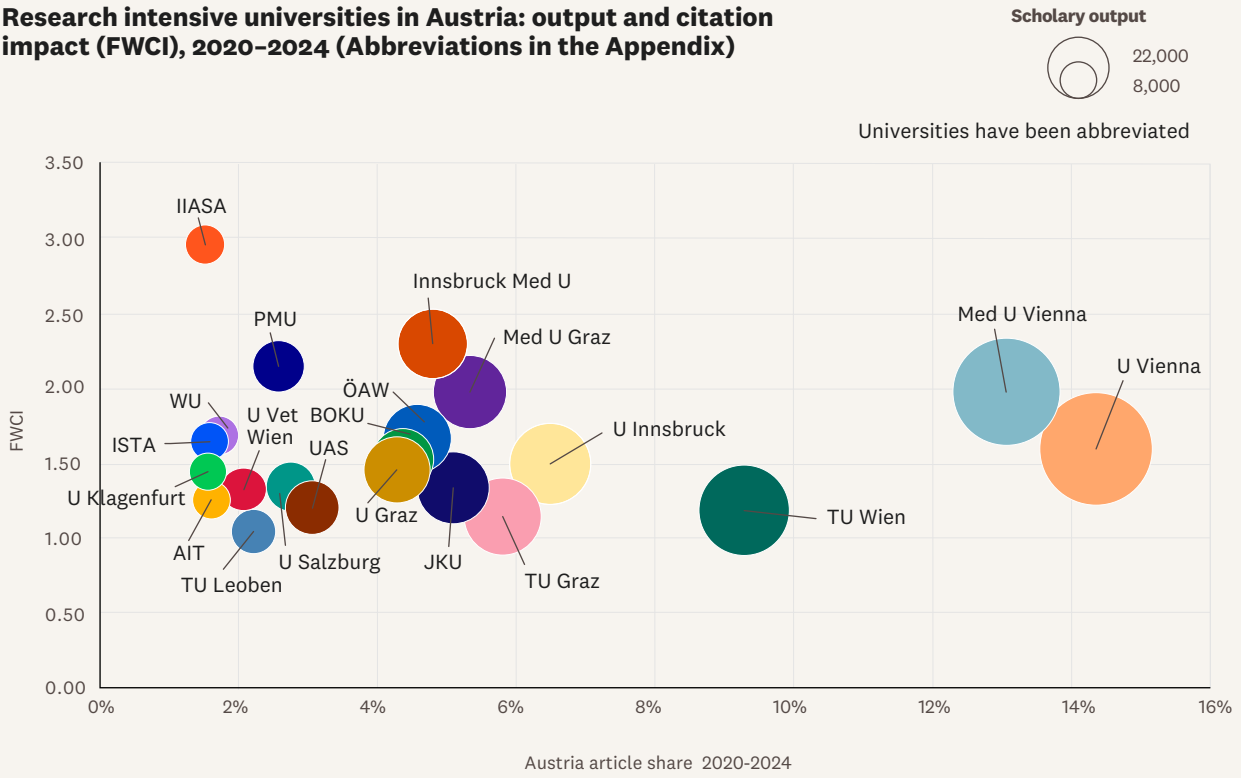


Austria's research system shows a clear division of labor across institutional types. Large comprehensive universities provide scale and disciplinary breadth; the medical universities combine high publication intensity with consistently strong citation performance; and the technical universities and applied institutes are especially prominent in domains where research connects directly to industry and innovation.

Rather than converging on a single "model" of institutional success, different parts of the system lead on different dimensions of knowledge creation and valorization, an asset for a small country that needs both global scientific visibility and credible pathways from research to socioeconomic returns.

Figure 8

Research intensive universities in Austria: output and citation impact (FWCI), 2020–2024 (Abbreviations in the Appendix)

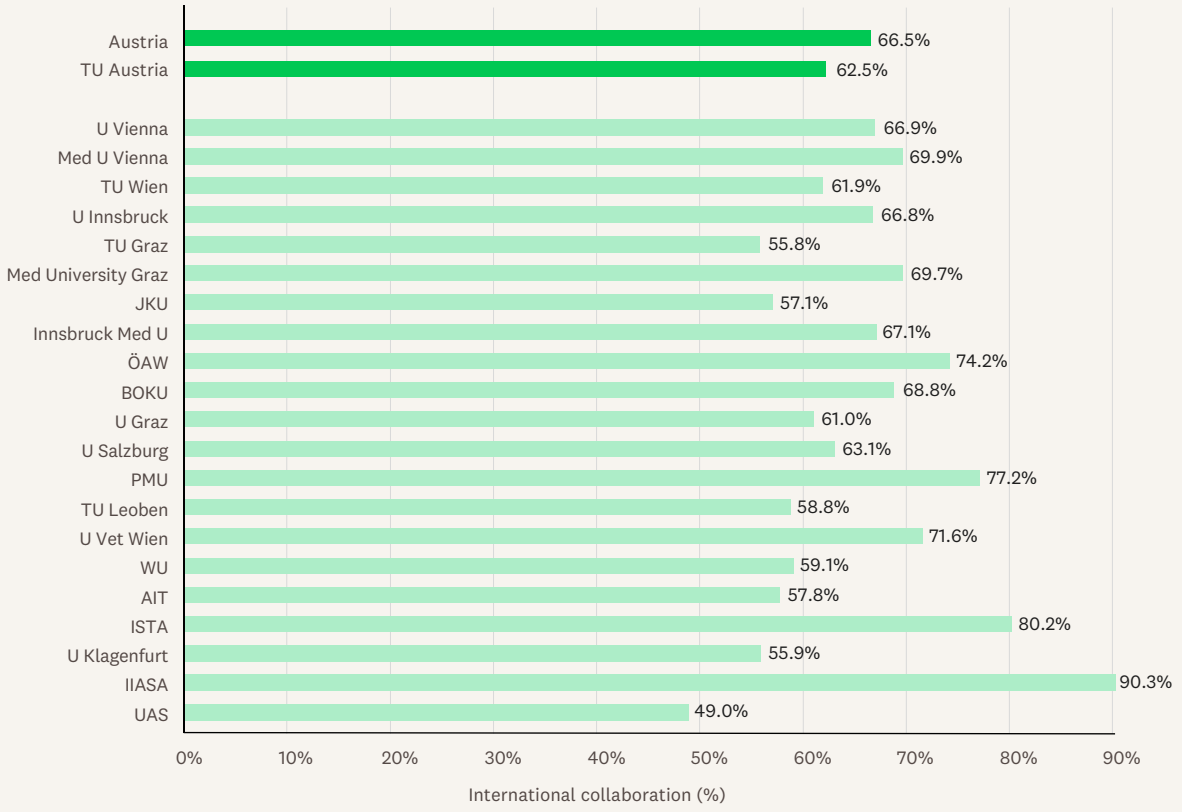


This division becomes visible when examining the top 20 universities by research output, Fig. 8. Publication volume is anchored by the largest comprehensive and medical institutions, with the University of Vienna and the Medical University of Vienna forming the core of Austria's output capacity. TU Wien and the University of Innsbruck sit in the next tier, followed by a wider group of smaller but often more specialized universities and institutes.

Shifting the focus from volume to citation impact changes the picture: performance becomes less driven by institutional size and more by portfolio and field mix. Several medical universities and selected specialized institutions rise to the top on field–weighted citation impact, suggesting that Austria's strongest citation performance is concentrated in areas, particularly clinical, health and life sciences, where international collaboration networks are dense, research questions are globally shared, and publication venues tend to be highly visible.

Figure 9

International co-publications of selected institutions in Austria, 2020–2024

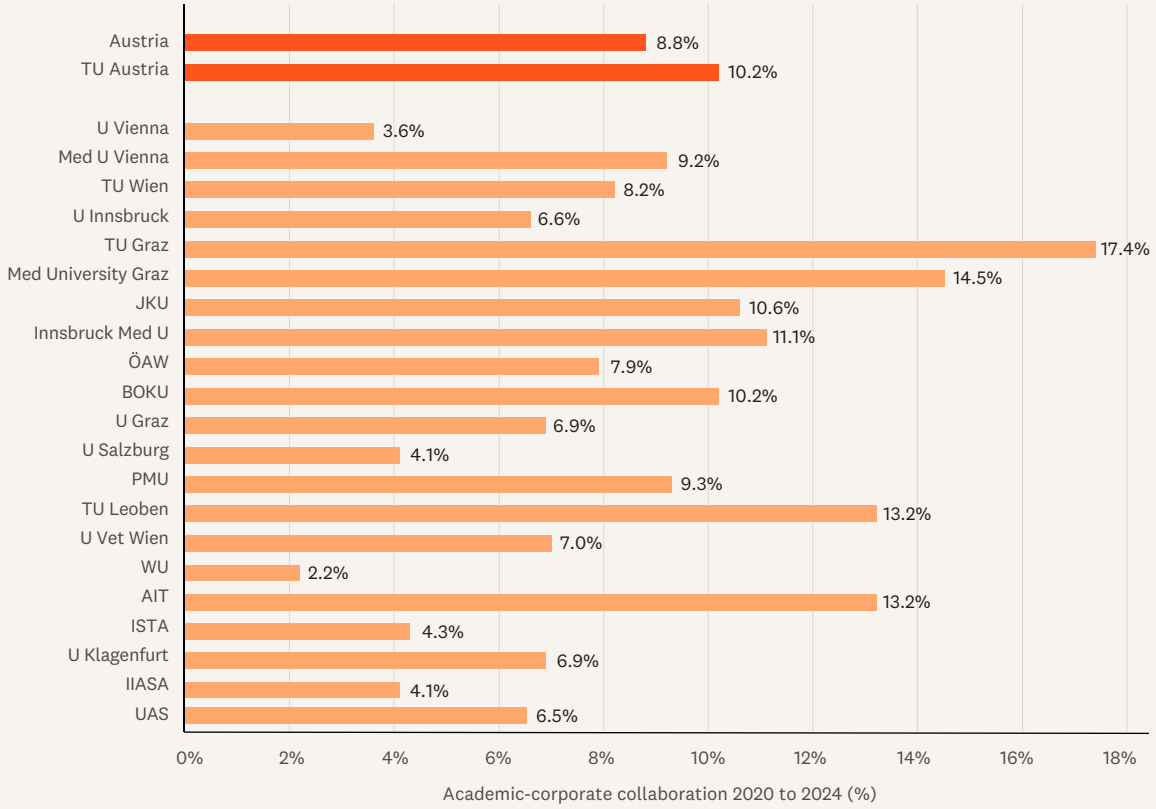


International collaboration is one of the most systemically important drivers of Austrian research performance. Across the top 20 universities, international co-authorship rates are high, and patterns of cooperation align closely with institutional mission, Fig. 9. Research institutes designed to operate as international platforms such as the International Institute of Applied Systems Analysis (IIASA, 90.3%) show the highest rates, underlining how organizational purpose shapes collaboration behavior. Several medical universities also display very high international collaboration levels, consistent with the global nature of biomedical research and the centrality of cross-border partnerships for access to data, infrastructure, and specialist expertise.

Comprehensive universities and technical universities remain strongly international as well, but generally cluster closer to the national average (66,5%), reflecting that they combine internationally oriented fields with domains that are more nationally rooted in topic and collaboration patterns. In analytical terms, Austria's international openness is strongest where research agendas are inherently global and where institutional incentives favor cross-border co-production of knowledge.

Figure 10

Academic–corporate co-publication of selected institutions in Austria, 2020–2024

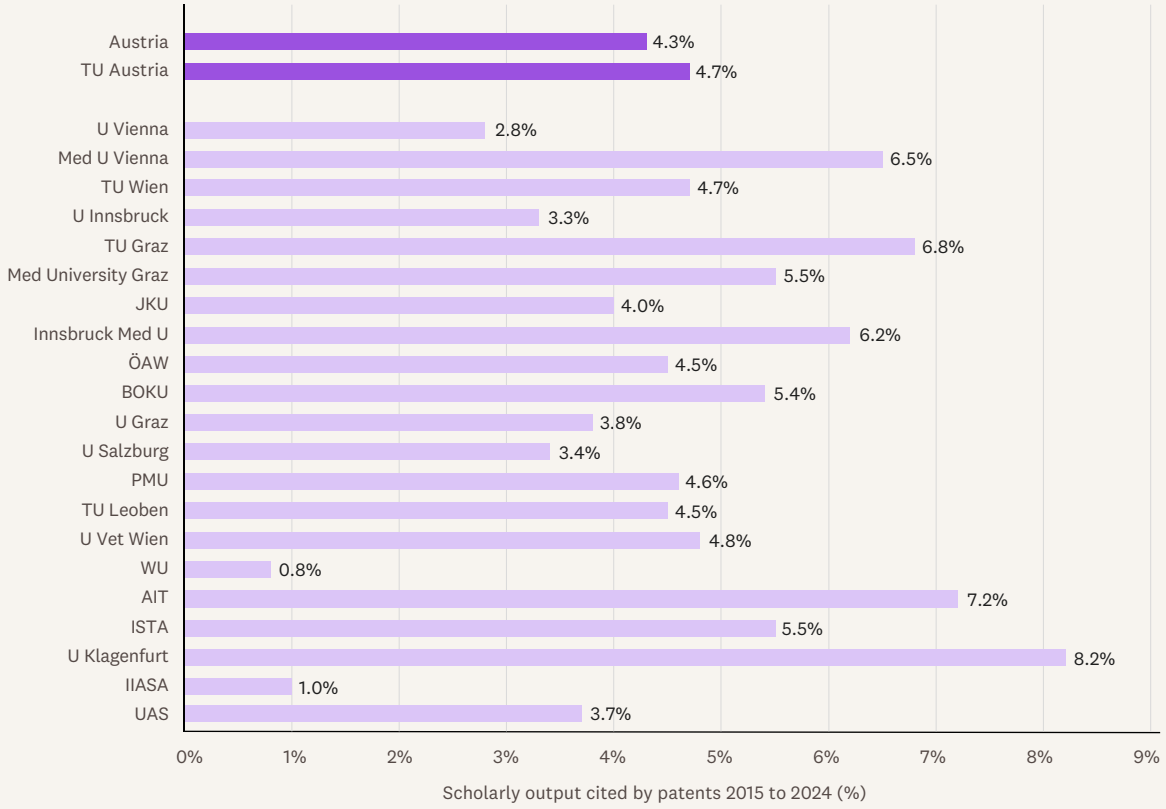


Looking at rates of academic–corporate collaboration shows a different hierarchy, one that highlights Austria's capacity for knowledge transfer through co-authored research with industry Fig. 10. Here, technical universities such as TU Graz (17.4%) display the highest shares of academic–industry co-publications, and applied research organizations also rank prominently, reflecting their mandate to work with corporate partners and translate research into usable technologies. Medical universities also perform strongly in many cases, consistent with translational medicine, clinical partnerships, and links to pharmaceutical and biotech innovation pipelines.

