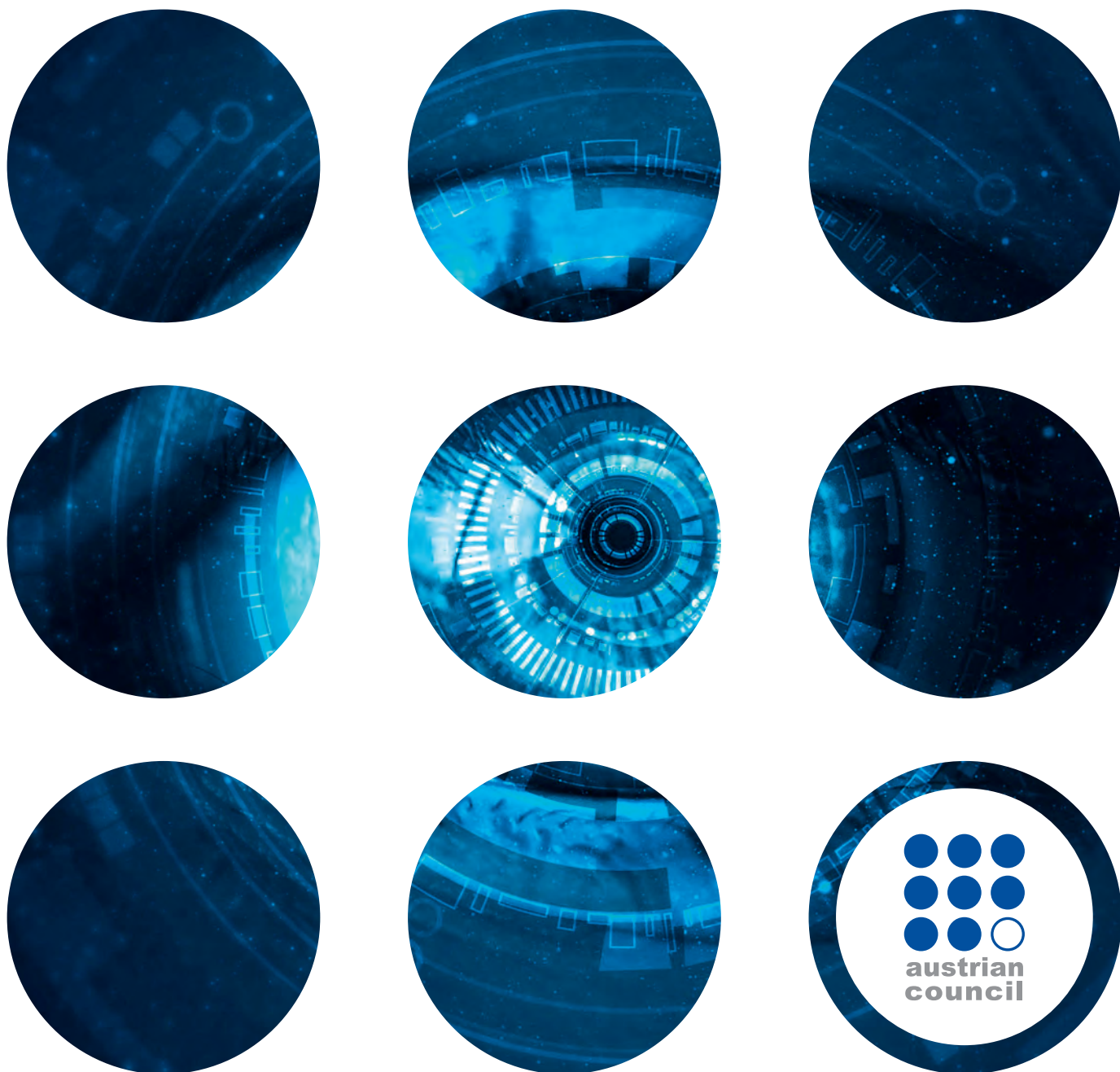


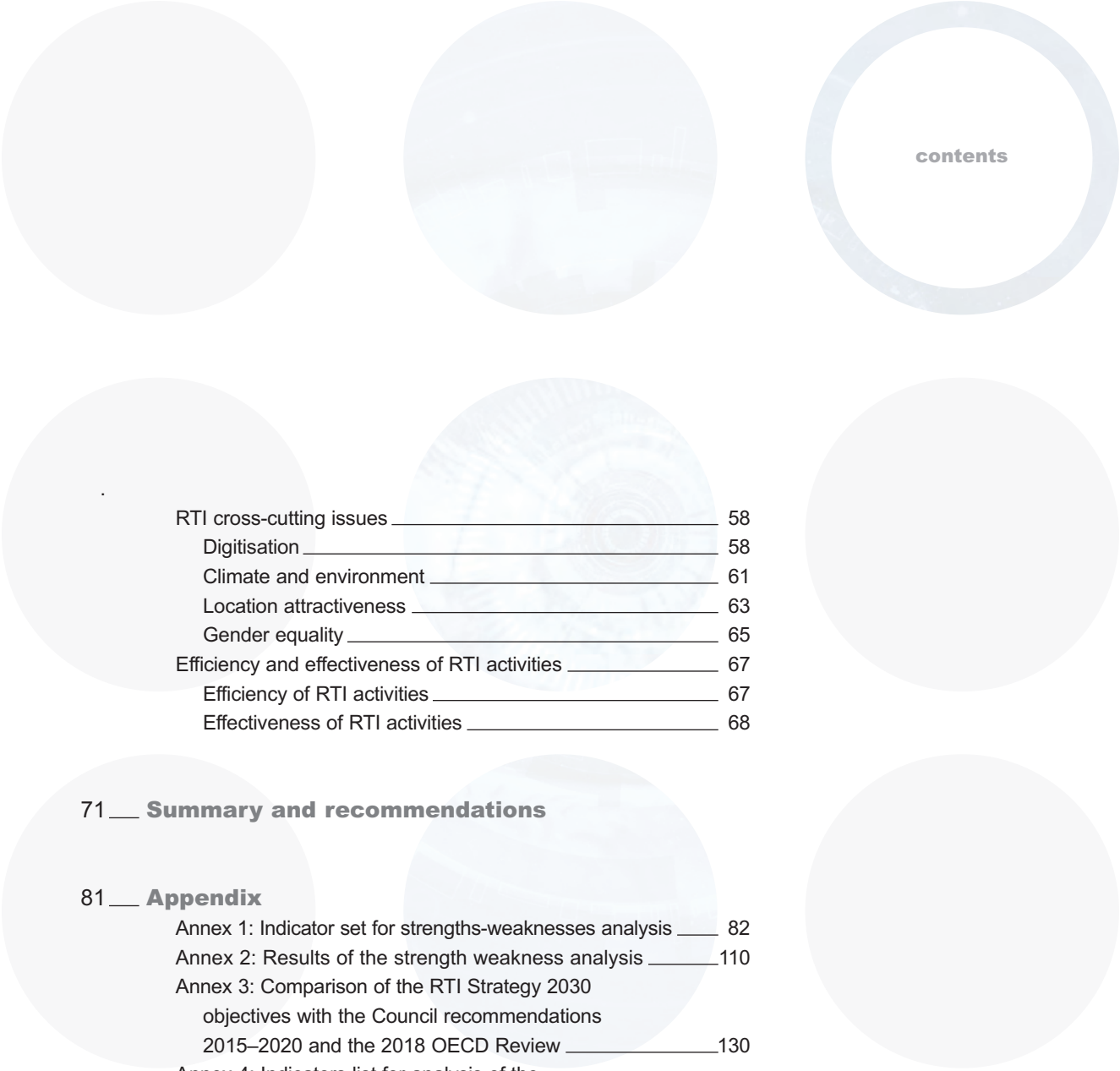


Report on Austria's Scientific
and Technological Capability
2021



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preamble

The COVID-19 pandemic has gripped the world for over a year now. The virus was first detected in December 2019 in Wuhan, China, and given the name SARS-CoV-2. Soon thereafter, alarming reports spread that this virus was a new and potentially dangerous pathogen, which could trigger a global pandemic. We all know what came next only too well. Completely unknown however, is how long the pandemic and its collateral damages might still be with us. All predictions indicate the years ahead will be characterised by slower growth, increased unemployment and higher inflation. Even if the ultimate effects of the pandemic cannot be reliably estimated at the moment, it is nonetheless already clear that in their totality these will mark the starkest milestone of recent decades.

