

Sustainability-oriented Research and Innovation

Sustainable Governance Indicators 2024



Indicator

Research and Innovation Policy

Question

How committed is the government to utilizing research and innovation as drivers for the transition to a sustainable economy and society?

30 OECD and EU countries are sorted according to their performance on a scale from 10 (best) to 1 (lowest). This scale is tied to four qualitative evaluation levels.

- 10-9 = The government is clearly committed to utilizing research and innovation as drivers for the transition to a sustainable economy and society.
- 8-6 = The government is largely committed to utilizing research and innovation as drivers for the transition toward a sustainable economy and society.
- 5-3 = The government is somewhat committed to utilizing research and innovation as drivers for the transition toward a sustainable economy and society.
- 2-1 = The government is not at all committed to utilizing research and innovation as drivers for the transition toward a sustainable economy and society.

Austria

Score 9

Austria has committed to a future-oriented and innovation-friendly policy. Its Research, Technology, and Innovation (RTI) Strategy is considered the foundation of sustainable growth and the increased resilience of the entire economic system (see Federal Government Republic of Austria 2020).

Austria, as a research, technology, and innovation (RTI) location, has shown dynamic development in recent years, exceeding the 3% of gross domestic product (GDP) target set by the European Union. In 2020, Austria ranked second within the EU. The Austrian research landscape comprises 22 public universities, 21 universities of applied sciences, five central non-university research institutions, 3,489 research companies, and a total of more than 5,000 research-performing units, including many leading international companies.

The strategy is based on several cross-cutting issues, including Sustainable Development Goals, digitalization, strengthening gender equality in RTI, Responsible Science, Open Science, and Open Innovation. Strategic planning, achievement, and implementation of RTI aim to be optimized through scientifically rigorous evaluations – both internal and external – designed to improve government activities concerning their relevance, efficiency, effectiveness, impact, sustainability, and coherence.

This commitment is evident in hard facts. For example, Austria recently ranked fifth out of 30 Western countries in patents for environment-related technologies as well as patents related to recycling and secondary raw materials. Additionally, Austria is ranked eighth among the 27 EU member states by the European Innovation

Scoreboard (EIS 2022). Furthermore, Austria is third in the EU on the Eco Innovation Scoreboard of the European Environment Agency (EEA 2022).

Still, innovation in universities is hampered by financial constraints; venture capital is too low.

Citation:

https://www.bmk.gv.at/en/topics/innovation/policy/open_innovation_strategy.html

https://openinnovation.gv.at/wp-content/uploads/2015/08/OI_Barrierefrei_Englisch.pdf

https://www.klimafonds.gv.at/wp-content/uploads/sites/16/EN_Summary_Research_and_Innovation_Strategy.pdf

Federal Government Republic of Austria. 2020. "RTI Strategy 2030. Strategy for Research, Technology and Innovation of the Austrian Federal Government." https://era.gv.at/public/documents/4489/RTI_Strategy_2030-1-1.pdf

EIS. 2022. "European Innovation Scoreboard." <https://op.europa.eu/en/publication-detail/-/publication/f0e0330d-534f-11ed-92ed-01aa75ed71a1/language-en/format-PDF/source-272941691>

EEA. 2022. "Eco-innovation index." <https://www.eea.europa.eu/en/analysis/indicators/eco-innovation-index-8th-eap>

Germany

Score 9

With the FONA strategy (Forschung für Nachhaltigkeit, research for sustainability) published at the end of 2020, the Federal Ministry of Education and Research (BMBF) has aligned its research funding for climate protection and greater sustainability with the United Nations 2030 Agenda. The FONA strategy focuses on the global SDGs and outlines three strategic goals to which research can significantly contribute. These goals are detailed in eight priority fields of action, each with specific measures to achieve the strategic objectives. For instance, to meet climate goals, one action involves establishing green hydrogen. To preserve habitats, another action is developing the biodiversity monitor for Germany. Like all such strategies, FONA expresses a political commitment, but it is not legally binding.

Startups benefit from various federal and state support schemes. However, like any other companies, they suffer from intense regulation and bureaucratic burdens in Germany across various fields, such as labor market, taxation, data protection, and environmental regulation. Venture capital markets are underdeveloped in Europe compared to the US. The German venture capital market has shown high growth rates over recent years, with investment more than doubling between 2018 (€1.5 billion) and 2021 (€4.0 billion) (Statista, 2024). After this peak, investment volumes decreased due to the difficult environment of high inflation and interest rates.

Since 2020, Germany has applied an R&D tax incentive. Since then, spending on R&D staff has benefited from a 25% tax allowance that will be paid out if the entity makes a loss. The allowance can be applied to a maximum of €2 million, which limits the subsidy to €500,000 per company per year. This amount was doubled for

the period between mid-2020 and mid-2026 in the context of pandemic support measures (Bundestag, 2023).

Responsibility for promoting science and research is divided between the federal government and the state governments. For example, the federal government exercises legislative powers in areas such as research funding and training grants (Art. 74 (1), no. 13 GG). The higher education sector, however, is fundamentally the responsibility of the federal states (Art. 30, 70 GG). The federal and state governments have two coordinating and advisory bodies at their disposal: the Gemeinsame Wissenschaftskonferenz (Joint Science Conference, GWK) and the Wissenschaftsrat (Science Council, WR). At the federal level, the Federal Ministry of Education and Research takes the lead.

The government continuously monitors the progress of its research and innovation policies and their outcomes. A key in-depth report is the Bundesbericht Forschung und Innovation (Federal Report Research and Innovation). The Federal Report is the standard reference work on Germany's research and innovation policy. It provides an overview of the activities of the federal and state governments in research and innovation and presents data and facts in a structured manner. The report is published every two years, with the most recent edition from 2022 (BMBF, 2022). Research and innovation policy is also evaluated annually by the independent Commission of Experts for Research and Innovation (EFI).

Agencies and research associations that receive public research funds are subject to continuous monitoring. This includes audits from state and federal audit institutions and, more important, performance-related reporting requirements to their sponsors. Moreover, responsible ministries send their delegates to the supervisory bodies of the sponsored units.

Citation:

BMBF. 2022. Bundesbericht Forschung und Innovation 2022. Berlin: BMBF.

Bundestag. 2023. Steuerliche Förderung von Forschung und Entwicklung, Wissenschaftliche Dienste Deutsche Bundestag, WD 4 - 3000 - 074/23.

Statista. 2023. "Volume of venture capital investments in Germany from 2012 to 2022." www.statista.com/statistics/1332187/venture-capital-investments-germany/

Norway

Score 9

A long-term plan for research and higher education was adopted by parliament in 2019 and has since been updated twice. The current plan covers the period 2023 – 2032 (Kunnskapsdepartementet, 2022). It sets a goal of allocating 4% of GDP to research and development and defines three overarching objectives: improve national competitiveness and innovative capacity, ensure environmental, social and economic sustainability, and maintain high quality of and good accessibility to research and higher education.

Within these objectives, there are six thematic priorities for increased financing: relationships between oceans, marine environments, and food production; health and quality of life; climate and energy production; new technologies for a sustainable future; security issues and societal preparedness for crises; and interpersonal trust and social cohesion.

The plan and its priorities are clearly inspired by the European Union concept of “mission-driven” research and development. The message from the government toward research institutions and universities is clear: Within the academic freedoms granted by law, institutions are expected to direct their scientific and educational activities to enhance Norway’s capacity to transform itself into an ecologically sustainable and still generous welfare society.

Citation:

Kunnskapsdepartementet. 2022. “Langtidsplanen for forskning og høyere utdanning 2023 – 2032.” <https://www.regjeringen.no/no/tema/forskning/innsiktsartikler/langtidsplanen-for-forskning-og-hoyere-utdanning-2023-2032/id2929453/>

United Kingdom

Score 9

Innovation is at the heart of the Sunak government’s policy approach, building on a strategy launched in July 2021. This strategy aims to boost productivity growth, which has stagnated over the past decade, and to create a cohesive system where businesses, government, R&D organizations, finance providers, and other stakeholders collaborate to achieve innovation goals. Recently, the government published a white paper titled “A pro-innovation approach to AI regulation,” with Rishi Sunak aiming to position the UK as a global leader in AI regulation.

Recent government initiatives include extending tax credits for R&D and business investment, establishing regional technology and innovation centers, investing in digital infrastructure and new university research facilities, and setting up Innovate UK to promote economic growth through science and technology. Innovate UK supports business-led innovation across all sectors, technologies, and UK regions, focusing on developing and commercializing new products, processes, and services. Innovation is also supported by the National Endowment for Science, Technology and the Arts (NESTA), which now focuses on three innovation missions: promoting a fairer start, a healthy life, and a sustainable future.