Comprehensive universities on average tend to record lower shares of academic–corporate collaboration, a pattern that is best understood structurally rather than evaluatively: institutions with large portfolios in basic research and in fields where corporate co–authorship is less common, especially parts of the humanities and social sciences, will naturally show lower proportions of academic–corporate collaboration even when their societal impact is substantial.

Figure 11

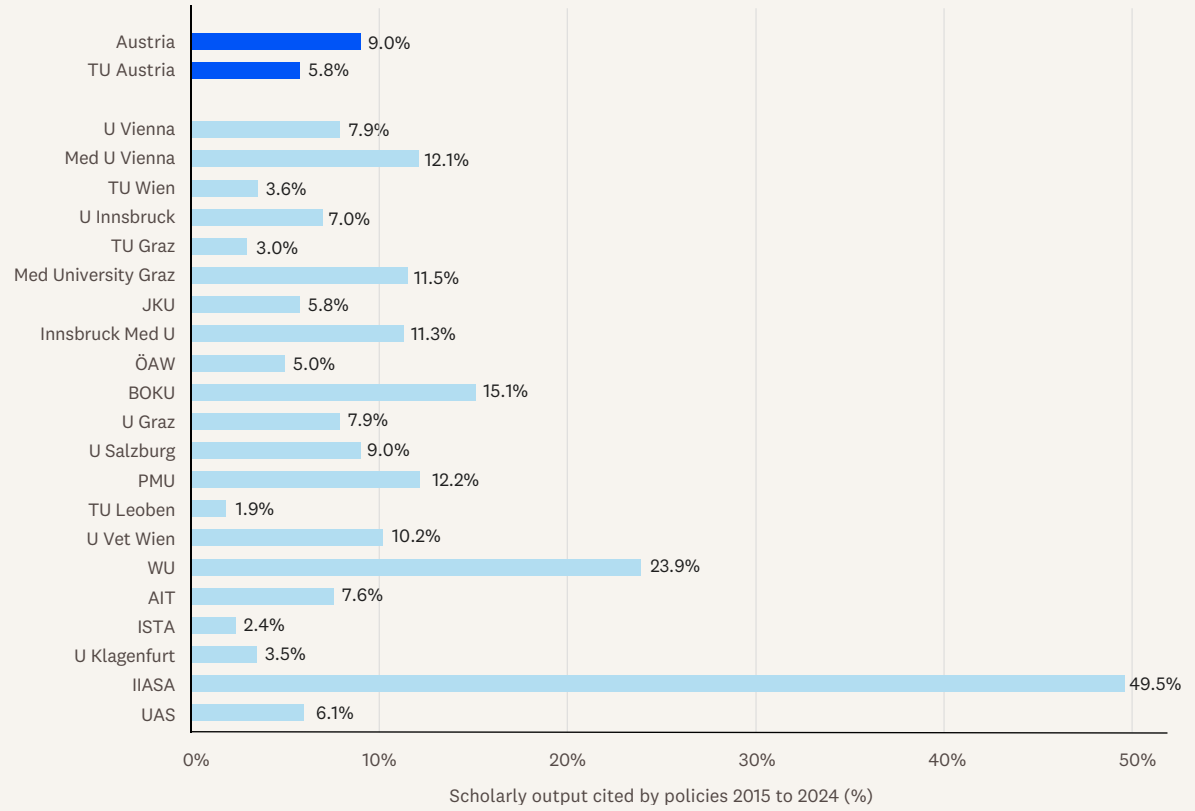
Patent citation levels of selected institutions in Austria, 2015–2024



Patent citation levels add an additional dimension to Austria's innovation profile by indicating where university research is most directly relevant in the development of new technologies, Fig. 11. The distribution again favors institutions such as the University of Klagenfurt (8.2%) with strong engineering, applied science, and technology-oriented portfolios, as well as applied institutes that sit close to industrial R&D needs. Notably, several medical universities such as Medical University of Vienna (9.2%) also appear among the stronger performers, reinforcing the interpretation that Austria's biomedical research contributes meaningfully to patent-relevant knowledge. Comprehensive universities, while central to Austria's overall research volume, tend to show more moderate patent-citation shares, reflecting a broader orientation toward foundational scholarship and diverse disciplinary coverage rather than a concentration in patent-intensive fields. Taken together with the results of academic-corporate collaboration, the patent-citation graphic suggests that Austria's innovation linkages are driven by a combination of engineering and applied technology capacity on the one hand and medically anchored translational research on the other.

Figure 12

Policy impact citation of selected institutions in Austria, 2015–2024



Finally, a look at policy citations shifts the lens from technological translation to instances in which academic research demonstrates marked societal and political relevance, Fig. 12. Here, the highest levels are concentrated in institutions such as the IIASA (49.6%) whose missions align closely with policy–facing research and in universities with strong profiles in economics, public administration, environment, and health. A particularly striking pattern is the emergence of policy–oriented research institutes such as the Vienna University of Economics and Business (WU, 23.9%) as exceptional contributors, indicating that Austria possesses institutional nodes designed explicitly to bridge evidence and decision–making.

Among universities, those with strong social science and economics portfolios perform especially well, reflecting the frequent uptake of such research in policy documents, strategy papers, and advisory processes. Life sciences and medical universities also appear prominently, consistent with the importance of research evidence in health policy, clinical guidelines, public health planning, and regulatory frameworks. Technical universities tend to appear less strongly on this indicator than on patents and corporate collaboration, which points to a division between impact pathways: technical research often manifests in innovation and industrial application, while policy citations capture influence on governance, regulation, and institutional decision–making.

Across these different dimensions, the overarching theme is of Austria's strength in complementarity across institutional types rather than uniform performance on a single metric. Medical universities repeatedly appear as high–impact and internationally connected institutions with strong presence in both innovation– and policy–relevant indicators, suggesting they are key multipliers of Austria's global scientific visibility and societal relevance. Technical universities and applied institutes are central to Austria's innovation interface, translating research into industry collaboration and patent–relevant knowledge.

Comprehensive universities underpin the system's scale and breadth, ensuring a wide research base and a strong national publication footprint while also feeding talent and knowledge into the more specialized parts of the ecosystem. This diversity of institutional roles helps explain how Austria can sustain performance across multiple dimensions without relying on a single dominant university model.

TU Austria

The TU Austria alliance is a strategic partnership between Austria's three public technical universities that aims to consolidate and strengthen the position of engineering and technical sciences within the national and European research, education and innovation landscape. The alliance is formally composed of Vienna University of Technology (TU Wien), Graz University of Technology (TU Graz), and Technical University of Leoben (TU Leoben). These core members coordinate on research initiatives, curricula development, infrastructure projects and strategic positioning toward policymakers and European partners, reflecting a shared commitment to advancing Austria's engineering and applied science capacities. In 2025, the alliance expanded its collaborative framework by welcoming associate members: the Faculty of Engineering Sciences at Johannes Kepler University Linz (JKU), the University of Natural Resources and Life Sciences, Vienna (BOKU), and the Faculty of Engineering Sciences at the University of Innsbruck.

Looking at the individual members, TU Wien combines deep roots in natural sciences and classic engineering disciplines bridging basic to applied research, with growing strengths in digital technologies (AI), quantum technology, and interdisciplinary research like material sciences or circular bioengineering, and it plays a central role in national and international innovation networks. Graz University of Technology is closely integrated with industrial partners and emphasizes applied research in fields such as mechanical engineering, materials and mobility technologies, contributing strongly to academic–industry collaboration. TU Leoben, historically rooted in mining and metallurgy, is highly specialized in raw materials, materials science and process engineering, positioning itself as a key institution for resource-related research and industrial application.

Among the associated members, Johannes Kepler University Linz (JKU) brings a broad academic profile that includes robust engineering and natural sciences alongside social sciences, law and business, enhancing interdisciplinary engagement in technology domains. BOKU University, formally the University of Natural Resources and Life Sciences in Vienna, contributes expertise in environmental sciences, sustainable technologies and bio-based systems, extending the alliance's reach into sustainability-oriented research. And the Faculty of Engineering Sciences at the University of Innsbruck adds strengths in core engineering disciplines tied to the alpine region and contributes to regional and international engineering research collaborations. Together, full and associate members form a collaborative ecosystem that supports Austria's strategic goals in research excellence, innovation and international competitiveness.

Table 1

TU Austria publication volumes, authors and FWCI across the six universities, 2020–2024

TU Austria institution	Scholarly output	Authors	FWCI
TU Wien	15,836	6,322	1.17
University of Innsbruck	11,062	4,694	1.48
Graz University of Technology	9,912	4,221	1.13
Johannes Kepler University Linz	8,698	3,328	1.33
University of Natural Resources and Life Sciences, Vienna	7,448	3,454	1.51
TU Leoben	3,782	1,554	1.03

Note: For bibliometric comparability, the indicators are reported at the level of the six participating universities (core members plus associate-member universities), even where TU Austria participation is organized through specific faculties.

The pattern of inter-institutional collaboration within TU Austria points to an alliance that functions as an integrated research system rather than a loose coordination label, Table 2. Regular co-authorship across the participating universities is more than a bibliometric signal: it indicates active scientific exchange, the development of shared agendas, and an ability to assemble teams that draw on complementary expertise across locations and institutional profiles. This capability is especially valuable in technologically complex and interdisciplinary areas, where progress depends on combining specialized skills, advanced infrastructure and distinct methodological traditions that rarely sit within a single organization. By connecting strengths spanning engineering, the natural sciences, life sciences and application-oriented technologies, TU Austria increases the depth of expertise available to researchers and expands problem-solving capacity in areas that require the integration of multiple knowledge bases. Sustained internal collaboration also implies the presence of organizational scaffolding that makes cooperation easier, supporting joint projects, shared supervision, coordinated use of facilities and more systematic participation in national and international research initiatives, thereby improving efficiency and reducing unnecessary duplication in a relatively small national system.

Table 2

Inter-TU Austria collaborations 2020–2024

TU Austria Inter-collaboration 2020–2024	TU Wien	University of Innsbruck	Graz University of Technology	Johannes Kepler University Linz	University of Natural Resources and Life Sciences, Vienna	TU Leoben
TU Wien	–	158	237	176	248	157
University of Innsbruck	158	–	90	81	173	18
Graz University of Technology	237	90	–	103	93	724
Johannes Kepler University Linz	176	81	103	–	28	44
University of Natural Resources and Life Sciences, Vienna	248	173	93	28	–	51
TU Leoben	157	18	724	44	51	–

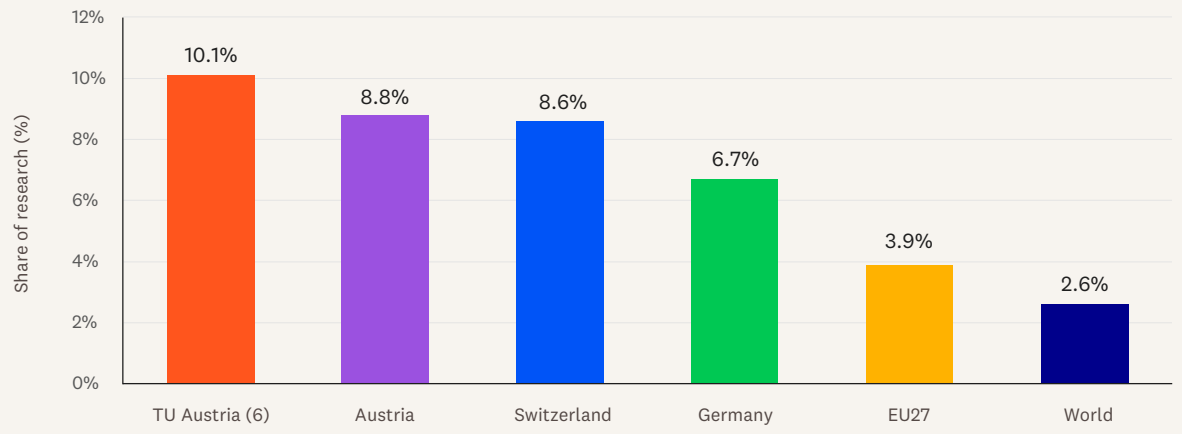
In a higher-education and research landscape of Austria's scale, this internal cohesion is also a mechanism for building the critical mass required to compete internationally. Aligning parts of research agendas, linking disciplinary complements and developing joint approaches to large scientific and technological challenges increases Austria's capacity to engage credibly with research questions that exceed the scope of any single institution, particularly in European and global programs where scale, demonstrable expertise and coordinated access to infrastructure are often decisive. At the same time, cooperation across the alliance can reduce fragmentation in a system where expertise is distributed across multiple sites, enabling more strategic investment choices, selective concentration in areas of comparative strength, and more efficient sharing of capital-intensive facilities, advantages that are especially relevant in engineering, advanced manufacturing, energy systems and materials research. Externally, an alliance structure can also strengthen TU Austria's role as a platform for engagement by providing international partners, funders and corporate actors with a clearer entry point into Austria's technical research landscape than a purely institution-by-institution approach.

This lowers transaction costs for assembling multi-site consortia, supports more complex multi-partner collaborations, and helps link fundamental research capacity with application-driven engineering and sector-specific expertise, making it more likely that scientific advances translate into prototypes, processes and technologies, while reinforcing the wider science-industry interface that underpins national priorities in innovation, competitiveness and societal impact.

Within Austria, TU Austria's relative strength is most visible in how it couples technical research scale with strong **knowledge valorization** pathways. The alliance's largest hubs (notably TU Wien and TU Graz) provide high-throughput technical production, while the other members extend coverage into domains closely tied to application, materials and resource-related engineering, environmental and agro-bio systems, and regionally distributed engineering capability. This portfolio aligns with the indicators that sit closest to translation: Austria shows comparatively high **academic-corporate collaboration**, and technical fields are where cross-sector co-authorship is typically strongest, signaling deep industry embeddedness rather than occasional partnership, Fig. 13.