The latest available forecasts show the strongest negative economic growth dynamic since the Great Depression for almost every country around the world. The pandemic has indeed mobilised scientific research in an unprecedented way (especially in the scientific-medical area), but we can now already see that companies are cutting their R&D expenditure and reducing their innovation activities due to the pandemic-related economic slumps. On the other hand, the high national debt can result for financing social and economic emergency programmes in states sharply limiting their budgets for supporting research and innovation in the near future.

This would have serious negative implications for both national RTI systems and for economy and society, as it would endanger long-term growth potential. If spending for R&D is sharply cut today, in view of the long-term applied nature of such investments, it would mean lower production potential with falling growth rates in the future and a lower capacity for meeting social challenges, such as that of climate change, for example. Faced with such a scenario, due to the above-average high domestic R&D intensity to date, it must be

feared that Austria could fall behind the innovation leaders, and even behind aspiring industrial nations. With the pending discussions on future budgetary prioritisations, the key role of the RTI area should therefore be given special consideration.

In this respect, it must be positively emphasised that the Austrian Government took RTI policy-relevant steps right in the middle of the pandemic's second wave. On 23 December 2020, the Cabinet adopted the Austrian Government's RTI Strategy 2030 and the RTI RTI Pact 2021-2023. With presentation of the strategy document a new strategic basis for the RTI policy of the coming decade was created; the RTI Pact is the basis for greater planning and financing security. The Austrian Council essentially welcomes the strategy and the RTI Pact. The Council believes the strategy includes ambitious and thoroughly specific objectives for the RTI system and a series of important agenda settings, with which the goal of having Austria join the international leaders and expanding into a top location for research, technology and innovation is further pursued. This would continuously send positive signals to the RTI community. The strategic objectives must therefore now be pursued with greater emphasis and the package and the measures it includes must be specifically implemented.

The Covid-19 crisis has illustrated the key role that science, research, technology and innovation have for our modern societies. RTI activities must therefore also continue to be anchored as key future areas on the political agenda and the steps required to implement the strategic goals must be taken consistently. As a supporting committee for the Austrian Government's work and the ministries responsible for the RTI area, the Council will also continue to accompany the implementation activities to achieve the strategic objectives in the RTI system. This report provides an evidence-based foundation for defining the priority areas of action based on available data.



Dr.ⁱⁿ
Klara Sekanina
Chairwoman of the Austrian Council



DIⁱⁿ Dr.ⁱⁿ
Sabine Herlitschka, MBA
Deputy Chairwoman of the Austrian Council



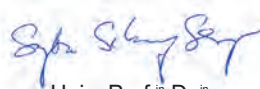
Univ.-Prof. Dr.
Jakob Edler



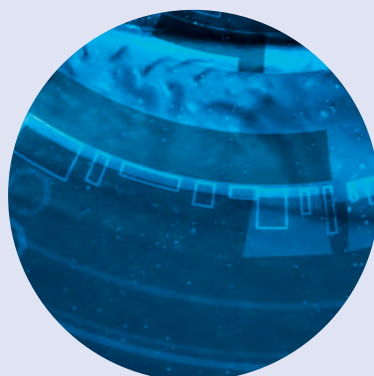
Dr.
Hermann Hauser



em. Univ.-Prof.ⁱⁿ Dr.ⁱⁿ
Helga Nowotny



Univ.-Prof.ⁱⁿ Dr.ⁱⁿ
Sylvia Schwaag-Serger



executive summary

This report records the results of the analysis of the objectives of the Austrian Government's Strategy for Research, Technology and Innovation

(RTI Strategy 2030) and the analysis of the current strengths and weaknesses of the Austrian RTI system in the international comparison.