The United Kingdom’s tradition of being an active player in research and innovation dates back to the Industrial Revolution. Its leading universities have long linked cutting-edge academic research with industries such as biotechnology and information and communications technology (ICT). Areas like the Cambridge-Oxford corridor north of London are recognized as innovation hubs, with recent successes including the rapid development of the AstraZeneca COVID vaccine.

Despite these strengths, overall R&D spending has been weaker, averaging around 1.75% of GDP in the years before the pandemic, falling short of the EU norm (no data yet for 2021 because of a revised measurement methodology). Additionally, converting innovation into sustainable, large-scale profitable production has been challenging. However, it's important to note that manufacturing constitutes a smaller share of UK GDP than in most OECD countries, and other indicators, such as ICT spending – crucial for service industries – must be considered to understand innovation trends in the UK.

The revamped UK innovation strategy is comprehensive in its aims and scope, but its likelihood of success remains to be seen.

Citation:

<https://www.gov.uk/government/publications/uk-innovation-strategy-leading-the-future-by-creating-it>

United States

Score 9

The federal government's commitment to using research and innovation as drivers for transitioning to a sustainable economy and society largely depends on the partisan affiliation of the administration in the White House (Karol 2019). Broadly speaking, Democrats support a transition to sustainability, whereas Republicans often question the need for or importance of such a transition (Gustafson et al. 2019). Nonetheless, some core institutional features drive this transition through R&D (Brown and Hess 2016). The Advanced Research Projects Agency-Energy (ARPA-E) funds clean energy research, including projects that might appear somewhat speculative or high risk and, therefore, less likely to attract private capital (Wurzelmann 2012). The Department of Energy (DOE), the National Institutes for Health (NIH), the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the National Institute of Standards and Technology, and the National Science Foundation (NSF) are agencies that play a significant role in funding research and development projects.

The federal government has a National Innovation and Entrepreneurship Strategy and a variety of programs to support innovation. The Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) programs provide funding to small businesses, including startups, to conduct research and development with potential for future commercialization (Qian and Hayes 2014).

The frequency of monitoring research and innovation outcomes depends on the nature of the research, the agency involved, and the specific objectives of the program. Typically, grant recipients are required to monitor progress and report on outcomes. The agency usually conducts its own evaluations and analyses, producing reports on how goals were or were not met and where improvements can be made for the future. Most of these reports are publicly available.

Citation:

Haifen Qian, and Kingsley Haynes. 2013. "Beyond innovation: the Small Business Innovation Research program as entrepreneurship policy." *Journal of Technology Transfer*.

Sam Wurzelmann. 2012. "Advanced Research Projects Agency Energy (APRA-E): Innovation through the US Department of Energy." Center for Climate and Energy Solutions.

Abel Gustafson et al. 2019. "The Development of Partisan Polarization over the Green New Deal." *Nature*.

David Karol. 2019. *Red, Green, and Blue: The Partisan Divide over Environmental Issues*. Cambridge: Cambridge University Press.

Kate Brown and David Hess. 2016. "Pathways to Policy: Partisanship and Bipartisanship in Renewable Energy Legislation." *Environmental Politics*.

Denmark

Score 8

In 2020 the Danish government published a national strategy concerning green research and innovation (Ministry of Higher Education and Science 2020). The strategy aims to help Denmark meet the goals set in the Climate Law, mentioned above. It identifies four "missions" intended to assist Denmark in reaching its climate targets.

First, more research and innovation are needed to develop technologies that can capture CO₂. Second, more research and innovation are required to develop green fuel and power-to-X technologies. Third, the strategy emphasizes the need for research in climate-friendly food production and agriculture. Finally, more research is necessary in the area of recycling.

To enhance research and innovation on climate issues, the government has increased funding for a special research fund named Research for Green Transition (Forskning i grøn omstilling). This initiative is provided with approximately DKK 100 million in yearly funding. To further promote cooperation between universities and private companies, the government has allocated funds to "grand solutions" programs. These programs target research aligned with the four missions outlined in the strategy. This initiative is furnished with DKK 1 billion in funding (Innovation Fund 2023).

Finally, the 2020 strategy introduced Denmark's Green Future Fund, which allocates DKK 25 billion for research and innovation aimed at enhancing the creation of green markets, particularly in middle-income and developing countries (Denmark's Green Future Fund).

Despite the aforementioned initiatives, the strategy for research and innovation to support the transition to a sustainable economy and society is largely driven from the bottom up, with research institutes and companies expected to take the lead in this area.

Citation:

Denmark's Green Future fund. (<https://dgff.dk/>)

Innovation fund 2023. (<https://innovationsfonden.dk/da/p/innomissions>)

Ministry of Higher Education and Science. 2020. "Fremtidens grønne løsninger – Strategi for investeringer i grøn forskning, teknologi og innovation." <https://ufm.dk/publikationer/2020/fremtidens-gronne-losninger-strategi-for-investeringer-i-gron-forskning-teknologi-og-innovation/fremtidens-gronne-losninger-strategi-for-investeringer-i-gron-forskning-teknologi-og-innovation>

Estonia

Score 8

Research, development, and innovation (RDI) are national priorities in Estonia, as reflected in the Estonian Research, Innovation and Entrepreneurship Strategy 2021 – 2035 (TAIE). This strategy aims to bring research closer to the economy, where outcomes have so far been modest in terms of patents and high-tech exports. Total RDI expenditures have remained stagnant at about 1.8% of GDP.

TAIE 2021 – 2035 highlights five focus areas based on smart specialization, each with a clear sustainability-oriented focus: all-sectoral digital solutions, health technologies and services, valorization of local resources, smart and sustainable energy solutions, and a viable Estonian society. Each focus area has a roadmap, which is updated regularly every three to four years to adjust activities and financing according to the area's needs. These roadmaps were developed in 2022 – 2023 in cooperation with ministries, higher education institutions and business representatives.

TAIE has measurable objectives and a regular monitoring mechanism. Reporting will be done by programs and through needs-based evaluations. An annual performance report will be jointly prepared by the Ministry of Education and Research (HTM) and the Ministry of Economic Affairs and Communications (MKM), who also hold responsibility for the specific focus areas. The report is presented to the TAIE Steering Committee, composed of representatives from various ministries and executive agencies.

There are two executive agencies in the RDI – the Estonian Research Council (ETAG) and the Estonian Business and Innovation Agency (EAS KredEx). The latter emerged from the merger of Enterprise Estonia and KredEx in January 2022 to unite financing and consulting services for enterprises and startups. ETAG, which previously mainly funded academic research, now places a much greater focus on knowledge transfer and applied business innovations.

Estonia is one of the few countries worldwide that does not have tax exemptions for enterprise-led R&D activities, nor is there any R&D-related risk-sharing between the public and private sectors. High costs and high risks undermine private sector motivation for investing in R&D. The government's policy toward this problem has been to encourage innovation and the transfer of scientific knowledge to enterprises via special grant schemes (NUTIKAS, SekMO) and by building the RDI planning capacity of professional associations (RITA 7).

As a result of these efforts, private sector RDI expenditures now exceed those of the public sector (1.01% versus 0.66% of GDP, respectively). R&D personnel in the private sector have continually increased, in contrast to a decrease in the public sector, changing the total balance of researchers by 2022 – 53% are employed in the private sector and 47% in the public sector (ETAG 2022).

Nevertheless, recent studies show that cooperation between research institutions and enterprises is still mainly ad hoc. Expectations and work methods of the parties are different; enterprises are seeking better access to top-level labs at higher education institutions and international RDI networks. Both research institutions and enterprises would like to see long-term financing schemes that allow them to undertake more ambitious product development projects (ETAG 2023).

Citation:

ETAG. 2022. "Eesti TA statistika." https://etag.ee/wp-content/uploads/2023/12/Eesti-TA-statistika_detsember-2023.pdf

ETAG. 2023. "https://etag.ee/wp-content/uploads/2023/03/Liitude_TAI_vajaduste_kaardistuste_koond.pdf"

Finland

Score 8

In general, research and innovation policy in Finland focuses on basic and applied research at research institutions, supports startups that convert scientific output into products, and seeks to foster productivity as well as social innovations.

The national research, development and innovation (RDI) road map was finalized in December 2021 (Ministry for Economic Affairs and Employment n.d.). It opens avenues for enhanced collaboration between businesses and research entities. This RDI road map aims to foster sustainable growth and create an environment that attracts domestic and foreign companies to invest in RDI activities within Finland. However, the road map is not binding, and there are no sector-specific action plans.

Twelve public research institutes operate under various ministries, promoting and coordinating the development of social innovations. The primary agency for technological research development is the Technical Research Center of Finland (VTT), which falls under the Ministry of Economic Affairs and Employment. VTT collaborates with companies, research institutes, higher education institutions and policymakers at both the national and international levels.