Figure 13

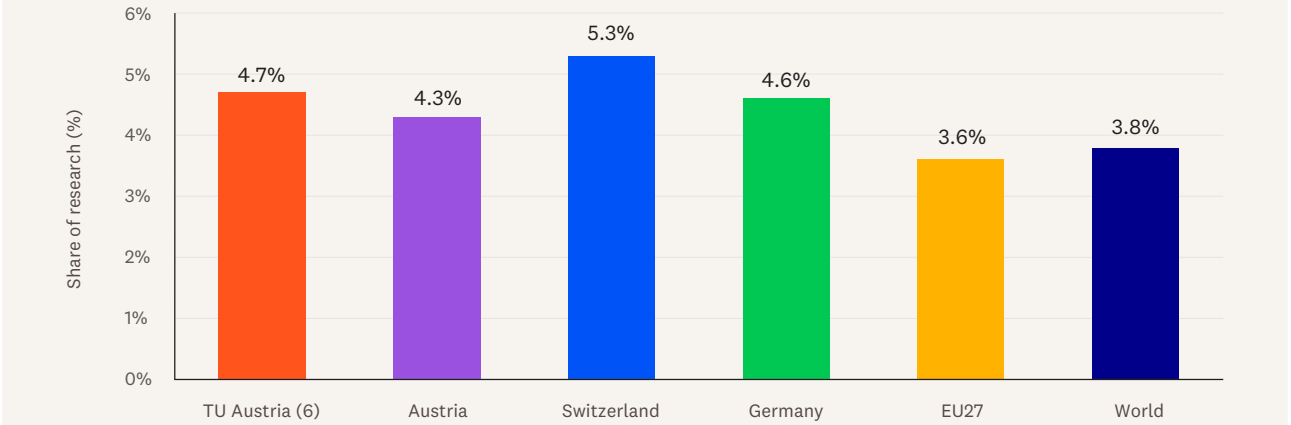
Academic-corporate collaboration levels [%], 2020-2024



Patent-linked signals add a second layer, indicating where research is feeding into invention and technology development, an especially relevant lens for engineering-heavy institutions, Fig. 14.

Figure 14

Share of research cited by patents [%], 2015–2024



Furthermore, Austria's research system is highly internationally collaborative, and TU Austria institutions are central contributors to that outward orientation, both as participants in cross-border teams and as nodes that connect Austria to leading European and global research centers. International cooperation strengthens visibility, accelerates knowledge exchange and improves partner attractiveness in competitive calls, especially where evaluators look for proven capability to work across borders and disciplines.

TU Austria's relative strength can be summarized as **"excellence with pathways"**: a system that produces internationally visible research while maintaining credible routes to application through industry collaboration, patent relevance and entrepreneurial outcomes. The innovation pathway evidence, especially where technical universities are prominent in deep-tech exits, fits the typical European "lag-time" reality of research-based ventures and underscores why technical research capacity is a strategic asset: it can generate innovations that are attractive to global industrial players, even if the payoff takes years. In the European context, where mission-driven funding and technology sovereignty are shaping priorities, TU Austria's combination of scale, connectivity, and translation-oriented signals positions it as one of Austria's most important comparative advantages, nationally consolidating technical capability and internationally acting as a competitive partner within Europe's research and innovation system.

Innovation and industry

Corporations publish academic papers to strengthen innovation and competitive advantage by partnering with universities to access frontier knowledge and expertise, support talent attraction and retention, reinforce IP and patent strategies, build scientific reputation and credibility, and accelerate commercialization and knowledge diffusion, an increasingly common model in Europe where most corporate publications are co-authored with academic partners.

Corporate research activity is therefore a significant component of Austria's innovation system. Table 3 presents the ten most publication-prolific corporate and industry-facing R&D organizations active in scholarly publishing. Importantly, the list is heterogeneous: alongside traditional firms that publish directly (e.g., large industry and technology companies), it also includes "COMET" competence centers and other research, technology and development (RTD) entities that act as collaborative intermediaries between academia and industry and are structurally oriented toward producing co-authored scientific outputs. The results should thus be interpreted as capturing publication-visible engagement with the academic research ecosystem across both conventional corporate actors and mission-driven applied research organizations.

It is important to note, however, that not all innovative industries participate in research in the same way. Many leading Austrian companies generate innovation through applied development, engineering excellence, design, process optimization, or proprietary R&D that does not result in academic publications and is therefore not captured in bibliometric data. Sectors such as energy, advanced manufacturing, construction, consumer goods, and services often innovate primarily through internal R&D, patents, pilot projects, or market deployment rather than through journal output.

Table 3

Austrian corporates by publication output, authors and FWCI, 2020–2024

Corporate institution	Scholarly output	Authors	FWCI
Silicon Austria Labs GmbH	750	348	1.31
AVL List GmbH	625	626	0.94
Steiermärkische Krankenanstaltengesellschaft m.b.H.	514	377	1.16
Austrian Centre of Industrial Biotechnology GmbH	488	330	0.94
Research Center Pharmaceutical Engineering GmbH	390	196	1.04
Kompetenzzentrum Das Virtuelle Fahrzeug Forschungsgesellschaft mbH	287	225	1.15
Klinikum Wels — Grieskirchen GmbH	277	121	2.78
Kompetenzzentrum Holz GmbH	272	139	0.88
voestalpine AG	255	164	0.94
MED-EL Elektromedizinische Geräte GmbH	227	138	1.09

Austria stands out for its exceptionally high level of academic–corporate collaboration, exceeding the EU average and the levels observed in other major research economies, including comparator G7 countries and China, and signaling a research system in which universities, research institutes and industry are tightly integrated, particularly in applied and engineering-oriented fields where basic research and technological development are closely intertwined.

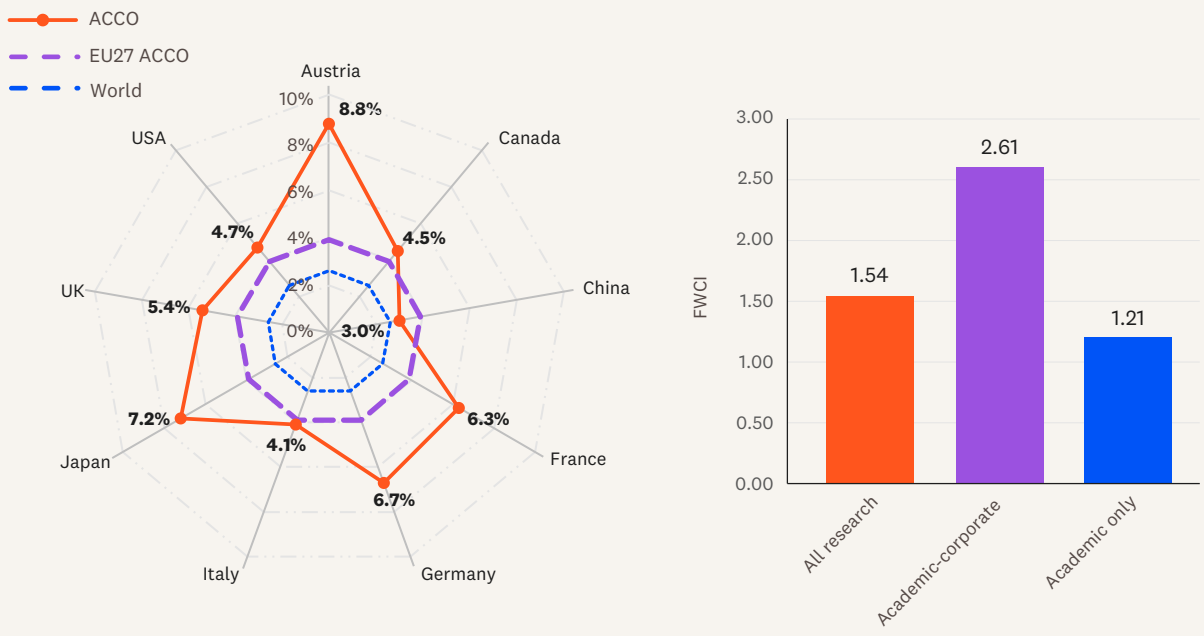
In the publication record, this integration is visible in the scale of cross-sector co-authorship: across 2020–2024, 8.8% of Austrian research output involves collaboration between academic institutions and companies, positioning Austria well above the EU benchmark, Fig. 15 left.

These partnerships are not simply transactional arrangements for funding or applied testing; rather, they reflect institutionalized modes of joint problem-solving that support knowledge exchange and accelerate the diffusion of technological advances into the wider economy.

Importantly, the benefits are also evident in research performance: publications produced through academic–corporate collaboration achieve substantially higher citation impact than research conducted solely within academia, reinforcing the role of industry engagement not only as a pathway to innovation and application, but also as a driver of international visibility and influence for Austria's scientific output. This translation strength is especially important for TU Austria, whose institutional profile is concentrated in engineering, applied science and industrially connected research fields where cross-sector co-publication is structurally most visible.

Figure 15

Left: Academic–corporate collaboration benchmark, 2015–2024
Right: Citation impact uplift by sector collaboration in Austria (FWCI), 2015–2024



A complementary perspective focuses on corporates that appear on publications with at least one Austrian–affiliated academic author and at least one corporate–affiliated author, regardless of whether the corporate partner is headquartered in Austria or abroad, Fig. 15 right. This lens is useful because it highlights a characteristic pattern of Austria's publication ecosystem: firms connected to Austrian research tend to publish predominantly through collaboration with academia, rather than via stand–alone corporate publication activity, so the table functions as a representation of corporates most embedded in Austria's university–industry interface, all of whom have research and development facilities in Austria.

It is also important to note that counts for individual organizations may differ from the chart above because the two views are constructed from different starting points: the earlier chart profiles corporate institutions based in Austria and counts their scholarly output wherever they collaborate globally, whereas Table 4 is built from the Austrian university perspective and captures corporates that co–author specifically with Austrian–affiliated researchers, bringing foreign partners into scope and, conversely, reshuffling the relative prominence of Austria–based corporates depending on the extent to which their publications are co–authored with Austrian institutions versus with partners elsewhere.

Table 4

Corporates doing research with or in Austria (≥1 Austrian author + ≥1 corporate author), 2020–2024

Corporate institution	Country	Scholarly output	FWCI
Infineon Technologies AG	Germany	593	1.48
Silicon Austria Labs GmbH	Austria	589	1.43
EURAC Research	Italy	486	2.26
Austrian Centre of Industrial Biotechnology GmbH	Austria	481	0.95
Steiermärkische Krankenanstaltengesellschaft	Austria	476	1.21
Fresenius AG	Germany	472	3.55
Research Center Pharmaceutical Engineering GmbH	Austria	369	1.05
Siemens AG	Germany	330	1.25
Boehringer Ingelheim RCV GmbH & Co KG	Germany	323	2.33
AVL List GmbH	Austria	319	1.19
Novartis AG	Switzerland	300	3.89
Kompetenzzentrum Holz GmbH	Austria	252	0.91

University entrepreneurship in Austria: Spin-offs and startups

Note: Austria does not currently have a uniform data basis for measuring university-linked startups across institutions and over time. Unlike the bibliometric sections of this report, startup and spin-off data rely on multiple external sources and estimation methods. While cross-checked where possible, these figures should be interpreted as ecosystem-level indicators rather than fully harmonized statistics.

Austria's innovation ecosystem has expanded over the last six years, and universities are increasingly visible within that growth. Official university IP spin-offs have risen over the period, indicating that Austria is not simply producing more companies overall, but is also strengthening the institutional mechanisms that convert research, talent, and university support into commercial activity. This suggests a maturing system of academic entrepreneurship, in which policy support, financing pathways, and knowledge-transfer structures are becoming more effective in moving ideas from the university environment into the market.

The broader startup landscape is much larger than the official university spin-off count alone, of course. Between 2018 and 2024, Austria recorded approximately 2,300 innovative startup foundations. Within that total, an estimated 947 ventures show a measurable university connection, based on founder background, incubation support, or research origin. Of these, around 238 can be classified as research-based startups, and 138 meet the narrower definition of formal university IP spin-offs.[1] Table 5, below, thus shows that universities contribute to startup formation through distinct channels rather than any single mechanism. The first layer isolates university-connected ventures, indicating that universities matter not only through patent licensing and laboratory science but also through founder training, incubators, mentoring, and entrepreneurial networks. The next layer narrows to research-based startups, where the knowledge base of the university is more directly embedded in the venture itself. At the bottom sit officially recognized IP spin-offs, the smallest but institutionally most formal category. Read this way, the table below signifies scale and diversity: universities influence a far larger share of entrepreneurial activity than official spin-off statistics alone suggest.

1 Startup and spin-off metrics are drawn from multiple sources with differing definitions and coverage: (i) official university spin-off counts from uni:data, Federal Ministry of Education, Science and Research (BMBWF), bmbwf.gv.at/unidata [accessed March 2026]; (ii) ecosystem-level indicators from the *Austrian Startup Monitor 2024*, austrianstartupmonitor.at [accessed March 2026]; (iii) further analysis of Austrian Startup Monitor data provided by Karl-Heinz Leitner and Georg Zahradnik, Austrian Institute of Technology (AIT), Vienna; personal communication, 2026; (iv) alumni-foundation and funding data from DACH entrepreneurship rankings and from: NGP Capital. *DACH Startups Decoded 2025*. Helsinki: NGP Capital, 2025 [URL / access date to be confirmed]; and (v) exit and capital-market data triangulated across NGP Capital; Dealroom (app.dealroom.co [accessed March 2026]); PitchBook (pitchbook.com [accessed March 2026]); *Life Science Report Austria 2024*); and FTI-Monitor, Autumn 2024, Council for Research and Technology Development (Rat für Forschung und Technologieentwicklung) (rat-fte.at [accessed March 2026]). As a result, figures should be interpreted as indicative and complementary rather than strictly additive; broader university-linked and alumni-based estimates depend on survey data and modeling assumptions and are not directly comparable to officially reported spin-off counts from Unidata.
The authors thank Christoph Adametz, Karl-Heinz Leitner, and Georg Zahradnik for their contributions to and advice on this section.