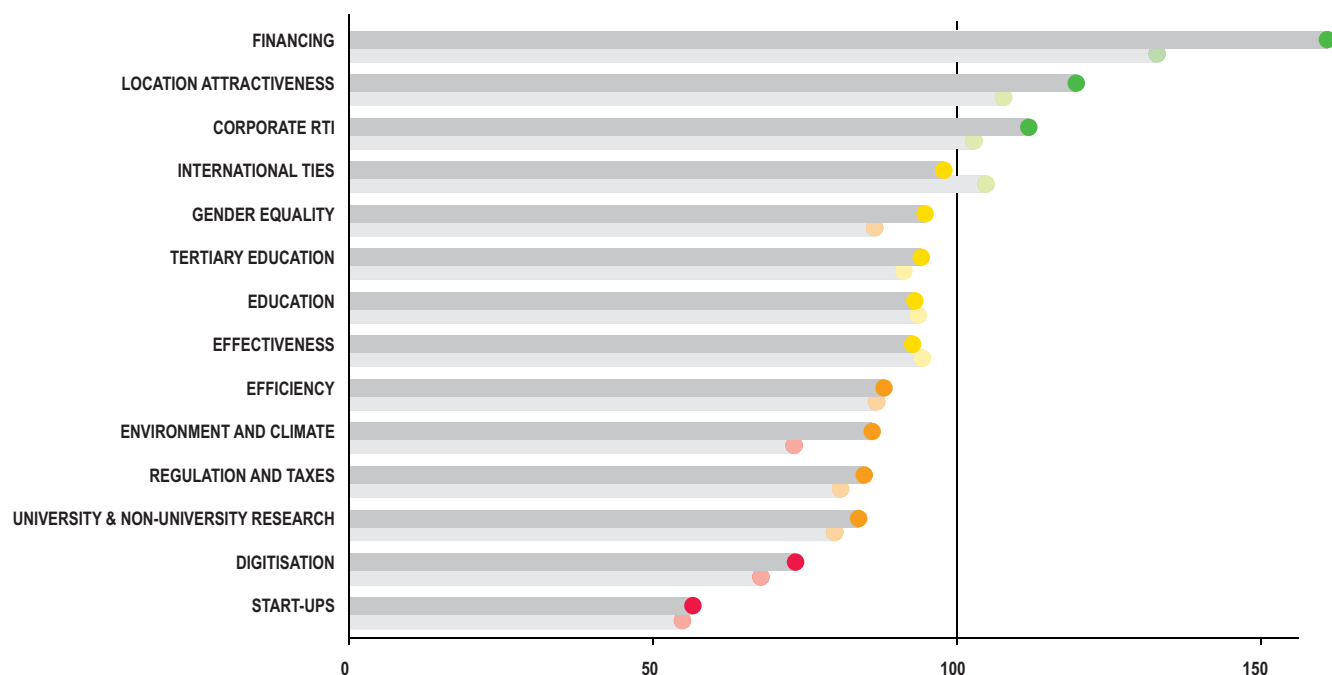
RTI system weaknesses outweigh the strength areas

The essential results of the strengths-weaknesses analysis are provided in figure I. It illustrates how the Austrian RTI system has remained stable for some years in international comparison, however it also shows patchy performance with some strengths and significant weaknesses. The RTI policy therefore still faces major challenges. In equal measure they affect the framework conditions for research, technology and innovation, the core RTI system,

the cross-cutting issues (especially digitisation, followed closely, however, by climate and environment), as well as the efficiency and effectiveness of RTI activities.

While three clear strength areas can be identified compared with the leading innovation nations, Denmark, Finland, Luxembourg, the Netherlands and Sweden, those areas in which Austria now even shows a significant distance to the innovation leaders predominate.

Figure I: Overview of Austria's strengths and weaknesses compared with the innovation leaders (light grey bars show previous year's values)



For sources, see Annex 1.

Key: Goal achievement = 100; **green**: value over 110; **bright green**: value between 100 and 109; **yellow**: value between 90 and 99; **orange**: value between 76 and 89; **red**: value under 75.