Regarding R&D activities, other public research institutes are more mission-oriented, encompassing a wide range of research objectives. Their mandates can span basic and applied research, along with additional responsibilities such as monitoring, data collection and management, certification, and inspection (Schiensack and Hämäläinen 2001).

The recognition of companies as key partners for research institutions is reflected in increased private sector cooperation in Finland's research sector. However,

successful startup companies tend to be acquired by technology giants (GAFAM), thereby eliminating the benefits of innovations at the local and national level.

Finland was previously among the leaders in research and development (R&D) spending, as well as in the number of researchers and patent applications. In 2014, Finland had the European Union's highest R&D intensity, followed by Sweden and Denmark. However, this leading position declined due to weakening economic prospects.

The innovation system's low level of internationalization is a particular weakness. Moreover, the focus of R&D has been on applied research, with basic research at universities and other institutes benefiting little. In the long run, given the obvious dependence of applied research on basic-research developments, the heavy bias in favor of applied research and the continuing neglect of the financial needs of schools and higher learning institutions will have negative consequences for product development and productivity.

Furthermore, the system of technology transfer from universities to the private sector is comparatively weak, and academic entrepreneurship is underdeveloped.

Citation:

The Research and Innovation Council of Finland. 2010. Research and Innovation Policy Guidelines for 2010-2015.

Schienstock, Gerd and Timo Hämäläinen. 2001. Transformation of the Finnish Innovation System: A Network Approach. Sitra Series 7. Accessed January 7, 2021. <https://media.sitra.fi/2017/02/28142146/raportti7.pdf>

Ministry for Economic Affairs and Employment. n.d. "The National Roadmap for RDI Creates Opportunities for More Intensive Cooperation Between Enterprises and Research." <https://tem.fi/en/the-national-roadmap-for-rdi>

Spain

Score 8

In 2020, the government approved the Science, Technology and Innovation Strategy (EECTI) for 2021 – 2027 in accordance with the Sustainable Development Goals, aiming to double public and private investment in R&I to 2.12% of GDP by 2027. The strategy was developed in collaboration with regional governments, economic and social stakeholders, universities, research organizations, and scientific bodies.

The strategy follows the strategic lines of the Horizon Europe themes, and several lines of action are established. For example, Action Line 1: Budget focuses on increasing the budget dedicated to R&I during 2021 – 2027 and encouraging private investment until it reaches the EU average.

In September 2022, Law 17/2022 amending Law 14/2011 on Science, Technology, and Innovation was adopted to align with the achievement of the Sustainable Development Goals.

Research and technology policy has traditionally been a weak point for Spain, as evidenced by the low number of patents registered. Bureaucratic hurdles are only one

obstacle. Nevertheless, according to the European Commission's 2023 Innovation Scoreboard, Spain's innovation performance has notably improved relative to 2010, with human resources being the strongest-performing innovation dimension. Moreover, Spain performs above the EU average regarding innovation-friendly environments and employment impacts, and the performance gap with the EU is becoming smaller. In 2023, strong increases were marked in the sales of innovative products. However, there have been significant decreases in environment-related technologies since 2016 (European Innovation Scoreboard 2023).

The government participated in the 2023 launch of the European Tech Champions Initiative (ETCI) to support early-stage technology startups by facilitating financing with European capital. The ETCI initiative complements efforts by the Ministry of Economy and Digital Transformation through the Instituto de Crédito Oficial (ICO), particularly the venture capital company Axis.

The Ministry of Science and Innovation is the lead unit for coordinating and promoting the Technology and Innovation Strategy. El Consejo de Política Científica, Tecnológica y de Innovación (Council for Scientific, Technological, and Innovation Policy) acts as the coordination body for scientific and technical research at the state (interministerial) and autonomous community levels. The Centro para el Desarrollo Tecnológico Industrial (CDTI) operates as a public business entity within the Ministry of Science and Innovation, focusing on fostering innovation and technological development. It serves as the conduit for all applications seeking financial assistance and support for R&D&I projects undertaken by Spanish companies, both nationally and internationally.

Law 17/2022 aims to enhance the capabilities of the Science, Technology, and Innovation System, with the goal of improving coordination, governance, and knowledge transfer. This legislation strengthens co-governance mechanisms between various administrations by outlining a Map of Unique Scientific and Technical Infrastructures. In this map, ownership is shared between the government and other relevant administrations, promoting collaborative efforts in advancing scientific and technological initiatives.

The National Open Science Strategy for 2023 – 2027, endorsed in 2023, includes all commitments related to open science made by various public entities within the system. It thoroughly examines the international and national landscape concerning open science.

Both the State Plan for Scientific and Technical Research and Innovation and the Strategy for Science, Technology, and Innovation undergo external and independent evaluation processes. The monitoring and evaluation are conducted in two phases: an interim evaluation and a final evaluation one and a half years after completion. For this, a Monitoring Committee has been created. This committee consists of representatives from ministerial departments and their funding agents, autonomous

communities, agents from both the public and private sectors, and civil society. So far, one report has been published.

Citation:

Government of Spain. 2021. "Report on the Analysis of Bottlenecks to the Diffusion of Innovation and Digitisation in Spain." <https://www.ciencia.gob.es/InfoGeneralPortal/documento/173f0ae4-d3d0-4a04-8bba-b1a095899378>

Government of Spain. 2021. "Science, Technology and Innovation Strategy 2021-2027." <https://www.ciencia.gob.es/en/Estrategias-y-Planes/Estrategias/Estrategia-Espanola-de-Ciencia-Tecnologia-e-Innovacion-2021-2027.html>

Law 17/2022 of 5 September

European Innovation Scoreboard. 2023. "https://ec.europa.eu/assets/rtd/eis/2023/ec_rtd_eis-country-profile-es.pdf"

Belgium

Score 7

Belgium's R&D policy is shared between the central government, which can offer tax incentives, and the subnational (regional and community) governments, which manage European subsidies and support university R&D and related projects. This arrangement increases subnational accountability but hampers coordination and limits economies of scale.

Since the onset of the financial crisis in 2007, general investment levels across the European Union have either declined or remained stable. However, Belgium has comparatively withstood this negative trend. The Gross Domestic Expenditure on R&D (GERD) as a share of GDP in Belgium increased from 1.85% in 2007 to 3.43% in 2022, one of the highest rates alongside Sweden (Eurostat data). Dumont (2022) points out that this increase began in 2005 with the introduction of tax incentives by the federal government, leading to a sustained rise in business enterprise investments in R&D. However, government and higher education expenditures on R&D have remained relatively low. The author concludes that while there has been a clear rise in applied research and experimental development by companies, this has not been matched by an increase in basic research by higher education and government institutes. Despite the chronic underfunding of higher education and government institutes, Belgium performs exceptionally well on the "Attractive Research Systems" dimension of the European Innovation Scoreboard. In 2023, Belgium's performance was well above the EU average in indicators such as the number of international scientific co-publications, the number of scientific publications among the top 10% most cited, and the number of foreign doctorate students (European Commission DG-R&D, 2023). The report ranks Belgium among the top-performing countries in the European Union in terms of innovation, alongside Denmark, Finland, and Sweden. Other strengths highlighted by the report include "Innovative SMEs collaborating with others," "Enterprises providing ICT training," and "Public-private co-publications." However, the European Semester points to a potentially low contribution of the Belgian private sector in terms of R&D for environmental sustainability. This is evidenced by the low share of environment-related patents in total Belgian patent applications. Additionally, there is a lack of business dynamism

in the innovation ecosystem, as indicated by low business creation and destruction rates (European Commission 2023).

Citation:

Eurostat. "Dataset: Intramural R&D expenditure (GERD) by sectors of performance and source of funds [rd_e_gerdfund]."

https://ec.europa.eu/eurostat/databrowser/view/rd_e_gerdfund__custom_9137463/default/table?lang=en

Dumont, M. 2022. Public Support to Business Research and Development in Belgium-Fourth Evaluation. Federal Planning Bureau. https://www.plan.be/publications/publication-2305-en-public_support_to_business_research_development_in_belgium_fourth_evaluation

European Commission, Directorate-General for Research and Innovation. 2023. European Innovation Scoreboard 2023. Publications Office of the European Union. <https://data.europa.eu/doi/10.2777/119961>

European Commission. 2023. "2023 European Semester: Country Report – Belgium." Brussels. Available at: https://economy-finance.ec.europa.eu/publications/2023-european-semester-country-reports_en#details

Czechia

Score 7

The government has made verbal commitments to improving research and innovation, but questions remain about the likely effectiveness of the proposed policies. Additionally, there is no strong orientation toward sustainability.