Table 5

The contribution of universities to foundations in Austria, 2018–2024

~2.3K Total startups
All innovative Austrian startups (ASM)

822 Venture-capital backed foundations
Secured a Series A or Series & funding round, University or non-University linked (FTI-Monitor, Dealroom)

~947 University-linked ventures (est.)
Startups by institution (calculated using DACH-Rankonal

238 Academic spin-offs (employment- or education-related)
The number is excluding alumni-founded companies (ASM, KH Leitner, AIT)

138 IP-based spin-offs
University self-reported (Wissensbilanz)

Institutional differences become clearer once the focus shifts to individual universities. Research-intensive universities dominate the formal pipeline, with TU Graz and TU Wien leading and WU Wien, BOKU Wien, University of Vienna and University of Innsbruck also contributing substantial numbers. Smaller and more specialized institutions add lower absolute numbers, but they often generate comparatively strong results in deep-tech and life-science niches.

Table 6

Austria university spin-offs, 2018–2024[2]

	2018	2019	2020	2021	2022	2023	2024	Total
Startups total (ASM)	368	385	354	392	255	280	235	2,269
TU Leoben	1	2	2	2	1	1.5	1	10.5
TU Graz	3	7	11.5	12	7	7	5	52.5
TU Vienna	6	5	10	5	6	3	4	39
WU Vienna and BOKU	2	3	5	6	3	3	2	24
Universities Innsbruck / Klagenfurt / Linz / Salzburg / Vienna	6	7	2	11	8	9.5	11	54.5
Others (Medical Universities, Universities of Applied Sciences, Research Institutes)	6	11	8.5	7	7	10	8	57.5
Total Spin-offs	24	35	39	43	32	34	31	238

A second institutional view broadens the lens to the full university-related foundation pipeline. Here the contrast between research-based and alumni-led entrepreneurship becomes especially clear. Technical universities dominate research-linked commercialization, whereas institutions with stronger business or interdisciplinary profiles contribute more through alumni-led startup creation.

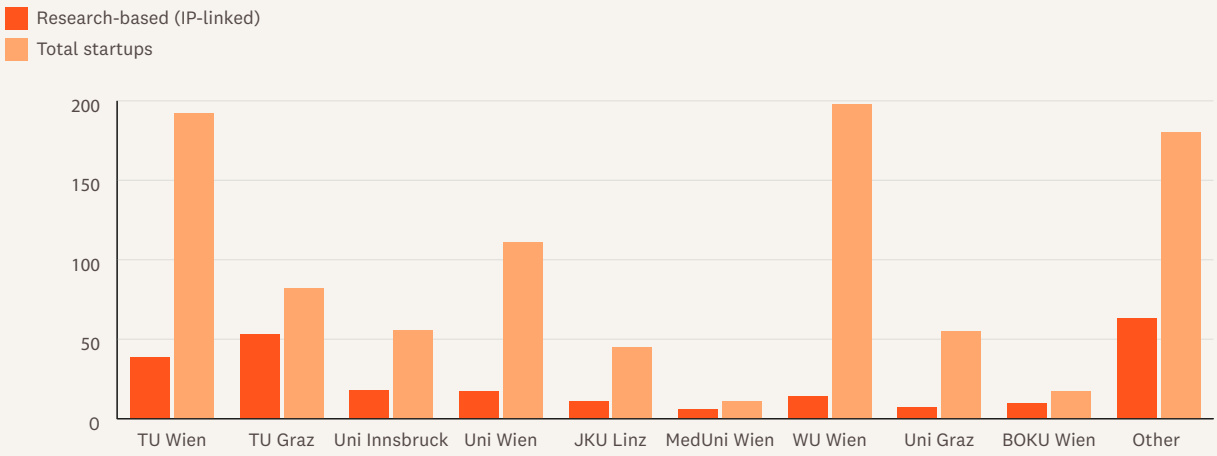
2 Half-values represent spin-offs attributed to more than one university. Data derived from analysis of Austrian Startup Monitor records by Karl-Heinz Leitner and Georg Zahradnik, Austrian Institute of Technology (AIT), Vienna; personal communication, 2025. Underlying dataset: *Austrian Startup Monitor 2024*, austrianstartupmonitor.at [accessed March 2026].

This distinction matters because it shows that universities shape entrepreneurship through different mechanisms: direct commercialization of research and the longer-run effects of education, mentoring, and incubation. The chart below shows that while total startup activity is broadly distributed across Austrian universities, research-based (IP-linked) startups are more concentrated, with TU Wien and TU Graz standing out as leading contributors.

In contrast, institutions such as the University of Vienna and WU Wien generate comparatively more startups overall than research-based spin-offs, reflecting their stronger role in alumni-driven and broader entrepreneurial activity within the system. The point is not that universities create only a few firms; it is that different kinds of firms appear at different stages of the pipeline and are counted under different definitions.

Figure 16

Spin-offs and startups by university, 2018–2024[3]



To assess ecosystem performance beyond formation counts, cumulative data for 2014–2024 track the progression from business registration (alumni entrepreneurial foundations) to the securing of professional venture capital funding. In total, around 3,700 innovative companies were founded in Austria after 2013. Of these, approximately 1,154 startups — about 31% — advanced to an investor validated, high growth stage by securing venture capital financing. While direct international comparison is constrained by definitional and coverage differences across datasets, this benchmark highlights the selectivity of scaling oriented entrepreneurship and illustrates the filtering role of capital markets in identifying ventures with high growth potential.[4]

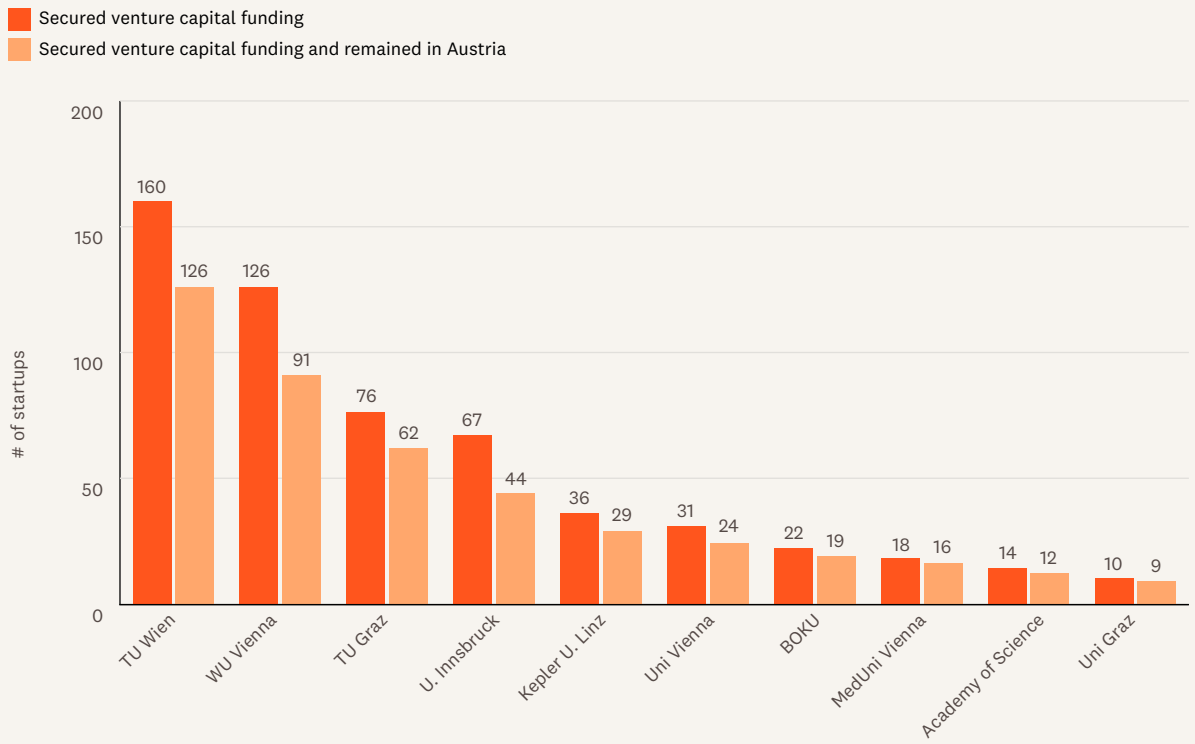
Conversion into VC-backed growth is not evenly distributed across institutions. Graduates of technical and medical universities consistently outperform the national average, often exceeding 50% funding conversion. That pattern is consistent with the characteristics of deep-tech and life-science ventures: they are capital intensive, but they also emerge from research environments with laboratory infrastructure, applied problem-solving, and clearer translational pathways for investors.

3 Research-based spin-off figures derived from analysis of Austrian Startup Monitor records by Karl-Heinz Leitner and Georg Zahradnik, Austrian Institute of Technology (AIT), Vienna; personal communication, 2026. Underlying dataset: *Austrian Startup Monitor 2024*, austrianstartupmonitor.at [accessed March 2026]. Total startup counts calculated from Dealroom data (app.dealroom.co [accessed March 2026]). BOKU figures based on Start-up Award records and BOKU:BASE spin-off listings; counts are conservative owing to the absence of a complete official registry. The 'Others' category is based on: Lemanczyk, S. et al. *Entrepreneurial Impact of Academic Institutions 2025 — DACH-Ranking (Munich Impact Study)*. Munich: Technical University of Munich (TUM), 2025.

4 Based on data from: *Austrian Startup Monitor 2024*, austrianstartupmonitor.at [accessed March 2026], for total innovative startup foundations; and *FTI-Monitor, Autumn 2024*, Council for Research and Technology Development (Rat für Forschung und Technologieentwicklung), Vienna, rat-fte.at [accessed March 2026], for VC-funded startup figures.

Figure 17

University-linked startups securing external venture Capital in Austria (2014–2024)[5]

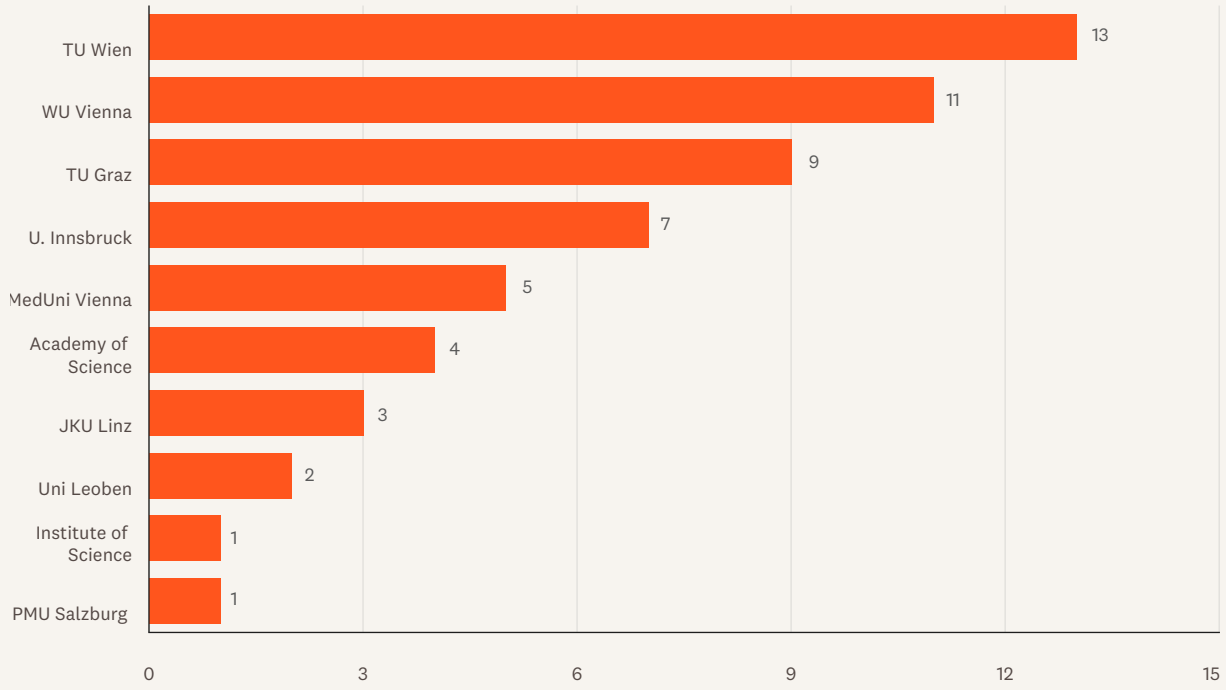


Funding success is only one indicator of ecosystem maturity. Another is whether firms remain anchored in Austria or relocate as they scale. The location comparison suggests that specialized research environments retain founders more often, whereas more business–oriented or digitally focused pathways show greater mobility toward larger international markets. In a small open economy, that outward movement is better interpreted as a feature of scaling than as a simple loss of innovative capacity.

5 The data is an approximation using triangulated data. The purple bar shows the total number of university–affiliated startups that secured venture capital funding, serving as a measure of research 'investability' (source: *FTI–Monitor, Autumn 2024*). The red bar indicates how many of these VC–funded companies remain headquartered in Austria; location data verified against the *Firmenbuch* (Austrian commercial register, Federal Ministry of Justice, justiz.gv.at/firmenbuch). The gap between the two bars reflects headquarter migration abroad.

Figure 18

Successful exits (M&A / IPO) since 2014[6]



The final stage of the startup lifecycle is exit, typically through acquisition or an IPO. Fig. 18 shows that exit activity is concentrated among technical universities, especially in engineering–intensive fields. Their advantage likely reflects the attractiveness of patented technologies and highly specialized solutions to established industrial buyers.

Exit totals nevertheless need to be read with caution. Research–based ventures often require seven to ten years to mature, so current exit counts reflect earlier cohorts of firms. The rise in spin–off formation after 2021 is therefore more likely to feed through into exit volumes later in the decade than immediately. Taken together, the figures point to a maturing, selective ecosystem. Austria's universities contribute at multiple stages: they generate founders, create research–based ventures, improve access to capital, and increasingly support a reinvestment cycle in which successful founders return money, expertise, and networks to new firms. That cumulative process strengthens Austria's position as a research–driven startup ecosystem with growing international credibility.

Austria currently counts two officially recognized unicorns linked to the Vienna talent ecosystem, alongside a growing number of notable academic origin exits across life sciences, digital platforms, and advanced engineering. Beyond individual success stories, a broader structural effect is becoming visible: successful founders reinvest capital, expertise, and networks into new ventures and university linked initiatives. This reinvestment cycle strengthens mentoring capacity, improves access to investors, and reinforces Austria's position as a research driven startup ecosystem with growing international credibility.