Strength areas face challenges, too

The RTI system's strengths include the generally above-average level of R&D funding, high RTI support and performance of existing companies and the attractiveness of the business location. Austria also performs well in the area of international networking – the distance to the leading nations is minimal here.

However, in many cases these positive findings are accompanied by deteriorations. The corporate innovation area, for example, shows considerably better performance in the inputs area. In terms of relevant outputs, however, Austria continues to be behind the innova-

tion leaders. This is particularly problematic with regard to the quality and quantity of technological inventions, as demonstrated especially by the weaker patent activities relative to the leading nations – they are of course a basis for future economic success. In the internationalisation area, we see that the scientific ties in particular exhibit downward trends in all analysed categories. And the high level of RTI funding conceals the problem of low innovation efficiency.

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RTI system weaknesses impede increases in innovation performance

The greatest weakness in the core RTI system is the area of innovative start-ups. This is problematic because, also and in particular in times of socio-economic crises, new, innovative and knowledge-intensive companies with given growth potential and appropriate growth plans are essential for structural change, technological transition and on the whole the dynamic development of modern national economies. Despite numerous initiatives in recent years, there are hardly any changes here. The corresponding objectives of the RTI Strategy to optimise start-up activity are therefore to be welcomed.

In the area of cross-cutting issues, the two global megatrends – digitisation and environmental and climate protection –, are the greatest challenges. Digitisation and digital infra-

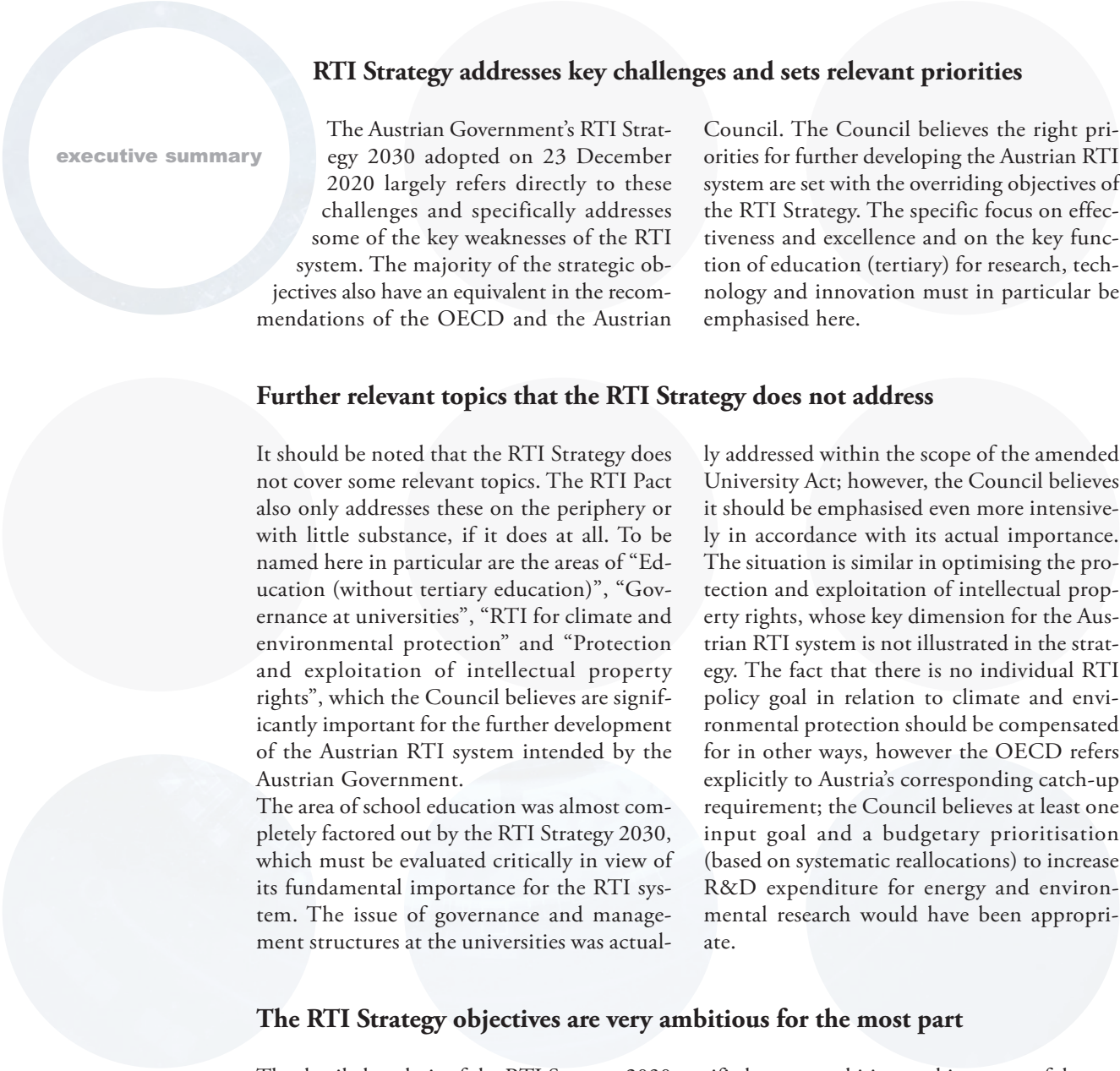
structures are the key pillars of all digital business models and therefore extremely important for the further development of modern national economies. Weaknesses in this respect must therefore be addressed specifically, as essentially intended by the RTI Strategy. Climate change is one of the key grand challenges of the near future, so there is also a need for a clear prioritisation here.