The most recent strategic document on research and innovation, "Czech Republic The Country For The Future," was developed by the Council for Research, Development, and Innovation within the Government Office under the Babiš administration. The stated aim was to increase R&D spending from 1.79% of GDP in 2019 to 3% of GDP by 2030, with 1% from the public sector and 2% from the enterprise sector. However, spending has been fairly stable for some years, with public spending at around 0.65% of GDP since 2011. This figure places the country in the middle of the EU and OECD ranges, reflecting spending in universities and research institutes.

In 2021, the last year with complete data, 59% of public spending was dedicated to fundamental research, mostly in the natural sciences. A weakness has been the relatively low level of research in enterprises, which has also remained fairly stable. Larger firms with modern technology are typically branches of foreign-owned multinationals. With a few exceptions, these firms have little interest in moving research activities to Czechia. Nevertheless, they dominate enterprise research spending, with the largest share in the automotive industry. For example, the Škoda car manufacturer, owned by Volkswagen, has a significant research facility, although it is not involved in developing the company's most modern technologies.

The government's plan does not address this issue and does not specify priority sectors or activities. The Council for Research, Development, and Innovation does identify successful research areas and has established a subcommittee for research on climate change issues, but it focuses on discussing research rather than its applications in the enterprise sphere.

Large, foreign-owned companies in 2021 received CZK 1.5 billion of the total CZK 2.4 billion in tax support. In contrast, of the CZK 3.8 billion in direct subsidies, CZK 3.3 billion went to domestically owned firms.

Further support for research is threatened by dependence on EU funding and by the government's prioritizing of spending cuts to reduce public debt. The NPO promises CZK 5 billion to support research and innovation in enterprises, conditional on the establishment of a coordinating group for that activity. Goals under this heading are vague, and no bids had been invited by February 2024.

Citation:

<https://www.czso.cz/csu/czso/statni-rozpocetove-vydaje-na-vyzkum-a-vyvoj>

<https://vyzkum.gov.cz/FrontClanek.aspx?idsekce=866015>

France

Score 7

Although the government has made rhetorical commitments to sustainable development and research, the two seldom form a national roadmap together. Of course, the national roadmap for research includes a dedicated section on the environment and sustainable development, entailing both a technological dimension and a social dimension. Conversely, the France 2030 roadmap for investment (which foresees €4 billion in investment expenditures) includes research as one of its policy domains. However, industrial innovation is considered more relevant in this regard. These roadmaps are not binding.

Overall, President Macron has sought to aid the business sector. “Start-up France” was one of his early leitmotifs, and his government has implemented several regulatory reforms aimed at facilitating the creation and support of emerging startups. Innovation in eco-friendly technologies is only a limited part of this narrative. The biggest exception is nuclear power, for which the government has articulated a general strategy that involves funding large-scale nuclear plants and developing innovative smaller reactors. The France 2030 investment strategy has been the primary governmental program to support start-up development. Up to € billion has been dedicated to this program for the period 2021 – 2025, under the supervision of the prime minister. Calls for proposals have been used to select the companies that will receive funding and aid in their industrial development.

Research and innovation progress are monitored by the government office as part of the country's key indicators. A research law sets a series of objectives in terms of funding and achievements, for instance with regard to the country's publication and patent ratings. Yet observers often argue that France has declined compared to other countries in Europe and worldwide (Larousserie 2021). Grounds for this decline are found in the relatively low productivity of French research, which in turn results from equipment investments lower than in other comparable nations, and the country's loss of attractiveness due to low average incomes among the country's research professionals.

The European Innovation Scoreboard (EIS 2022) ranks France 11th out of 27 countries. France is seen as belonging to the second-highest group of countries – the “strong innovators” (behind the “innovation leaders”) – with a performance level slightly above the EU average. Similarly, the Eco-Innovation Index created by the European Environment Agency (EEA 2022), which assesses innovation linked to environmental objectives, ranks France seventh out of 27 countries, with a performance above the EU average.

Citation:

Larousserie, D. 2021. “Les raisons du déclin de la recherche en France.” *Le Monde* September 28. https://www.lemonde.fr/sciences/article/2021/09/28/recherche-les-raisons-du-declin-francais_6096227_1650684.html#:~:text=Une%20productivit%C3%A9%20en%20baisse,OST%20dans%20son%20dernier%20rapport

EIS. 2022. “European Innovation Scoreboard.” <https://op.europa.eu/en/publication-detail/-/publication/f0e0330d-534f-11ed-92ed-01aa75ed71a1/language-en/format-PDF/source-272941691>

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Japan

Score 7

Despite a severe fiscal situation, Japan has significantly increased spending for promotion of science and technology compared to other expenses since the beginning of the 21st century. In the budget for FY2023, the funds for science were increased by 1.1% compared to the previous year, with emphasis both on promoting R&D of advanced technologies such as quantum and AI, and on supporting basic research and young researchers.

Research and innovation policy is planned by the Council for Science, Technology and Innovation in the Cabinet Office, which also coordinates its implementation by governmental agencies and ministries. In March 2021, the council issued the sixth Science and Technology Basic Plan for 2021 – 2025, which aims to create “Society 5.0,” integrating cyberspace and physical space to balance economic development with the resolution of social problems. This also includes goals such as reducing emissions and promoting “sustainable industrialization.” Referring to the SDGs, JPY 30 trillion (€190 billion) of public funds were planned for JPY 120 trillion (€770 billion) worth public-private investments in R&D. The Basic Plan contains numerical targets and concrete measures for the realization of specific tasks, such as “promoting social change and discontinuous innovation to overcome global issues,” “formation of an innovation ecosystem that is the foundation for creating new industries that share value,” and “promoting university reform and expanding functions for strategic management.” A JPY 10 trillion (€64 billion) university fund was established to increase the global competitiveness of Japanese universities in response to a stagnant number of researchers per 1,000 employment, and insufficient collaboration between academia and industry.

The Japan Science and Technology Agency, with an annual budget of about JPY 280 billion, is engaged in developing initiatives to achieve the SDG goals through

science and technology. Its activities are linked to the SDGs Promotion Headquarters in the Cabinet Office, which coordinates SDG-related activities and initiatives across ministries. The headquarters issues an annual SDG Action Plan. The 2021 plan emphasized four pillars: preparing for the next pandemic, building back better strategies for businesses, regional revitalization and social initiatives aimed at strengthening civil society.

Citation:
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Japan Science and Technology Agency (JST). 2021. “Mobilizing Science, Technology and Innovation for SDGs Japanese Actions in STI for SDG.” https://www.jst.go.jp/sdgs/en/pdf/sti_for_sdgs_report_en_apr_2021.pdf

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Lithuania

Score 7

The government is committed to utilizing research and innovation as drivers for transitioning to a sustainable economy and society. Lithuanian authorities have used EU structural funds to improve the country’s R&D infrastructure. More recently, in 2022 – 2023, investments into green and digital transitions have been supplemented by Next Generation EU funding. Science clusters have been developed, integrating higher-education institutions, research centers and business areas working within specific scientific or technological domains.

However, efficiently using this new research infrastructure remains a major challenge, and cooperation between industry and research organizations is still weak. The government has supported the sector through financial incentives, particularly an R&D tax credit for enterprises, as well as regulatory measures. The current government program includes numerous provisions dedicated to the sustainability agenda. Both the previous and current governments have allocated budgetary resources to increasing salaries for university researchers, with the latest decisions to come progressively into force in 2024.

Demand-side measures encouraging innovation are less developed. Bureaucratic procedures remain an obstacle to research and innovation. The existing system of innovation governance is complex, with limited synergies between the various implementing agencies and support schemes. Due to insufficient funding and the rules for calculating the salaries of scholars participating in EU-funded programs such as Horizon 2020, incentives to apply to these programs are weak.

In the Ecorys (2022) report on Lithuania’s eco-innovation profile, the country is categorized as an average eco-innovations performer. The report notes that Lithuania’s performance relative to the EU has improved over time. Similar trends are highlighted by the European Innovation Scoreboard 2023, which places Lithuania in the group of moderate innovators. Although Lithuania’s performance

remains below the average for the moderate innovators group, its rate of increase between 2016 and 2023 was higher than the EU average.

In 2022, the government established an Innovations Agency responsible for supporting innovations in all stages of business development and made structural changes such as merging the Agency of Science, Technology and Innovations with the Research Council of Lithuania, which was allocated more resources. A new program for scientific research, experimental development and innovation was adopted. Additionally, the government established a mission-driven model of science and innovation to foster cooperation between research institutions and businesses in three areas, one of which is called “Smart and Climate-Neutral Lithuania” (The Government Annual Report for 2022, 2023).