6 The data is an approximation using triangulated data. The purple bar shows the total number of university–affiliated startups that secured venture capital funding, serving as a measure of research 'investability' (source: *FTI–Monitor, Autumn 2024*). The red bar indicates how many of these VC–funded companies remain headquartered in Austria; location data verified against the *Firmenbuch* (Austrian commercial register, Federal Ministry of Justice, justiz.gv.at/firmenbuch). The gap between the two bars reflects headquarter migration abroad.

Key technologies

Research in key technologies has become a central pillar of economic development and long-term competitiveness across advanced economies. Countries increasingly prioritise strategic technology domains, such as digital, green, and enabling technologies, as foundations for productivity growth, industrial resilience, and societal wellbeing. Within this context, both the European Union and Austria have placed targeted investment in key technologies at the heart of their research and innovation strategies, recognizing their role in shaping future prosperity and technological sovereignty.

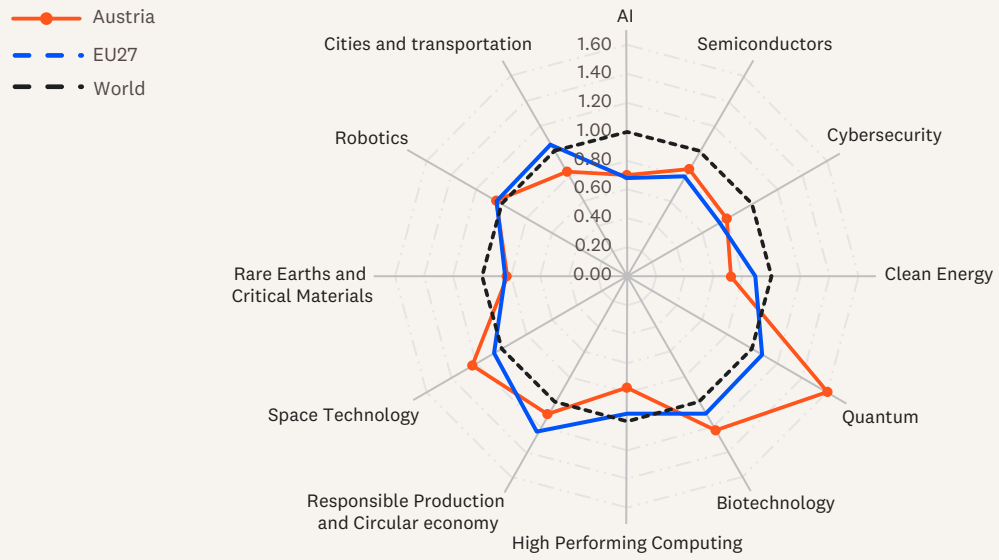
Fig. 19 shows Austria's Relative Activity Index (RAI) across selected key technologies, indicating where national research activity is concentrated compared with the global average. Values above 1 signal areas of relative specialization, while values below 1 indicate fields where Austria's research presence is less pronounced.

Austria displays clear strengths in a subset of key technologies, where research activity exceeds the global benchmark. These areas reflect long-standing scientific capabilities and strong links between academia, applied research institutes, and industry. In several of these technologies, Austria combines above-average research intensity with high citation impact, reinforcing their strategic relevance.

By contrast, in some globally prominent technologies Austria's research activity remains closer to or below the world average, suggesting a more selective engagement rather than broad-based coverage across all priority fields. This pattern points to a research system that emphasizes depth and focus over scale, concentrating resources and expertise in areas of comparative advantage.

Figure 19

Relative research activity in key technologies, Austria and EU27, 2020–2024



Deep dive into four key technologies: AI, quantum, biotech and critical materials

The next four profiles (artificial intelligence, quantum technologies, biotechnology, and rare earths and critical materials) summarize Austria's position in strategic technology areas using the same lens each time: research volume and citation impact, academic–corporate collaboration, research cited by patents, and international collaboration.

Together, they show a differentiated portfolio: an established AI footprint with strong institutional leaders and knowledge–transfer signals (Fact Sheet 1); a smaller but high–quality, highly international quantum field (Fact Sheet 2); a significant biotechnology pillar with clear translation pathways (Fact Sheet 3); and a more specialized critical materials focus linked to sustainability and industrial relevance (Fact Sheet 4).

Fact sheet 1. Artificial intelligence

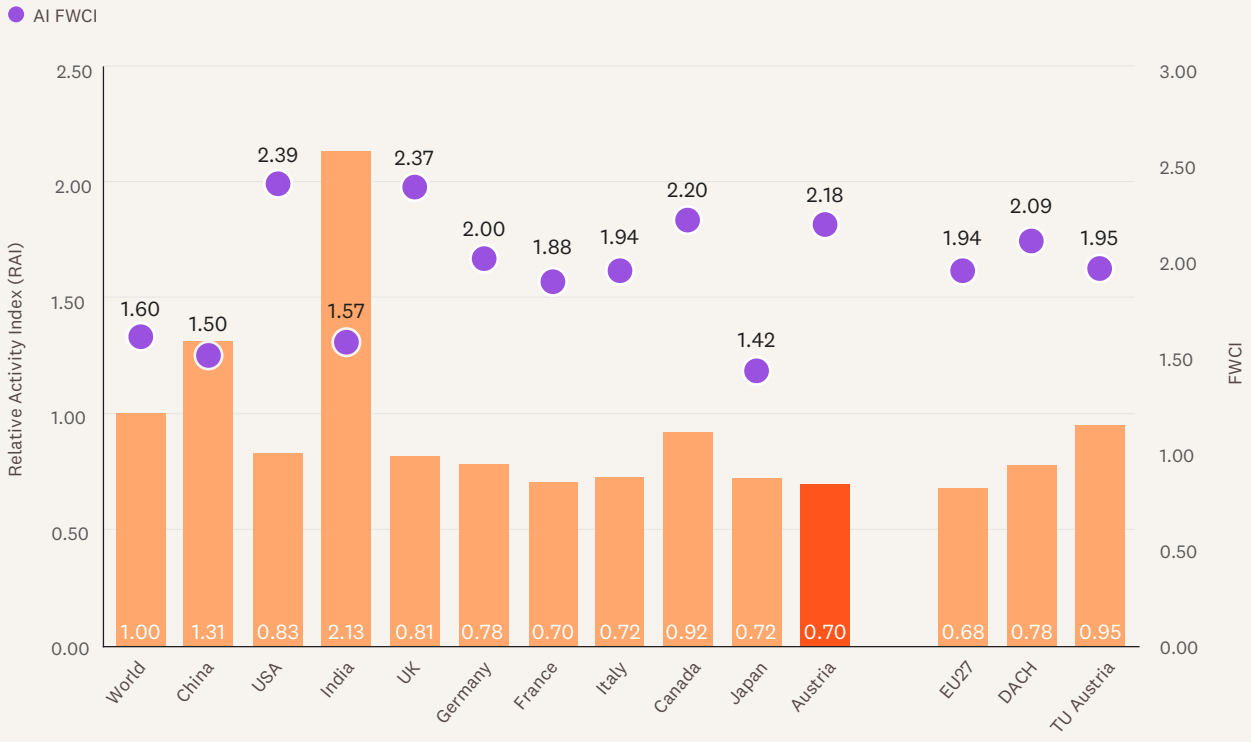
Volume and citations

Austria's artificial intelligence research activity, measured through RAI, is broadly aligned with the global baseline and close to the EU average. While Austria is not among the most highly specialized AI producers globally, its positioning reflects a selective but established engagement in the field.

The most prolific institutions are TU Wien with 1,032 publications and FWCI 1.87. Graz University of Technology comes second with 724 publications and FWCI 1.86 and third is the Medical University of Vienna with 547 papers and FWCI 2.91.

Globally, the AI research landscape is dominated by China, which holds a substantial 32% share of global scholarly output. The U.S. and the EU each have a global share of approximately 15%, while India has emerged as a significant contributor with a 14.8% share, and the U.K. follows with 5%.

Figure 20

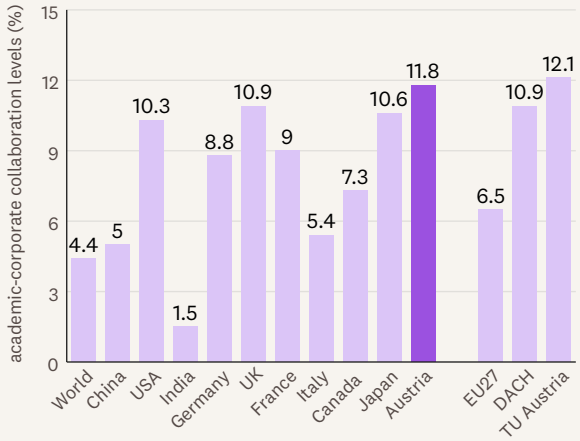


Academic–corporate collaboration

Austria, Germany and Japan have the highest level of academic–corporate collaboration when it comes to AI research.

Top corporate collaborators working with Austria in AI research are also the same found to be the main collaborators with TU Austria. These are: Silicon Austria Labs GmbH, German Infineon Technologies AG and Siemens AG, Alphabet Inc., Microsoft Corp. and IBM, Austrian AVL List GmbH and Dutch Koninklijke Philips N.V. among others.

Figure 21

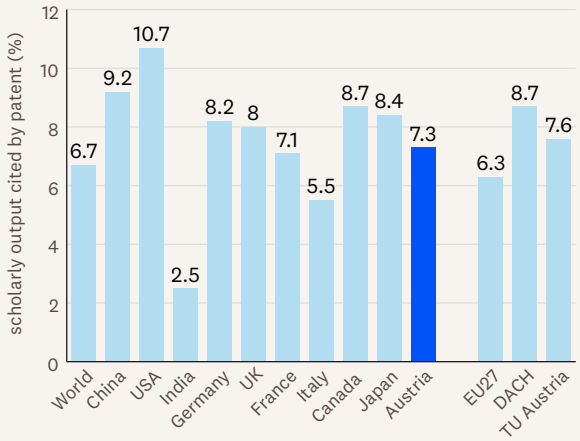


Research cited by patents

The U.S. leads in AI research cited by patents, with 10.7% of its output receiving patent citations, followed by China at 9.2%. Austria, at 7.3%, is above EU27 (6.3%).

Higher numbers of scholarly output cited by patents comes from Graz University of Technology and TU Wien, while among corporates we find IBM and Siemens represented.

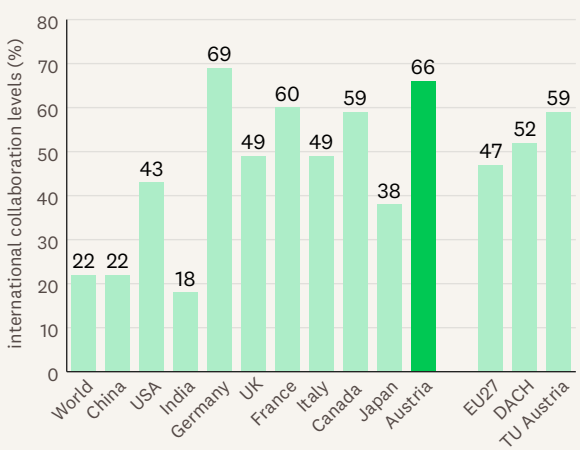
Figure 22



International collaboration

Germany is the largest international collaborator with almost 1,500 co-authored publications, following by the U.S. (950) and U.K. (710). Top international institutions collaborating with Austria in AI are Technical University of Munich (165), Ludwig Maximilian University of Munich (Germany) (133), and University of Oxford (132). Top international institutions collaborating with TU Austria in artificial intelligence are University of Oxford (96), New York University (79) and Technical University of Munich (56).

Figure 23



Fact sheet 2. Quantum technologies

Volume and citations

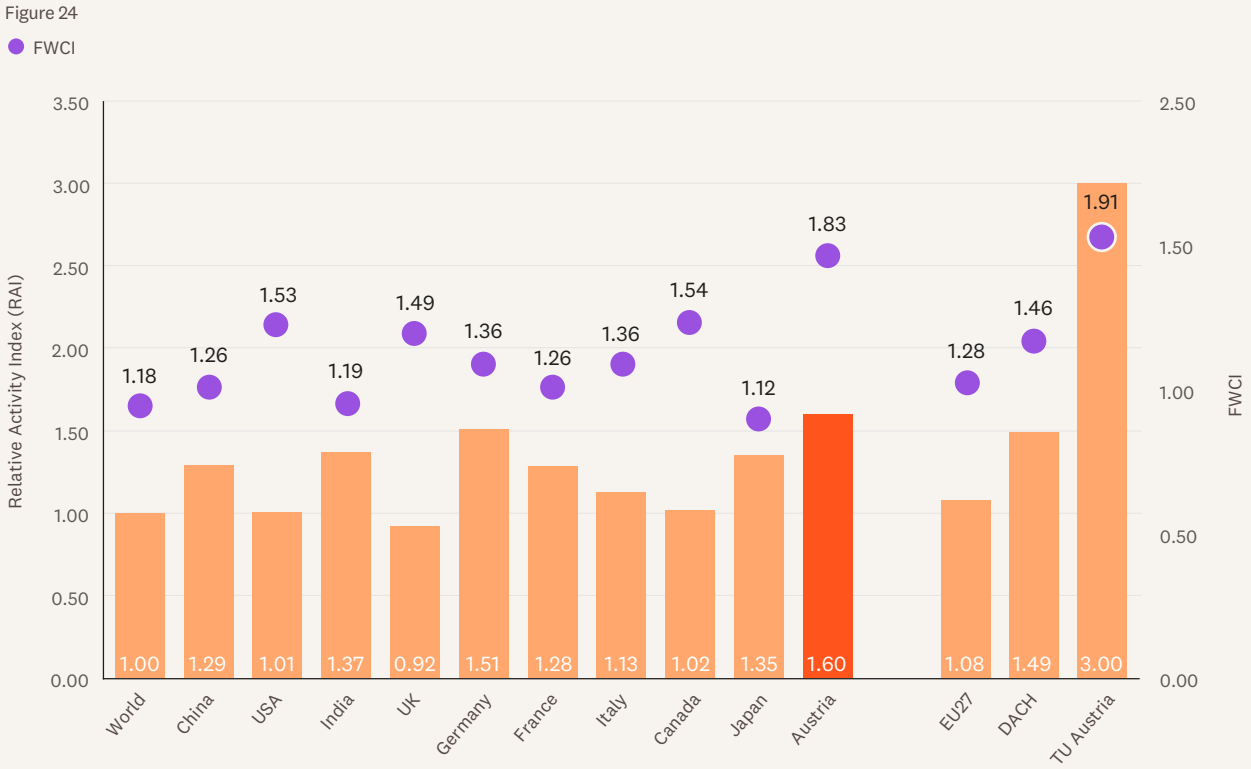
Quantum technologies research in Austria represents a focused and high quality segment of the national research portfolio. Activity spans core areas such as quantum information, sensing, communication, and computing, building on longstanding scientific strengths.