There is also improvement potential in all sub-areas of the Austrian RTI system, which must be leveraged to increase innovation performance. Especially worth mentioning is the educational system in all its variety, the framework conditions for the universities and research performance, as well as the areas of regulation and taxes.

Distance to the innovation leaders remains high

On the whole, the strengths-weaknesses analysis illustrates the need for optimisation in many areas of the RTI system. It is also evident that the development dynamic has not been sufficient in recent years to actually achieve the level of the leading nations in the majority of the examined sub-areas of the RTI system – especially in the core RTI system. On the whole,

there is still a distance to the leading European innovation nations, Denmark, Finland, Luxembourg, the Netherlands and Sweden, but also Switzerland. This has even increased further in some areas.



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RTI Strategy addresses key challenges and sets relevant priorities

The Austrian Government's RTI Strategy 2030 adopted on 23 December 2020 largely refers directly to these challenges and specifically addresses some of the key weaknesses of the RTI system. The majority of the strategic objectives also have an equivalent in the recommendations of the OECD and the Austrian

Council. The Council believes the right priorities for further developing the Austrian RTI system are set with the overriding objectives of the RTI Strategy. The specific focus on effectiveness and excellence and on the key function of education (tertiary) for research, technology and innovation must in particular be emphasised here.

Further relevant topics that the RTI Strategy does not address

It should be noted that the RTI Strategy does not cover some relevant topics. The RTI Pact also only addresses these on the periphery or with little substance, if it does at all. To be named here in particular are the areas of "Education (without tertiary education)", "Governance at universities", "RTI for climate and environmental protection" and "Protection and exploitation of intellectual property rights", which the Council believes are significantly important for the further development of the Austrian RTI system intended by the Austrian Government.

The area of school education was almost completely factored out by the RTI Strategy 2030, which must be evaluated critically in view of its fundamental importance for the RTI system. The issue of governance and management structures at the universities was actual-

ly addressed within the scope of the amended University Act; however, the Council believes it should be emphasised even more intensively in accordance with its actual importance. The situation is similar in optimising the protection and exploitation of intellectual property rights, whose key dimension for the Austrian RTI system is not illustrated in the strategy. The fact that there is no individual RTI policy goal in relation to climate and environmental protection should be compensated for in other ways, however the OECD refers explicitly to Austria's corresponding catch-up requirement; the Council believes at least one input goal and a budgetary prioritisation (based on systematic reallocations) to increase R&D expenditure for energy and environmental research would have been appropriate.