Citation:

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Netherlands

Score 7

Regarding the overall knowledge infrastructure, the Netherlands stands out as a leading performer, ranking fourth among 133 countries in the Global Knowledge Index 2023 (GKI) and fourth among the 61 countries with very high human development. Strengths highlighted in the GKI include youth engagement in education and training, individual internet activities, government expenditure on vocational education, insolvency recovery rates and the number of secure internet servers per million people.

In terms of Research and Innovation (R&I), as defined narrowly, the 2023 EU Innovation Scoreboard identifies Denmark as the new top innovator, with Sweden, Finland, the Netherlands and Belgium also among the innovation leaders. The Netherlands’ performance, while slightly above the average of these leaders, also shows a rate of increase that is marginally higher than the EU average (8.5 percentage points). The country’s performance lead over the EU is thus becoming larger. The country excels in areas such as public-private co-publications, foreign doctoral students, lifelong learning opportunities, international scientific collaborations and citizens with advanced digital skills. However, it is weaker in the areas of non-R&D innovation expenditures, sales of innovative products, exports of medium- and high-tech goods, environmental technologies, and the number of doctoral graduates.

Dutch investment in R&D has significantly increased, from half a billion euros in 1964 to €9.5 billion in 2021. However, the overall share has remained between 1.64% and 2.31% of GDP for over five decades. Despite aiming to meet the EU’s

Lisbon Treaty target of 3% of GDP, achieving this would require a leap of +0.7% of GDP. In fact, neither public nor private investments in R&I are likely to rise by this level. Public spending on R&D as a percentage of GDP has stagnated at about 0.63% to 0.70% despite nominal increases, reflecting the fact that economic growth has outpaced R&D spending growth. Similarly, business investment in R&D in the Netherlands, which is below the OECD average of 1.75%, is not expected to increase substantially, despite significant government fiscal incentive programs.

Challenges in increasing R&D expenditure are rooted in the Dutch economic structure, where sectors like ICT/software, high tech, automotive and pharmaceuticals are R&D-intensive, but others such as oil and gas, trade, hospitality and construction dominate. This mix strongly influences private R&D investment levels, with the Netherlands having comparatively low representation in three of the four most R&D-intensive sectors. Among the R&D-intensive sectors, the Netherlands has the greatest presence in high tech, with companies like Philips, ASML and NXP.

The aspiration of reaching R&D expenditure totaling 3% of GDP cannot be realized through incremental funding increases alone. Instead, a knowledge and innovation covenant aims to foster collaboration among government, businesses and knowledge institutions on five core missions: energy transition, circular economy, agriculture-water-food, health and care, and safety. This initiative involves ministries, interprovincial consultation bodies and private sector partners like Invest NL and regional development agencies (ROMs). The budget overview consists of a long list of promised contributions by the ministries, knowledge institutes (like TNO, Deltares, NLR), applied universities, and the public-private investment “vehicles.” All in all, this is not a focused push to increase public R&D spending to 3% of GDP, but a haphazard cobbling-together of existing initiatives with already approved budgets.

Citation:

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Invest NL. 2023. “Terigblik 2023: bredere rol als Nationale Financierings- en Ontwikkelingsinstelling.” December 20.

Sweden

Score 7

Research and innovation policies have traditionally been a priority for a country whose competitive advantage lies in the knowledge sector. Sweden is one of the eco-innovation forerunners (Rosenberg Johansen, 2022) and, through its commitment to the circular economy, has a distinct focus on sustainable development, economy, and society. Innovation is driven by Vinnova, which has a series of publications for

different sectors. However, there is no single national strategy that can be characterized as a roadmap for innovation.

One of Sweden's research councils, FORMAS, is the Swedish Research Council for Sustainable Development. It funds basic and needs-based research in the fields of the environment, agriculture, and spatial planning. The council's budget was SEK 1.87 billion in 2023. The 2021 budget increased under the previous government's higher education and research policy titled "Research, Freedom, Future – Knowledge and Innovation for Sweden."

However, this is about to change. A recent commission of inquiry proposes that FORMAS – as well as other research councils – be phased out as they restructure into three (or alternatively, two) funding agencies. It is unclear how sustainability will be addressed in this structure; the word appears twice in the English summary (once in a footnote) and once in Swedish (SOU, 2023).

Citation:

Rosenberg Johansen, M. 2022. "Eco-Innovation Country Profile: Sweden." <https://circabc.europa.eu/ui/group/96ccdecd-11b4-4a35-a046-30e01459ea9e/library/a28d6b32-bc8e-4dc9-9280-d26b368ad824/details>

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Sveriges Riksdag. 2020. "Forskning, frihet, framtid – kunskap och innovation for Sverige." Utbildningsutskottets betänkande 2020/21: UbU16. <https://data.riksdagen.se/fil/D71AB561-F45A-4EBB-93AD-8FAA9A7FD49C>

Switzerland

Score 7

Switzerland's achievement in terms of innovation is considerable. It spends 3.4% of GDP (2021) on research and development, placing it among the world's top spenders on R&D, comparable to the U.S., Sweden, Austria and Germany, and clearly ahead of the EU average of 2.1% (2021; OECD 2023; FSO 2021). Switzerland is ranked among the five leading nations in terms of innovation (Foray 2022).

Sixty-eight percent of research spending is corporate spending with the direct aim of economic innovation, an important factor in the country's strong overall competitiveness. With a share of about 29%, public research funding plays a lesser role than in other European countries. The R&D system depends on six main actors: the universities of applied sciences, the cantonal universities, the two federal institutes of technology, the National Science Foundation, the Federal Commission for Technology and Innovation, and the academies of sciences. These actors are independent of each other but cooperate based on complementarity and (limited) competition. The various institutions are highly autonomous, and research policies and processes are driven by bottom-up operations.

Thus, Swiss research policy is not centralized, but rather relies on a concept of decentralized innovation with periodic intervention by the federal government. The

output of the research system is impressive. The federal institutes of technology in Zurich and Lausanne number among the top-ranked universities in the world, and the universities of Basel, Bern, Geneva and Zurich regularly appear on the list of the 150 best universities worldwide.

Given this decentralized structure of research and innovation; a university system which is based on the cantons – with the exception of the two federal institutes of technology – and a strong reliance on privately financed R&D, the role of the federal government in utilizing research and innovation as drivers for the transition to a sustainable economy and society is very limited. Every four years, it submits a document to the national parliament detailing its requests for public funding of R&D and stating its goals. It claims to contribute “to sustainable development and equal opportunities in all areas. In this way, it also contributes to the implementation of the 2030 Agenda and thus supports the development of the 2030 Sustainable Development Strategy” (Federal Council 2020).

Basically, an observer’s own political views will affect judgments of whether a sustainable economy and society requires a clear commitment and strategy on the part of the central government, or whether sustainability may be best served by a decentralized and competitive approach. The latter stance would probably correspond to the views of a large share of the Swiss political elite.

A major problem for Swiss R&D is exclusion from EU research funding and researchers’ limited access, as external partners financed by Swiss institutions, to these EU programs (Baschung and Leresche 2023). This has been due to stalled negotiations that have undermined the relationship since May 2021. At the time of writing, some rapprochement between the EU and Switzerland appeared evident, which may mitigate these problems in the foreseeable future.

Citation:

Baschung, Lukas, and Jean-Philippe Leresche. 2023. “Research, Technology, and Innovation Policies.” In *The Oxford Handbook of Swiss Politics*, eds. Patrick Emmenegger, Flavia Fossati, Silja Häusermann, Yannis Papadopoulos, Pascal Sciarini, and Adrian Vatter. Oxford: Oxford University Press, 623–641. <https://doi.org/10.1093/oxfordhb/9780192871787.013.32>.

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Ireland

Score 6

In 2023, the Department and Minister for Higher and Further Education, Research, Innovation and Skills (DHFERIS) oversaw the merger of the Science Foundation Ireland (SFI) and the Irish Research Council (IRC) into The Research and Innovation Agency (Taighde Éireann-Research Ireland). Although its launch was not explicitly linked to sustainable goals, it was connected to climate change, poverty, economy, and society. The agency is regulated by the binding Research and Innovation Bill (2023). This approach is arguably more central and sustainable than previous economic innovation-oriented organizations, such as Forfás (1994; the national policy advisory board for enterprise, trade, science, technology and innovation) or the National Competitiveness Council (1997), which analyzed data on sectors of the Irish economy. The World Economic Forum's Global Competitiveness Report 2023 ranked Ireland 2nd out of 64 countries in terms of global competitiveness (11th in 2022), based on the ability to create and maintain a competitive business environment. However, Enterprise Ireland (2023) highlights that venture capital for scaling up from small to medium enterprises remains a long-term problem in Ireland, hindering an innovation-friendly environment that enables startups to effectively translate scientific advancements into more resource-efficient products.