We found about 2,100 papers equivalent to 1.2% of Austria research related to quantum technologies; this represents a higher share than the averages for the world (0.8%) and also higher than EU average which is also on par with global average (0.8%). Austrian papers are also higher cited than the comparator countries and regions shown in the chart.

The most prolific institution is the Austria Academy of Science (ÖAW) with 667 publications and FWCI 2.26, followed by the University of Innsbruck with 507 publications and FWCI 2.45, and third is the University of Vienna with 488 papers and FWCI 1.69.

Globally, the quantum technology research landscape is dominated by China, which holds a substantial 32% share of global scholarly output. The EU has a global share of approximately 25% and the U.S. 18.5%.

Figure 24



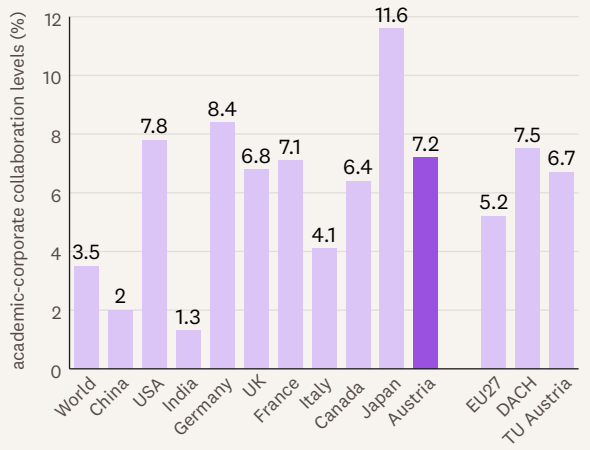
Academic–corporate collaboration

Academic–corporate collaboration in quantum technologies is present but more selective than in AI, reflecting the early stage and science driven nature of the field.

Japan has the highest level of academic–corporate collaboration when it comes to quantum technology research.

Top corporate collaborators in Austria research are IBM, Infineon Technologies Austria AG and Microsoft Corp. Silicon Austria Labs GmbH is also showing promising contribution to research in this field.

Figure 25

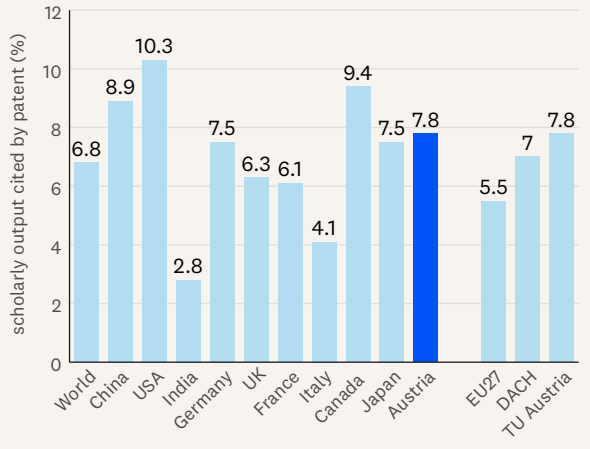


Research cited by patents

Patent citations highlight emerging pathways from fundamental research to applied technologies.

The USA leads in research cited by patents, with more than 10% of its output receiving patent citations, followed by Canada and China. Austria is well ahead of EU average with 7.8% of its quantum technologies research being cited by patents with highest numbers of scholarly output cited by patents has the participation of the Austrian Academy of Science (ÖAW).

Figure 26



International collaboration

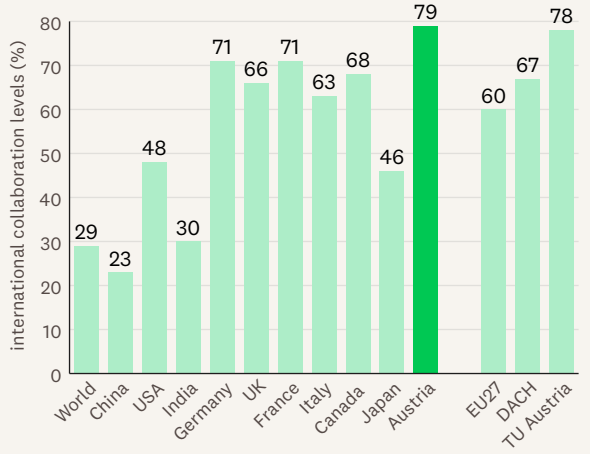
Quantum research involving Austria is highly international, with collaboration centered on a small number of leading research countries and institutions. This pattern reflects the global concentration of expertise in quantum science.

Austria research in quantum technologies is highly international with 79% of all its research involving at least one foreign partner (higher than the average for all Austria research which stands at 66.5%). We also see that this level of internationalization is higher than all the other countries shown in the charts (which include all the G7 and China).

Germany is the largest international collaborator of Austria in this space, partnering with in about a third publications. The U.S. follows (20% co–publications with Austria), and then the U.K. (approx. 12%)

Top international institutions collaborating with Austria are the TU Munich and the Swiss Federal Institute of Technology (ETH) Zurich.

Figure 27



Fact sheet 3. Biotechnology

Volume and citations

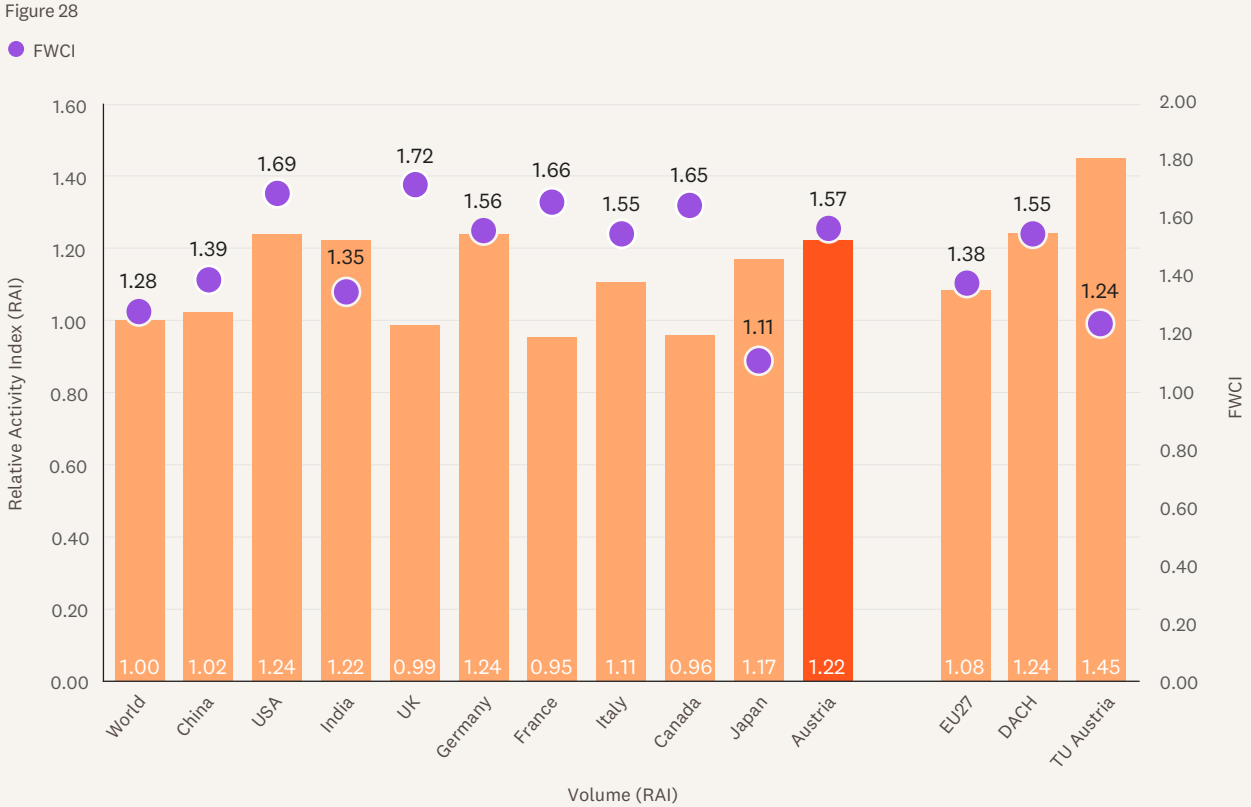
Biotechnology research forms a significant component of Austria's life sciences landscape. Activity is driven by both medical and biological research, with Austria contributing to internationally visible research areas despite its smaller system size.

We found about 2,700 papers equivalent to 1.6% of Austria research related to biotechnology this represents a higher share than the averages for the world (1.3%) and higher than EU average (1.4%). Austria papers are also higher cited than EU average, but U.S. and U.K. emerge with the highest citation impact, followed by France and Canada.

The most prolific institution is the Medical University of Vienna with 500 publications and FWCI 2.47, followed by the University of Natural Resources and Life Sciences, Vienna (BOKU) with 400 publications and FWCI 1.30. Next is the University of Vienna with 280 papers and FWCI 1.68.

Globally, China and the EU are the two blocks with highest volume of publications in this space, each holding approx. 25% share of global scholarly output. The U.S. follow closely with 23% global share and with higher citation impact than EU and China.

Figure 28



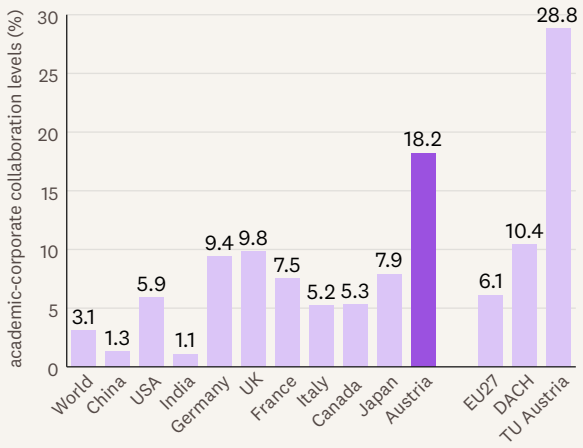
Academic–corporate collaboration

In biotechnology, academic–corporate collaboration supports knowledge transfer, particularly in medically and commercially relevant areas.

Austria has highest level of academic–corporate collaboration when it comes to biotechnology research than any of the G7 and other regions shown.

Top corporates collaborating with Austria in biotechnology is the Austrian Centre of Industrial Biotechnology GmbH, following by German Boehringer Ingelheim GmbH, and then Novartis.

Figure 29



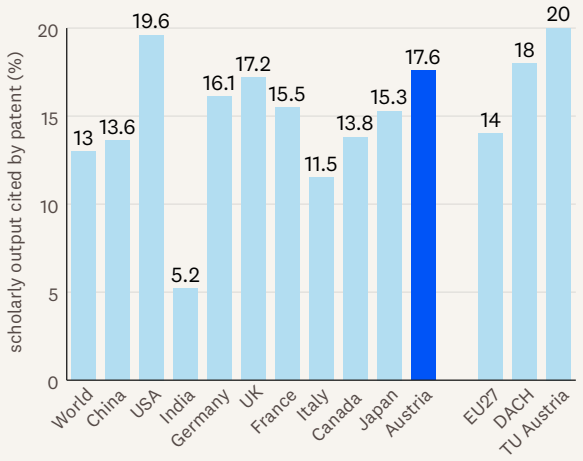
Research cited by patents

Patent citations indicate that a portion of Austrian biotechnology research feeds directly into innovation pipelines.

Patent citations are particularly high in this field, and the U.S. has the highest levels, with Austria in second place, well ahead of the EU average.

The highest scholarly output cited by patents comes from research by the University of Natural Resources and Life Sciences, Vienna (BOKU).

Figure 30

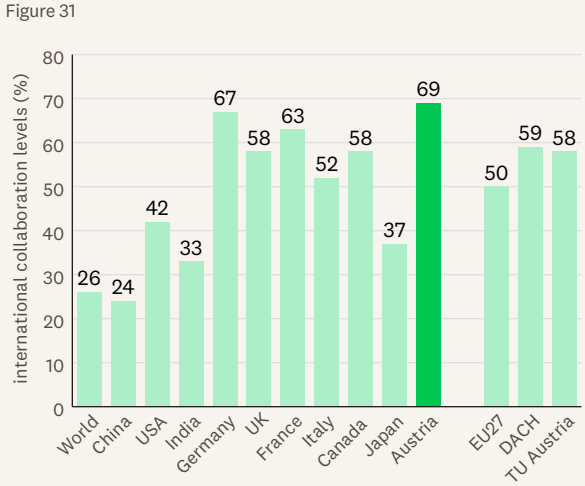


International collaboration

Biotechnology research in Austria is strongly international, with collaboration concentrated among leading European and global research partners. This reflects the globalized nature of biomedical and biotechnological research. Germany is the largest international collaborator of Austria in this space, partnering with in about a quarter of its publications, followed by the U.S. (21% co–publications with Austria), and then the U.K. (approx. 12%).

Top international institutions collaborating with Austria is the Institut national de la santé et de la recherche médicale (INSERM), followed by Harvard University and LMU Munich.