The RTI Strategy objectives are very ambitious for the most part

The detailed analysis of the RTI Strategy 2030 objectives produces a heterogeneous picture. Whereas individual goal values have already been achieved, other objectives show a distance between targeted and actual value, which is so high that goal achievement is rather unlikely. Figure II provides an overview of the respective distance to the goal values. It shows that the number of ambitious objectives with a high goal distance outweighs the others. Of the 17 objectives allocated to a defined goal, 12 can be clas-

sified as very ambitious; achievement of the targeted value only appears realistic with dedicated implementation activities. From today's perspective, the intended expansion of venture capital investments to 0.1 percent of GDP in particular and the objective of placing two Austrian universities in the top 100 appear to be over-ambitious. By contrast, the goal values connected with a top 10 placing with the ERC grants were already achieved, as was the top 3 placing with the success rate with Horizon Europe.

Conclusions

The essential conclusions delivered by the results of the analysis of the current strengths and weaknesses of the Austrian RTI system in the international comparison and the objectives of the RTI Strategy 2030 are as follows:

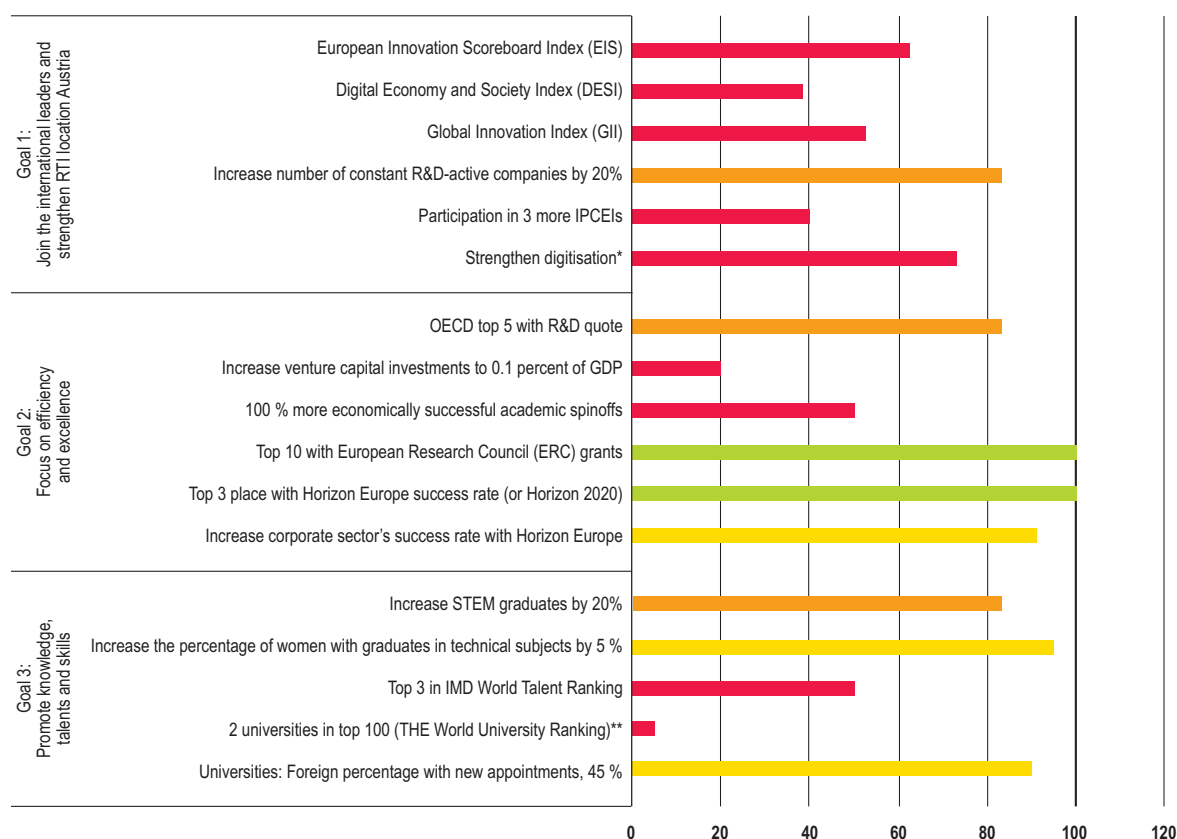
- The RTI Strategy 2030 objectives address the correct topic areas to improve the RTI system's performance. To achieve the goals,

however, key areas require ambitious steps to implement the measures defined in the RTI Pact.