Ireland's Climate Change Assessment (O'Mahony and Torney 2023) considers the national public innovation policy as evolving toward further embracing climate action, as seen in the recent national innovation strategy 'Impact 2030' (DFHERIS 2022). The assessment notes that Impact 2030 uses terminology and framing associated with systems change and deeper integration associated with transformation. However, it has not employed transformational time frames extending to 2050 and beyond. The assessment also highlighted that the absence of a strategic assessment of long-term impacts and opportunities in Ireland, combined with limited transformational policy framings, negative conclusions on transition, and constrained funding for climate and sustainability-related R&D, suggests a misalignment of national research, innovation and investment with transformational outcomes and associated benefits (O'Mahony and Torney 2023).

The assessment acknowledged that Irish innovation policy has evolved and is framed differently by various public policy actors. It also noted the strengths of the recent research and innovation strategy to 2030 (DFHERIS 2022), which includes climate, environment and sustainability as one of five key challenges and opportunities. However, international observers have pointed out weaknesses in Ireland's innovation system, including low R&D funding, unbalanced support for businesses, and insufficient cooperation between firms and research bodies (European Commission 2020). The OECD (2021) noted that overall funding for R&D in Ireland, both public and private, is half the EU average when measured as a

percentage of GDP. Furthermore, government funding for R&D is relatively dominated by agriculture, at 13% in 2019, while environment and energy received only 2% of government R&D funding, among the lowest shares across the OECD.

Citation:

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DFHERIS. 2022. Impact 2030: Ireland's Research and Innovation Strategy. Department of Further and Higher Education, Research, Innovation and Science. <https://assets.gov.ie/224616/5f34f71e-e13e-404b-8685-4113428b3390.pdf>

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Italy

Score 6

Italy has struggled with research and innovation policy due to low public funding and an economic structure based on small and medium-sized enterprises with a lower propensity to invest in research and innovation. Italy is a moderate innovator according to the latest European Innovation Scoreboard, which shows a decline in public and private funding indicators between 2022 and 2023, as well as a decrease in product innovators and innovative enterprises.

The governance of R&I in Italy is complex, involving multiple ministries, including the Ministry of Higher Education, the Ministry of University and Research, the Ministry of Economic Development (referred to by the Meloni government as the "Ministry of Made in Italy"), the Ministry of the Environment, and the Ministry of Transport and Infrastructure. Coordination of R&I has been poor, particularly regarding its links with other policy areas like industrial policy, development policy, and digitalization.

This logic posits that public research serves as a catalyst for private investment in research and innovation. By fostering conducive ecosystems, public research helps transform ideas into new products, processes, and services. The ultimate goal is to create high value-added jobs and engage the most dynamic and productive sectors in international markets.

The NRRP seeks to change this perspective by placing research policy within a broader transformation of the Italian economic system. It integrates public expenditure on research with experimental development, technology transfer, and

private spending on research, aiming to create favorable ecosystems for innovation. The NRRP plans to invest over €6 billion in R&I activities, including direct transfers to companies, partnerships between companies and universities, “innovation ecosystems,” “territorial R&D leaders,” national R&I champions, and doctoral programs for innovation and industry.

This effort is part of a complex plan linking to the national research plan (2021–2027), the strategic plan for AI (2022–2024), and the plan for the ecological transition. Despite efforts to improve the quality and impact of R&D policy, there appears to be no significant and effective government monitoring of these policies’ results.

Citation:

Acciai, C. 2023. Policy Design for Research and Innovation Politics, Institutions and Interest Intermediation Practices. London: Palgrave.

European Innovation Scoreboard. 2023. “Italy.” https://ec.europa.eu/assets/rtd/eis/2023/ec_rtd_eis-country-profile-it.pdf

CNR. 2022. Relazione sull’innovazione e la ricerca in Italia (2021). https://www.dsu.cnr.it/wp-content/uploads/2023/10/Relazione_sulla_ricerca_e_innovazione_in_Italia_2021.pdf

New Zealand

Score 6

New Zealand has several research and innovation strategies, the most notable of which is the National Statement of Science Investment (NSSI). This document outlines the country’s approach to investing in research, science and innovation. Additionally, there are sector-specific strategies and initiatives aimed at promoting research and innovation in key areas such as agriculture, health, technology and environmental sustainability.

The Ministry of Business, Innovation and Employment (MBIE) is the lead government agency responsible for implementing research and innovation strategies. A key function of MBIE is to facilitate collaboration and partnerships among government agencies, research institutions, industry and other stakeholders.

The government has demonstrated a commitment to using research and innovation as drivers for the transition to a sustainable economy and society. Two strategies that focus on leveraging research and innovation for sustainable development are particularly noteworthy.

First, the government has allocated funding and support for research and development (R&D) initiatives, aiming to foster innovation in areas such as clean energy (Stuff 2023), sustainable agriculture (Flaws 2020) and conservation (Green 2022). Second, policies have been enacted to promote technological advancements and innovation in key sectors, emphasizing sustainability goals. For example, the Labour-Green government has made efforts to support renewable energy

technologies and the development of eco-friendly practices through its 2022 Emissions Reduction Plan (Gibson 2022).

However, it is important to place these strategies in the context of New Zealand's research and innovation regime, which has long been criticized for its ineffectiveness (OECD 2007). In the latest Bloomberg Innovation Index, which scores countries using seven criteria including R&I spending and the concentration of high-tech public companies, New Zealand ranked only 25th. This ranking followed a four-place drop in 2018, which saw New Zealand slip from 19th to 23rd place and then to 24th place in the subsequent Bloomberg Innovation Index (Jamrisko et al. 2021). Likewise, in the 2023 Global Innovation Index published by the World Intellectual Property Organization, New Zealand ranked only 27th. The report highlights relatively low levels of science and innovation investment as a particular weakness (World Intellectual Property Organization 2023).

Citation:

Flaws, B. 2020. "Government contributes \$10m to future farm technology programme." Stuff, December 21. <https://www.stuff.co.nz/business/farming/123707601/government-contributes-10m-to-future-farm-technology-programme>

Gibson, E. 2022. "What you need to know about the country's first-ever emissions plan." Stuff, 16 May. <https://www.stuff.co.nz/environment/climate-news/300588033/what-you-need-to-know-about-the-countrys-first-ever-emissions-plan>

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Slovenia

Score 6

According to Eurostat, gross domestic expenditure on research and development (R&D) as a percentage of GDP in Slovenia was 2.11% in 2022. Considering that R&D expenditure in eight EU member states was less than 1% of GDP in 2022, Slovenia's performance appears favorable. However, several countries, including Slovenia, saw significant declines in R&D intensity compared to 2012, with Slovenia experiencing a decrease of 0.30 percentage points.

The data on gross domestic expenditure on R&D by sector in 2022 (as a percentage of GDP) indicates that the Slovenian business enterprise sector invested the most at 1.4%. This was followed by the government sector at 0.33% and the higher education sector at 0.27%, while the private nonprofit sector made almost no investments. This pattern is similar to other EU countries and closely aligns with the EU average across all sectors.

In terms of gross domestic expenditure on R&D in Slovenia by source in 2021, the business enterprise sector accounted for 48.7%, compared to the EU average of 57.7%. The government contributed 24.3% (EU average: 30.3%), the higher education sector accounted for 0.5% (EU average: 1.2%), and the rest of the world contributed 26.4% (EU average: 9.7%).

Slovenia is also above the EU average in the number of researchers per 1,000 employed persons in 2021, with 10.51 researchers compared to the EU average of 9.34. Although Slovenia lagged in 2000 with 4.74 researchers compared to the EU average of 5.09, there has been an almost continuous increase in this respect over the last two decades.

Overall, the data presents a relatively good or improving picture for Slovenia in 2022.

Nevertheless, some more critical views persist. For example, the Joint Innovation Index shows that Slovenia is still one of the moderate innovators. The EU's innovation performance improved from 2014 – 2021, while it deteriorated in Slovenia until 2020 and only showed improvement in 2021. During 2018 – 2022, the share of companies engaged in innovation activities in manufacturing and selected services was 55.2% (the ratio between the number of companies with innovation activities and all companies).

Recently, more ambitious targets have been set. Several important legal acts have been adopted to achieve these goals, such as the Law on Scientific Research and Innovation Activities (2021) and the Resolution on the Slovenian Scientific Research and Innovation Strategy 2030 (2022). The latter is the most important strategic document in this area and is closely linked to several other strategic documents. It forms the basis for formulating policy measures for social, economic, sustainable development, and societal challenges.