Figure 31



Fact sheet 4. Rare earths and critical materials

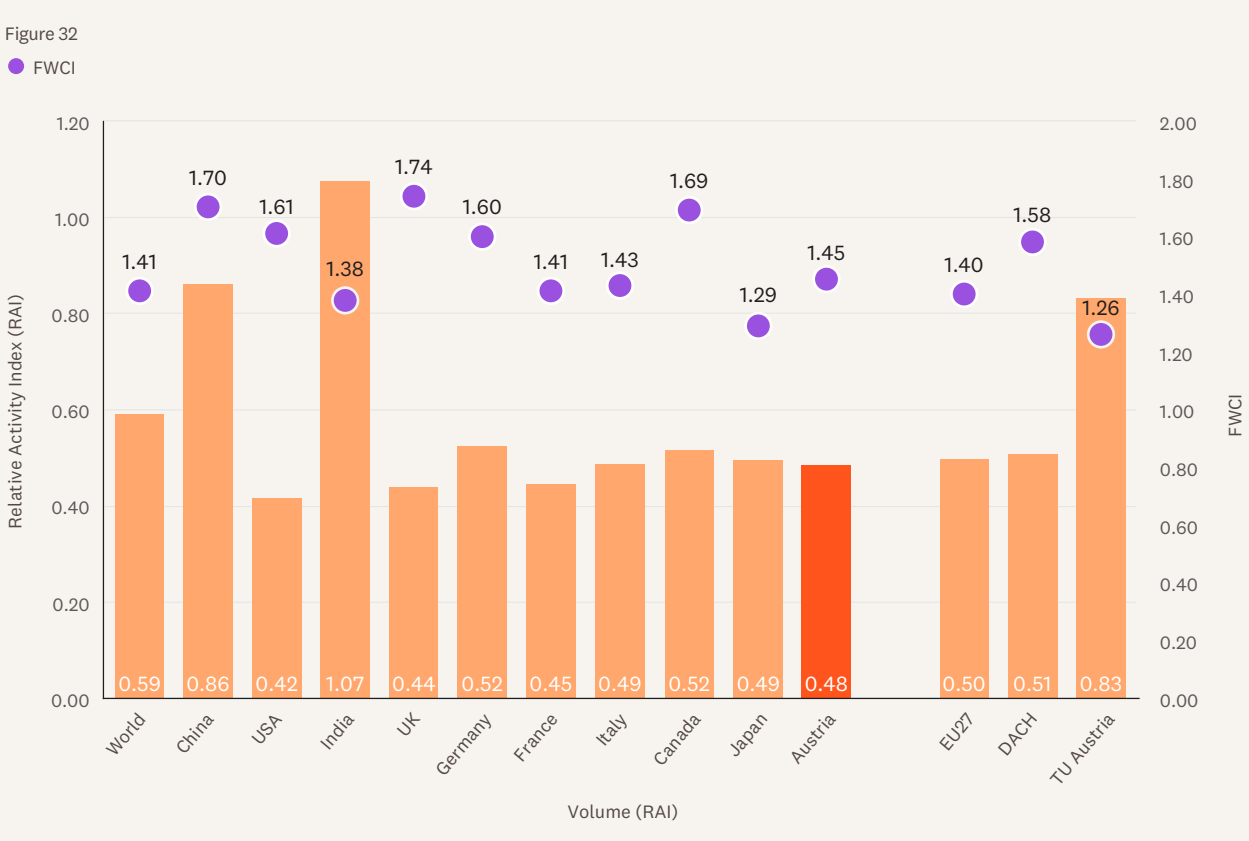
Volume and citations

Research on rare earths and critical materials in Austria is relatively specialized and closely linked to strategic themes such as sustainability, energy transition, and resource security. Activity reflects Austria's strengths in materials science and applied research. We found about 1,060 papers equivalent to 0.6% of Austria research related to rare earths and critical material. This represents a lower share than the averages for the world (0.8%) but on par with EU average (0.6%).

The most prolific institutions are the TU Leoben with 180 publications and FWCI 1.17 followed by TU Wien with 153 publications and FWCI 1.13 and third is Graz University of Technology with 121 papers and FWCI 1.37.

Globally, the rare earths and critical material research landscape is dominated by China, which holds a substantial 36% share of global scholarly output. The EU has a global share of approximately 19%. The U.S. holds a 13% share global share while India has emerged as a significant contributor with 12.7%, almost the same than the US.

Figure 32

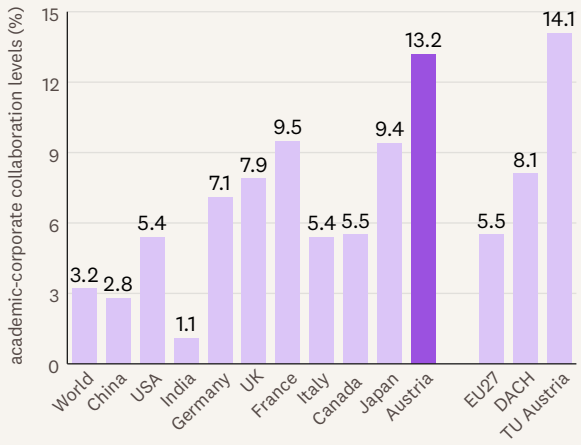


Academic–corporate collaboration

Academic–corporate collaboration plays a visible role in this field, consistent with its applied and industrial relevance. Austria is again showing the highest level of academic–corporate collaboration compared to the other countries shown.

Top corporate collaborators working with Austria universities in this area are voestalpine AG, Research Center Pharmaceutical Engineering GmbH, and the German Infineon Technologies AG.

Figure 33



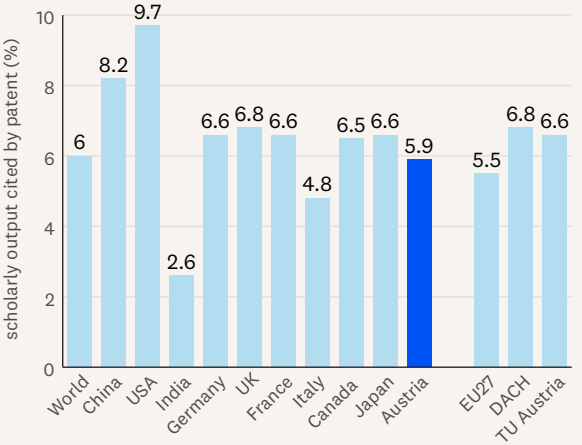
Research cited by patents

Patent citations suggest pathways from research into technologies relevant for energy systems and advanced manufacturing.

The U.S. leads in rare earths and critical materials research cited by patents, with almost 10% of its output receiving patent citations, followed by China at 8.2%. Austria with 5.9% is a little above EU average.

Higher numbers of scholarly output cited by patents comes from TU Wien, Graz University of Technology and TU Leoben.

Figure 34



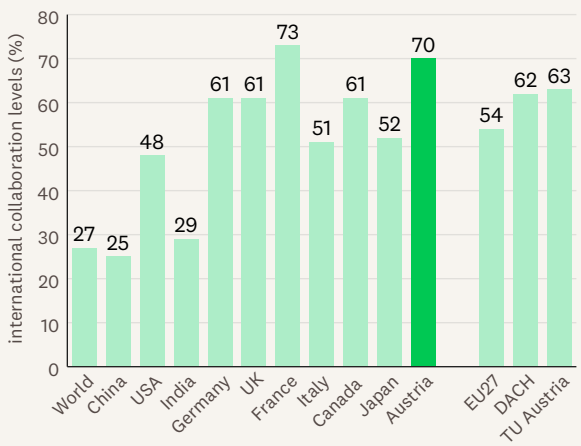
International collaboration

International collaboration is a defining feature of Austria's research on critical materials, with partnerships reflecting the global nature of supply chains and resource related research challenges.

Again, we find that Germany is the largest international collaborator of Austria, co–authoring about 20% of research with Austria in this field. The U.S. and U.K. both follows each with about 11% co–publications with Austria.

Top international universities collaborating with Austria are Swiss Federal Institute of Technology Zurich, followed by the Czech Academy of Sciences and RWTH Aachen University

Figure 35

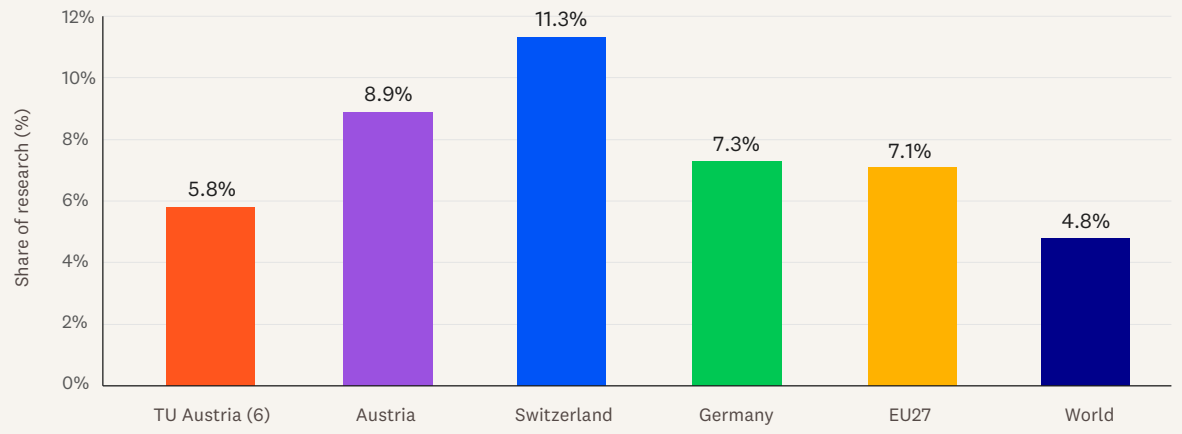


Societal impact

Societal impact is captured through two complementary lenses: research cited in policy documents (policy uptake) and research aligned to Sustainable Development Goals (SDG “portfolio signatures”), Fig. 36.

Figure 36

Share of research cited by policy documents, 2015–2024



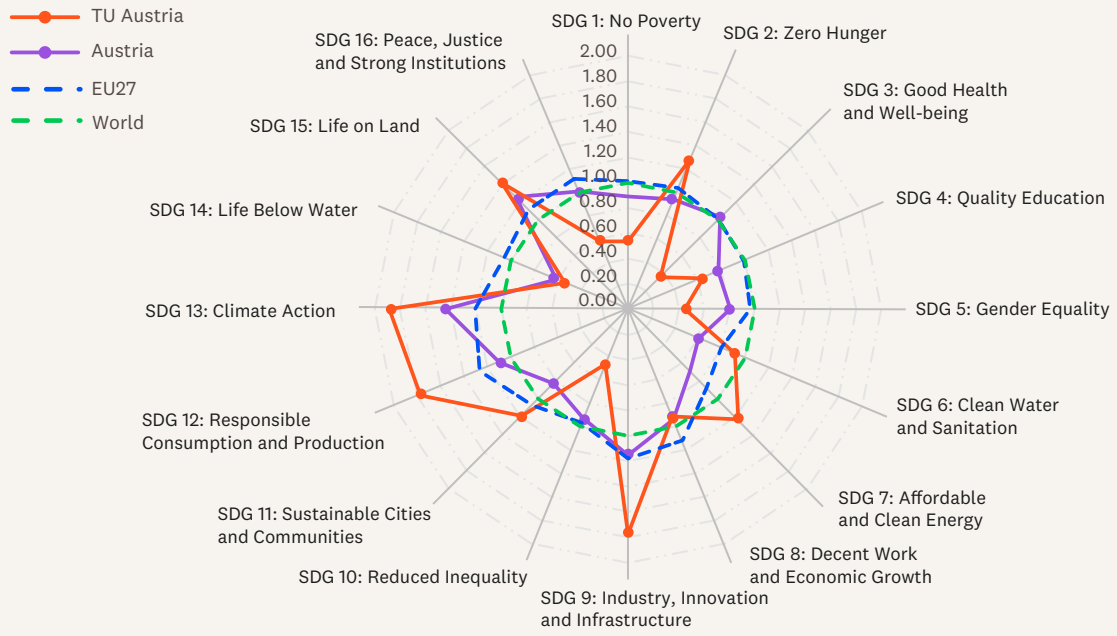
Policy citations indicate where academic research informs policy documents, guidelines and other decision-support outputs. In this indicator, Austria performs strongly: 8.9% of Austrian research is cited in policy documents, placing it above the EU average (7.1%) and above Germany (7.3%), while also substantially exceeding the world benchmark (4.8%). Switzerland stands out as the highest comparator at 11.3%, suggesting an even stronger propensity for research to be taken up in policy-facing outputs. Overall, the distribution in the chart indicates that Austria’s research has a comparatively high level of policy visibility in a European context, consistent with a system where parts of the research portfolio connect closely to public-sector priorities and decision-making needs.

Another way to assess the societal impact of research is to examine how Austria’s output aligns with the UN Sustainable Development Goals (SDGs). This report does so using portfolio profiles based on the Relative Activity Index (RAI), which indicates whether Austria publishes more or less than the world average in each SDG area (RAI = 1.0 as the global baseline). The result is a clear “societal contribution signature” that makes Austria’s relative emphasis easy to compare across SDGs and against the global average.

Fig. 37 visualizes this signature as a radar profile, with Austria shown against the world benchmark. The chart indicates that Austria’s relative emphasis is strongest in SDG 13 (Climate Action) and SDG 15 (Life on Land), where the Austrian line sits clearly above the global baseline, and it also shows above-average activity in SDG 9 (Industry, Innovation and Infrastructure) and SDG 12 (Responsible Consumption and Production). By contrast, Austria under-indexes in several socially oriented goals, most notably SDG 5 (Gender Equality), SDG 6 (Clean Water and Sanitation) and SDG 7 (Affordable and Clean Energy), where the profile dips below the world reference. Across the remaining goals, Austria clusters closer to parity with the global pattern, suggesting a broadly distributed sustainability portfolio with a handful of pronounced peaks and troughs rather than an even spread.

Figure 37

SDG research in Austria and among the six TU Austria universities, 2020–2024



Taken together with policy-citation evidence, the SDG view helps situate Austria's societal impact beyond innovation outcomes alone. Policy citations capture where Austrian research informs decision-support outputs and public-sector priorities, while the SDG profile shows which societal challenges Austria's research system emphasizes relative to global patterns. Importantly, the SDG lens also highlights that volume and orientation are not the same as quality or influence: some areas where Austria is not a major contributor in absolute global terms can still achieve high visibility and relevance, while RAI clarifies where the system's thematic focus diverges from the world average and aligns more closely with national strengths and priorities.

Against this national SDG "signature," the TU Austria universities help explain how Austria's relative strengths translate into technical capability and societal delivery. Their SDG tables and cobweb charts indicate especially strong contributions in technically and infrastructure-oriented areas, most notably SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 7 (Affordable and Clean Energy), which closely reflect the alliance's applied, engineering-led mission.

TU Austria's SDG-linked research is not defined only by scale. In several of these goals it also shows strong citation impact, suggesting that the work is both societally relevant and scientifically influential, while the RAI lens highlights that this contribution is selective and concentrated rather than evenly distributed across all SDGs. The breadth that does appear across goals underscores the interdisciplinary character of impact, where engineering intersects with environmental sciences, digital technologies, and life sciences. This positions TU Austria's societal impact as a structural feature of Austria's science system: research that supports upstream agenda setting and policy design, while also enabling downstream implementation through technically grounded solutions. Lower relative activity in more social or institutional SDGs should therefore be read as mission alignment rather than a shortfall.