The Resolution defines the ministries and sectors responsible for implementation and their reporting obligations to the government and the National Assembly. Concurrently, the Development Council of Slovenia also monitors activities in this area. Regular evaluations must include experts from abroad, and some action plans have already been adopted.

For many research organizations, EU funds for research and innovation remain the most important source of funding, as they cannot obtain funding from national

sources for their research. Additionally, there is a general lack of resources in certain areas (e.g., social sciences and humanities).

Citation:
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https://www.oecd-ilibrary.org/economics/oecd-economic-surveys-slovenia-2022_d63f5a2f-en

Israel

Score 5

In general, Israel's research and development (R&D) sector is based on three pillars: scientific research, primarily conducted in academia at seven universities; research performed in government and public research institutes; and research carried out by civil-industrial partnerships. Government and public bodies are the primary sources of R&D funding, providing financial support for well over half of Israel's R&D activities. The major share of these funds for civil R&D purposes is allocated for economic development, mainly in the industrial and agricultural sectors (Israel Ministry of Foreign Affairs, Science, n.d).

The Israel Innovation Authority is the leading government agency responsible for national innovation efforts. This includes enhancing startups and the high-tech industry as a whole. The authority has several units that focus on startups, growth, international efforts and infrastructure. It provides grants and consults with various companies.

The authority's focus includes climate and sustainability issues. According to its recent report, USD 0.14 in every U.S. dollar invested in Israeli high-tech are directed toward climate-related ventures. Between 2022 and 2023, there was a 13% increase in Israeli companies developing various technological solutions to address climate challenges (an increase of 90 companies).

In 2022, the government adopted the 1685 decision, "encouraging Israeli innovation and promoting collaboration with the high-tech industry to address the issue of climate change." The decision includes various activities to encourage the tech sector to invest more in developing solutions for climate change and increase the use of renewable energy. However, the decision did not increase the budget for the Ministry of Science nor the Innovation Authority, and explicitly stated that any additional funding will come from the ministry's existing resources. Thus, while the decision was an important step in promoting innovation and research on climate change, the resources provided were insufficient.

The government does not periodically monitor these activities.

Citation:

Israel Innovation Authority and PLANETech. 2023. "Israel's State of Climate Tech 2023." <https://innovationisrael.org.il/en/digital-reports/>

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Latvia

Score 5

In the European Innovation Scoreboard 2023, Latvia is ranked as an "emerging innovator" with a relative performance level of 52.5 compared to the EU. This performance reflects the average investment in R&D, as Latvia allocated 0.24% of GDP in 2022, or €49.6 per inhabitant. Among EU countries, Latvia is one of those that allocated the smallest portion of its income to R&D, indicating that innovation is a low priority for national development. This lack of prioritization is evident in public debates, budgetary processes, and even strategic discussions about the country's future. R&D investments in the Latvian business sector also remain low.

In 2023, the OECD assessed the innovation framework in Latvia as weak due to minimal government and business investments in R&D relative to GDP. Additionally, the OECD highlighted that low-quality higher education needs to produce more PhD holders to boost innovation. Overall, the government needs to enhance financial incentives for business R&D.

Meanwhile, the State Chancellery has launched the "Innovation Lab" initiative, selecting 15 projects for 2023 – 2025. The aim is to improve the working practices of public administration by introducing an innovation ecosystem and a culture of experimentation.

In the 2022 Eco-Innovation Scoreboard, Latvia is among a group of average performers. This indicates that while Latvia excels in eco-innovation academic publications, it remains weak in eco-innovation-related patents and R&D. Meanwhile, venture capital funding is a new phenomenon in Latvia, with government agencies and other institutional investors currently providing the venture capital. Although the Global Startup Ecosystem Index 2023 ranks Latvia 39th in the world, there is potential for startups to become an economic driver.

The government has approved the National Strategy for Science, Technology Development, and Innovation 2021 – 2027 (approved in 2021). The National Strategy outlines specific goals and actions designed to boost innovation and activate R&D. However, maintaining the same GDP allocation as in 2022 risks implementation failures for the strategy.

The innovation policy is a shared responsibility involving several Latvian ministries, including the Ministry of Education and Science, the Ministry of Economy, and the

State Chancellery. However, interministerial policy coordination is hindered by the formal boundaries within the scope of each ministry, which substantially slows down the process.

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Portugal

Score 5

The National Innovation Agency (ANI) plays a pivotal role in advancing innovation in Portugal, aiming to transform the economy through science. It focuses on three key national objectives: energy transition, digital transition, and cohesion. ANI's responsibilities include promoting knowledge transfer to generate value for the national economy, setting priorities, and defining indicators to support the adoption of knowledge and technology by businesses and society. It also measures the performance of the National Innovation System and the impact of technology valorization and innovation policy promotion.

Furthermore, ANI oversees the National Research and Innovation Strategy for Smart Specialization (ENEI 2030), a strategic initiative aimed at fostering national innovation. It ensures the effective coordination and monitoring of this strategy's implementation, maximizing complementarity and synergies across different territorial levels. The ENEI 2030, which is transversal in nature, focuses on six priority domains corresponding to the thematic priorities for the current decade: Digital Transition, Green Transition, Materials, Systems and Production Technologies, Society, Creativity and Heritage, Health, Biotechnology and Food, and Great Natural Assets (ANI, 2023).

The country achieved a record high in total R&D spending in 2022, reaching 1.7% of GDP, with the private sector as the major contributor, accounting for 62% of national R&D expenditure (PORDATA, 2023). However, this remains below the EU-27 average of 2.2%. Similarly, Portugal's government sector expenditure on R&D accounts for only 4% of total R&D expenditure, compared to an average of 11% in the EU (Eurostat, 2023).

Although the government emphasizes research and innovation, particularly in technology, public support has not significantly increased. Portugal's R&D investment is not only below the OECD average of 2.7% but also falls short of the Council of Ministers' 2030 target of 3%.

In the 2023 European Union Innovation Scoreboard, Portugal is categorized as a “moderate innovator,” the second-lowest of four categories. Its performance is below the average for its category, with an increasing gap compared to the EU. Strengths include foreign doctoral students, government support for business R&D, public-private co-publications, broadband penetration, and international scientific co-publications. However, weaknesses are evident in areas like air emissions, innovation expenditure per employee, venture capital investments, environmental technologies, and resource productivity.

Despite these challenges, Portugal offers a somewhat favorable environment for startup development, including investments in “unicorn hubs” that support innovation communities in fields like AI, gaming, blue tech, fintech, sustainability, foodtech, and XR. This initiative began in 2023 with the launch of the Soft Launch and Scaling Up programs (ECO, 2023). Additionally, Lisbon has hosted the Web Summit – Europe's largest technology conference – since 2016.

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Slovakia

Score 5

The Slovak government rhetorically commits to leveraging research and innovation as key drivers for transitioning to a sustainable economy and society. The Council of the Government for Science, Technology, and Innovations has been established. The most recent national research and innovation strategy (Výskumná a inováčná autorita, 2023) was prepared by the Slovak Research and Innovation Authority, an entity within the Office of the Government of the Slovak Republic responsible for coordinating research and innovation. The preparation of this strategy involved over 200 experts from both the public and private sectors.

A roadmap for executing this strategy is in place, detailing clearly defined goals, time frames, and, in most cases, resources and performance indicators outlined in the annex to this strategy. However, the strategy and its annexes are not legally binding. The first part of the annex specifies sector-specific goals, which align well with the overall targets. The second part of the annex lists cross-sectoral goals (activities) designed to support research and innovation in Slovakia. For example, Activity 1.1.1.2 aims to develop a plan for consolidating the responsibilities of individual ministries, agencies, and institutions involved in research and innovation policy and support. The expected outcome of this activity is improved research and innovation development management, with participation anticipated from 11 ministries.

The government promotes an innovation-friendly environment through various measures. According to Pisár, Ďurčeková, and Křápek (2021), EU funding has been the primary source of public support for business innovation in Slovakia since 2006. National public investment in research and innovation remains among the lowest in the EU.

Specific measures are in place to enable startups to effectively translate scientific advancements into more resource-efficient products. The Conception for the Support of Startups exists but has not been updated for nearly a decade. Startups receive both financial and in-kind benefits.

Specialized bodies supporting startups include the Slovenská záručná a rozvojová banka and the Slovak Business Agency. There are no significant bureaucratic obstacles hindering the application process for support.

While raising venture capital for startups may pose challenges, private banks also offer specific programs providing loans to startups. For example, Slovenská sporiteľňa runs a special program, “Program pre začínajúcich podnikateľov a podnikateľky,” designed to support startups.

Citation:

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<https://www.sbagency.sk/>

<https://www.slsp.sk/sk/biznis/zaciname-podnikat>

Australia

Score 4

The government has expressed its commitment to innovation to advance its climate goals, but this has not been matched by concrete policies and outcomes. Since 2021, the government has released Low Emissions Technology Statements (LETS) as part of a roadmap to achieve net-zero emissions by 2050 (Commonwealth of Australia 2021). The LETS is a key policy document in this effort, outlining the technology-reliant path to net zero and aligning with government funding plans while signaling to private sector investors. Five priority technologies were identified in the first LETS, released in 2020: clean hydrogen production, improvements in energy (electricity) storage, low emissions materials production (particularly steel and aluminum), reducing the cost of carbon capture and storage, and reducing the cost of soil carbon measurement. The most recent LETS, released in 2021, added ultra low-cost solar power to the list of technology priorities.

However, the LETS initiative's focus on technology highlights the multiple meanings of innovation in the Australian context. Some approaches emphasize technology, while others focus on culture. Commentators (Lewis and Mikolajczak 2023) argue that these diverse approaches indicate a lack of coherence in thinking and policymaking around innovation. Australia has cited innovation as key to reducing greenhouse gas emissions. While there has been progress in some sectors, reforming laws and incentives could stimulate greater innovation in support of Australia's net-zero target (Dean et al. 2023).

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Canada

Score 4

Very little thought is given to sustainability transitions in Canada. No overarching national strategy with binding targets guides R&D across sectors, and efforts are uneven across industries and regions. Some sector-specific plans exist (e.g., cleantech strategies) but are siloed, as inconsistent prioritization and coordination across departments and industries is the norm (Niosi 1991; 1998).

Multiple agencies and ministries fund innovation with overlapping mandates – for example, the NRC, CFI, NSERC, and SSHRC – supporting both academic and industry research without emphasizing sustainability issues. Base funding for researchers remains below that of global peers, and tax incentives for private R&D are complex and inadequate. This situation follows a series of scandals in the 1990s and 2000s involving excessively loose incentives.

Despite large public investments in innovation policy, outcomes in that area are generally unimpressive. Yet, there are at least two exceptions to this observation. Canada has improved its situation with regard to access to venture capital and investments in higher education research and development (Scharf 2022).

Some monitoring of economic trends occurs through output metrics such as patents and publications, but comparable measures of environmental and economic impact are generally lacking.

While reasonably strong supports exist for startups and venture capital funding, scaling firms still face commercialization barriers from established companies, especially in the nearby U.S. market.

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Greece

Score 4

While Greece has a comparable number of researchers to other EU countries (researchers per 1,000 employed, Eurostat 2021a), public and private expenditure on research and innovation are far below the EU average (Eurostat 2021b).

There is a national strategy and a national plan to promote research and innovation (Ministry of Development 2023, Greek Government 2023). The strategy and the plan

are formulated by the General Secretariat for Research and Innovation (GGEK) – a central unit of the Ministry of Development – and an independent council of scientists and experts, the National Council for Research, Technology, and Innovation (ESETEK).

However, the government does not consult the ESETEK council on a systematic basis, and the implementation of the national strategy, which is centralized, is slow. Monitoring the progress of research and innovation outcomes occurs sporadically.

Compared to other OECD countries, Greece lags in high-tech exports, intellectual property licenses, and various types of patents (Eurostat 2021). This deficit is primarily due to the relatively small size and low internal differentiation of Greek firms, as well as the chronic underfunding of research and innovation.

There is a newly emerging sector of innovation-oriented startup companies, but it is too early to assess its evolution. Moreover, there are good prospects for enhancing research and innovation soon, as this policy area is included in the fourth pillar of the “Greece 2.0” plan, financially supported by the EU’s Recovery and Resilience Facility (Greek Government 2021).

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The website of the General Secretariat for Research and Innovation (GGEK) is <https://gsri.gov.gr/en/>

The website of the National Council for Research, Technology, and Innovation (ESETEK) is <https://esetek.gov.gr/en/home/>

Hungary

Score 4

Hungary presents a mixed picture concerning research and innovation. The country’s overall number of patents is low, but intellectual property holdings are stronger. Concerning high-tech exports, the performance is solid. Hungary belongs to the eco-innovation catch-up group (Gulyas 2022: 3), having shown a slow but continuous climb up the ranks in this group, while still displaying a growing gap relative to the

EU average. Hungary was at 69.8% of the EU average in 2022, and while the EU improved by 9.9%, Hungary achieved only a 7.1% improvement (European Innovation Scoreboard 2022). In the eco-innovation index, Hungary reached 96.2% of the EU average, with extraordinary strength in societal behavior (134.7) but weaknesses in the area of business operations (78.4) (Gulyas 2022:3).

Hungary's strengths lie in the number of foreign doctorate students, the level of government support for business R&D, medium and high-tech goods exports, and job-to-job mobility in a flexible labor market. However, there has been a decrease in the areas of sales of innovative products, environment-related technologies, resource productivity and innovation expenditures per employee (European Innovation Scoreboard 2022).

Data from the Hungarian Statistical Office (KSH) indicate that R&D expenditures in the public sector grew steadily until recently, but have now taken a negative turn. From the peak year of 2021, R&D expenditure as a share of GDP fell sharply to 1.39% in 2022. R&D as a share of total investment peaked in 2017 at 1.10% but decreased to 0.69% in 2022.

In recent years, the government has initiated highly controversial structural reforms that have infringed upon academic freedom (Enyedi 2018; Pető 2018) and are likely to weaken the country's research and innovation (R&I) performance. The creation of the new, powerful Ministry of Innovation and Technology (ITM) has been accompanied by the "privatization" of universities and the restructuring of the Academy of Sciences (MTA). Privatizing universities has involved placing eight institutions under newly established "private" foundations controlled by loyal Fidesz supporters. Some of these supporters have had to resign due to conflicts of interest flagged by the European Commission within the rule-of-law conditionality mechanism (Balkan Insight 2023). The MTA has been stripped of its research institutes, leading to the creation of the Lóránd Eötvös Research Network (ELKH, Eötvös Lóránd Kutatási Hálózat). Officially justified as an attempt to make the public research sector more competitive, these changes have drastically reduced the autonomy of the institutions. The R&D sector faces significant challenges, and government action is required. Cooperation between scientific institutions appears to be an issue, particularly in the energy sector and with regard to carbon neutrality policies. The current plan provides minimal information on research, innovation and competitiveness measures in clean and low-carbon energy technologies. It does not include quantified national-level targets (European Commission 2023:6). Following the 2022 general elections, the government structure was reformed again. The Ministry of Innovation and Technology was dissolved, and a new Ministry of Culture and Innovation was established. This new ministry no longer controls energy policy, which has been outsourced to a separate Ministry of Energy.

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Poland

Score 4

Government attention to research and innovation has increased, but outcomes have been modest. Oversight for these areas falls under the Ministry of Development and Innovation and the Ministry of Education and Research. These bodies have issued strategies for sustainable development, such as "Innovations for a Digital, Green, Healthy and Socially Sustainable Future" (2022) and "State Scientific Policy" (2022). Although these strategies address digital and green transformation and sustainable development, their goals were broadly defined but not quantified, and were not formalized in legislation. The National Center for Research and Development (NCBR), which sits under the Ministry of Funds and Regional Policy, is tasked with advancing new technologies. Despite programs addressing strategic energy, AI and health, allegations of grant system transparency issues emerged in 2023.

One significant development in the research sector has been the evaluation of higher education institutions. The 2022 evaluation, which followed controversial changes in journal scoring – especially affecting Polish journals – was criticized for its impact on results and research relevance. The next evaluation will cover the 2022 – 2025 period.

There are positive signs, such as increased R&D spending. In 2022, gross domestic expenditure on research and development (GERD) rose to PLN 44.7 billion, an 18.6% increase from the previous year. GERD per capita reached PLN 1,182, up 19.2% from the prior year. The number of R&D entities grew by 0.8% (GUS 2023a). Pro-innovation tax incentives have been effective, with the R&D tax credit now allowing deductions of up to 200% of qualified costs. Between 2020 and 2022, 36.1% of industrial and 34.2% of service enterprises engaged in innovation. In 2022, revenue from new or improved products accounted for 6.9% of total sales for industrial enterprises and 2.7% for service enterprises (GUS 2023b).

In the 2023 European Innovation Scoreboard, Poland scored 68 points, surpassing the EU average within the "emerging innovators" category, but still well below the EU average of 110 points (European Commission 2023). In the area of eco-

innovation, Poland outperformed the EU average in only two areas – water productivity and eco-innovation-related academic publications – and ranked second-lowest among EU members with a score of 67.4 points, comparable to the 2013 EU average (European Environment Agency 2023).

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