Conclusion

Austria's position as a science and technology nation is defined by a distinctive combination of characteristics: a comparatively modest global share of research output coupled with consistently high citation impact and a strongly international collaboration profile. In a global research landscape that has shifted both geographically and technologically, Austria has sustained performance levels well above the European average, demonstrating that scale is not a prerequisite for visibility or influence. The analysis highlights strengths in Clinical & Health, the Life Sciences, and selected technical domains, while also showing that excellence is broadly distributed across disciplines and institutions. These patterns underscore the structural resilience of the Austrian research system amid intensifying global competition.

TU Austria complements comprehensive universities by focusing where engineering, modeling, and technology deployment most directly shape outcomes. As a concluding takeaway, the combined SDG and policy-citation signals frame TU Austria as a delivery-oriented partner for mission-driven agendas in energy transition, climate action, industrial transformation, and resilient urban systems, where long investment horizons and technical complexity make research-to-policy translation especially valuable.

Importantly, the findings suggest that Austria's performance extends beyond academic visibility, while also reflecting the structure of its innovation ecosystem. High academic-industry co-publication rates are shaped not only by traditional corporate R&D, but also by the prominent role of COMET competence centers and other RTD intermediaries that are explicitly designed to broker collaboration and publish jointly with academic partners. Alongside these collaboration vehicles, robust patent-publication citation linkages — including in emerging areas such as artificial intelligence — and signals of policy uptake indicate that research outputs are translated into industrial innovation and evidence-informed decision-making. Overall, the data point to a system in which knowledge creation, technological capability, and societal application are closely interconnected, supported by a networked, outward-looking research model that is strongly oriented toward valorization and mission-driven impact.

Taken together, these results reinforce the broader conclusion that universities must function not only as producers of publications but also as institutions that safeguard evidence-based discourse, strengthen critical thinking, and contribute to democratic resilience. In a context shaped by geopolitical uncertainty, digital transformation, and the societal implications of artificial intelligence, Austria's research system already embodies many of the required attributes: international openness, impact orientation, and growing alignment with technological and societal missions. The strategic priority ahead is therefore consolidation rather than reinvention, ensuring stable framework conditions, sustained talent development, and continued openness, so that Austria can maintain its dual role as a hub of scientific excellence and a driver of innovation, informed policy, and long-term societal progress.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Appendix: Definitions, abbreviations and data sources

This report is based on bibliometric and analytics indicators derived primarily from Scopus and SciVal, complemented by policy-document signals from Overton and patent-based indicators as noted in the source material. Indicator values should be interpreted in context: bibliometric measures are influenced by field mix, publication types and collaboration patterns.

Scholarly output

Scholarly output describes the products of scholarly activity indexed in Scopus (e.g., journal articles, reviews, conference papers and other forms of research dissemination). Output can be compared in absolute terms or as a share of world output.

Citation

A citation is a formal reference to earlier work. Citation counts can be used as one proxy of scholarly visibility and influence, but they vary strongly by field, publication type and time since publication.

FWCI (Field-Weighted Citation Impact)

FWCI compares the citations received by a publication set with the expected citation rate for similar publications (year, type and subject area). A value of 1.0 corresponds to the world average; values above 1.0 indicate higher-than-expected impact.

Subject area classification

Subject areas are based on journal and publication classification systems used in Scopus/SciVal. A publication can be linked to more than one subject area; for this reason, subject-area shares may sum to more than 100% depending on the view used.

International collaboration

Indicated by publications with author affiliations from at least two different countries.

Academic–corporate collaboration (ACCO)

Indicated by publications with at least one academic affiliation and at least one corporate affiliation (based on sector classification). ACCO is a publication-based proxy and does not capture non-publishing collaboration.

RAI (Relative Activity Index)

RAI is the share of an entity's publications in a topic relative to the global share of publications in the same topic. A value above 1.0 indicates above-average focus; below 1.0 indicates below-average focus.

Policy citations

Policy citations indicate whether publications are referenced in policy documents indexed by platforms such as Overton. They are an uptake signal and should be interpreted alongside field mix and policy-source coverage.

Scholarly output cited by patents

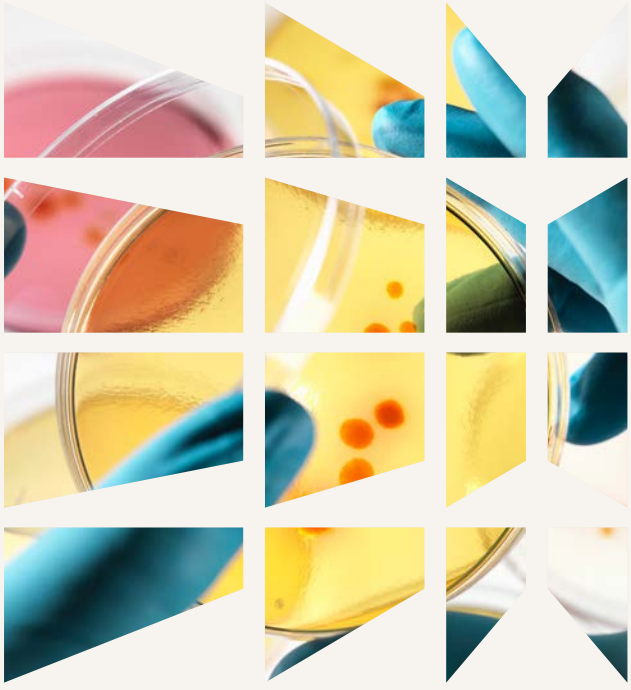
Patent citations to scholarly publications provide one proxy of knowledge transfer from research into patented inventions. Patterns vary by sector, technology area and citation practices.

Data sources

- **Scopus:** Publication metadata and citation data used to measure scholarly output and citation-based indicators.
- **SciVal:** Analytics platform used to compute FWCI and to derive collaboration indicators, subject-area views, and benchmark comparisons.
- **Overton:** Policy-document database used to identify publications cited in policy documents.
- **Patent-based sources:** Patent-linkage data used to derive indicators such as scholarly output cited by patents.
- **Start-ups and spin-offs analysis:** Startup and spin-off figures are based on mixed-source triangulation and should be read as indicative ecosystem evidence, not as a harmonized statistical series.

For clarity, the startup and spin-off material draws on three source groups:

- **Administrative and official sources:** Scopus, SciVal, Overton, patent-linkage data, and uni:data / BMBWF. These sources provide the core research, translation, and officially reported university spin-off indicators.
- **Ecosystem monitoring sources:** Austrian Startup Monitor (ASM). This source is used to contextualize startup formation and the broader Austrian startup ecosystem beyond the narrow category of formal university IP spin-offs.
- **Commercial and triangulation sources:** Dealroom, PitchBook, NGP Capital, Life Science Report Austria, and FTI-Monitor. These sources are used to triangulate broader university-linked startup activity, venture funding, exits, and ecosystem patterns where no single harmonized administrative dataset exists.



Note: Figures from these source groups should not be treated as directly interchangeable, and apparent differences between them reflect differences in definition, scope, and measurement rather than simple inconsistencies.

Abbreviations and key terms (alphabetical)

AI	Artificial intelligence.
ASM	Austrian Startup Monitor.
AUT	Austria (ISO country code).
AWS	Austria Wirtschaftsservice.
BMFWF	Federal Ministry of Women, Science and Research.
BMIMI	Federal Ministry for Innovation, Mobility and Infrastructure.
BMWET	Federal Ministry for Economic Affairs, Energy and Tourism.
BOKU	University of Natural Resources and Life Sciences, Vienna.
CAGR	Compound annual growth rate.
CDG	Christian Doppler Research Association.
CHE	Switzerland (ISO country code).
COMET	Competence Centers for Excellent Technologies (program supporting academia–industry collaboration).
DACH	Germany–Austria–Switzerland region grouping.
DEU	Germany (ISO country code).
ETH Zurich / ETH	Swiss Federal Institute of Technology Zurich (Eidgenössische Technische Hochschule Zürich).
EU / EU27	European Union / the 27 EU Member States (post–Brexit).
FFG	Austrian Research Promotion Agency (Österreichische Forschungsförderungsgesellschaft).
FTI	Research, Technology and Innovation (Forschung, Technologie und Innovation).
FTI–Monitor	Austrian monitoring/reporting instrument on research, technology and innovation (as cited in sources).
FWCI	Field–Weighted Citation Impact (see above).
FWF	Austrian Science Fund.
G7	Group of Seven major advanced economies.
IIASA	International Institute of Applied Systems Analysis.
INSERM	Institut national de la santé et de la recherche médicale (France).
IP	Intellectual property.
IPO	Initial public offering.
ITA	Italy (ISO country code).
JKU	Johannes Kepler University Linz.
LMU	Ludwig Maximilian University of Munich (LMU Munich).
MedUni Wien	Medical University of Vienna.
NGP Capital	Venture capital firm and data source referenced.
NYU	New York University.
ÖAW	Austrian Academy of Science.
R&D	Research and development.
RTD	Research, technology and development.
SDG / SDGs	Sustainable Development Goal(s) (United Nations).
TU Austria	Alliance of Austria's technical universities.
TU Graz	Graz University of Technology.
TU Loeben	Technical University of Leoben.
TU Wien	Vienna University of Technology.
UAS	Universities of Applied Sciences (Fachhochschulen)
U.K.	United Kingdom.
U.S.	United States.
uniko	Universities Austria.
Uni Graz	University of Graz.
Uni Innsbruck	University of Innsbruck.
Uni Wien	University of Vienna.
VC	Venture capital.
WU	Vienna University of Economics and Business (Wirtschaftsuniversität Wien).

Datasets for key technologies

Key technologies	Dataset used (2019–2024)	How dataset was obtained
AI	Research Area in SciVal from Elsevier 2019 Report methodology	Created by RADs for the publication of the Elsevier AI report in 2019 and publicly available to SciVal subscribers.
Quantum Technologies	Research Area in SciVal created with an ad hoc string based on selected keyword(s)	((("qubits" OR "quantum information" OR "quantum sens*" OR "quantum comput*" OR (entanglement AND quantum) OR (teleportation AND quantum) OR "quantum cryptography" OR "quantum key" OR "quantum logic gate*" OR "quantum circuit" OR "quantum register" OR "quantum thermodynamics" OR "quantum metrology" OR "quantum key distribution" OR "quantum communicat*" OR "qumode" OR "quantum fluctuations" OR qkd OR "quantum optical communicat*" OR "quantum clock*" OR "quantum process*" OR "quantum processor*" OR "quantum algorithm*" OR "quantum imaging" OR "circuit qed" OR "cavity qed" OR "circuit quantum electrodynamics" OR "ion traps" OR "atom traps" OR "rydberg atom" OR "nanomechanical resonators" OR "quantum fluids" OR "quantum dots" OR "NV centers in diamond" OR ("nitrogen-vacancy" AND diamond) OR "superconducting qubits" OR "topological quantum computing" OR "adiabatic quantum computation" OR "quantum error correction" OR "quantum simul*" OR "adiabatic comput*" OR "quantum gates" OR "atom interferometer*" OR (SQUID AND quantum) OR (quantum AND optomechanics) OR "single phonon" OR (optical AND cooling) OR (parametric AND conversion AND optical) OR "optomechanics" OR (josephson AND qubit) OR (superconducting AND qubit) OR (quantum AND electromechanics) OR "quantum synchronization" OR "quantum random number" OR "ising machine" OR (nonhermitian AND optomechanics) OR "nonlocality" OR "non-locality" OR "Bell's theorem" OR (Kochen AND Specker) OR "quantum contextuality" OR "quantum repeater" OR "quantum internet" OR "quantum network" OR "quantum phase transition" OR "quantum illumination" OR "quantum photonics")))
Biotechnology	Research Area in SciVal created with an ad hoc string based on selected keyword(s)	(biotechnology OR "gene editing" OR "genome editing" OR "CRISPR-Cas9" OR "synthetic biology" OR "biopharmaceuticals" OR "gene therapy" OR "cell therapy" OR "bioreactors" OR "metabolic engineering" OR "protein engineering" OR "biocatalysis" OR "antibody engineering" OR "mRNA vaccine" OR "regenerative medicine" OR "tissue engineering")
Rare earths and critical materials (extended)	Research Area in SciVal created with an ad hoc string based on selected keyword(s)	("sustainable" OR "sustainability" OR "environmentally friendly" OR "eco-friendly" OR "supply-chain" OR "green energy" OR "renewable energy" OR "sustainable energy" OR "clean energy" OR "low-carbon energy" OR "energy transition" OR "decarbonization" OR "fossil fuel transition" OR "digital transition" OR "strategic" OR "critical") AND ("mine" OR "mining" OR "extraction" OR "process" OR "processing" OR "treatment" OR "refining" OR "utilize" OR "utilizing" OR "use" OR "using" OR "application" OR "applying" OR "lithium-ion batteries" OR "cobalt batteries" OR "nickel batteries" OR "manganese batteries" OR "graphite batteries" OR "vanadium batteries" OR "zinc batteries" OR "wind turbine" OR "wind turbines" OR "wind energy" OR "super magnet" OR "solar") AND ("rare earth" OR "rare-earth" OR "critical material" OR "critical element" OR "critical metals" OR "cobalt" OR "nickel" OR "manganese" OR "graphite" OR "vanadium" OR "zinc" OR "copper" OR "aluminium" OR "steel" OR "lithium" OR "lanthanum" OR "cerium" OR "praseodymium" OR "neodymium" OR "promethium" OR "samarium" OR "europium" OR "gadolinium" OR "terbium" OR "dysprosium" OR "holmium" OR "erbium" OR "thulium" OR "ytterbium" OR "lutetium" OR "scandium" OR "yttrium" OR "bauxite" OR "antimony" OR "arsenic" OR "baryte" OR "beryllium" OR "bismuth" OR "baron" OR "borates" OR "coking coal" OR "feldspar" OR "fluorspar" OR "gallium" OR "hafnium" OR "helium" OR "HREEs" OR "LREEs" OR "magnesium" OR "niobium" OR "phosphate rock" OR "phosphorus" OR "platinum group metals" OR "silicon metal" OR "strontium" OR "tantalum" OR "titanium metal" OR "tungsten")

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