- As part of implementation activities, the two greatest weaknesses of the RTI system in particular (start-up activity and digitisation) and the socially highly relevant environment and climate area must

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Figure II: Overview of distance to target values of the RTI Strategy 2030



For sources, see Annex 4.

Key: Goal achievement = 100; **green**: value over 110; **bright green**: value between 100 and 109;

yellow: value between 90 and 99; **orange**: value between 76 and 89; **red**: value under 75.

* The distance from the target is calculated based on the composite value for the "digitisation" aspect of the strengths-weaknesses analysis (see Appendix 2, table 11).

** Current value = 0; the bar was adapted in order to show the value.

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be afforded the highest priority, to ensure the connection with international trends is not lost.

- Two areas that are especially important for the RTI system's performance (the education system from primary to tertiary level and the higher education area), whose performance shows significant weaknesses in the most diverse sections,

must also be specifically addressed to improve the overall performance.

- At the same time, the existing strength areas of the RTI system must be further supported to also generate positive results in the future.
- Efficiency and effectiveness must also be increased further in all RTI system sub-areas (as also intended by the RTI Strategy).

Recommendations

Achieving the overriding objective of the RTI Strategy 2030 – joining the group of leading innovation nations and therewith the economic development to also secure social well-being and quality of life and the environment –

requires accelerated implementation efforts for the measures outlined in the RTI Strategy and the RTI Pact. In this respect, the Council in particular recommends focusing on the following areas:

Recommendations concerning Goal 1: Join the international leaders and strengthen Austria as an RTI location

- **Strengthen international competitiveness / Ranking improvement in international indices**

Particularly in view of the current crisis, the Austrian Council recommends setting a policy prioritisation on science, research, technology and innovation. The further development of the higher education area, optimisation of start-up activity, acceleration of the digital transformation and improving performance in the climate and environment area must be treated as priorities here.

- **Accelerate digital transformation**

To remove deficits in the area of digitisation, the Austrian Council recommends special focus be made on the digital transformation and the corresponding measures from the RTI Pact be implemented with greater emphasis. A national plan of action for the development of the ICT sector must in particular be adopted here and active cooperation in shaping the European framework conditions for ICT is also required.

- **Swift expansion of data infrastructures and guaranteed data access for research**

The Austrian Council recommends the swift implementation of the planned Austrian Micro Data Center at Statistik Austria. At the same time, the governance for using data must be improved to guarantee data access for research and therefore support an evidence-based policy.

- **Increased participation in European initiatives**

The Austrian Council recommends swift implementation of the RTI Pact measures provided for, in order to accelerate participation in European initiatives. The national reconstruction plan for financing participation in the two current "Important Projects of Common European Interest (IPCEIs)" must be specifically utilised to secure Austria's position in strategic value creation chains.

Recommendations concerning Goal 2: Focus on efficiency and excellence

- **Targeted funding of excellent basic research**

The Austrian Council recommends a significant increase in the share of funds for basic research awarded in competition to at least the average level of the leading nations. For this purpose, the planned excellence initiative must be implemented as quickly as possible; the proposed financing volume should also be significantly expanded. Corresponding potential for budgetary reallocation from other areas must be exploited here.

- **Improvement in innovative start-up activity**

To increase the start-up dynamic, the Austrian Council recommends a further reduction and acceleration of administrative requirements in the start-up process. To in-

crease Austria's attractiveness for risk capital investors, the Council recommends the removal of the equity capital discrimination vis-à-vis loan capital and the swift implementation of necessary structural reforms in corporate and insolvency law.

- **Increase the effectiveness of RTI activities**

The Austrian Council recommends the intended RTI Strategy contribution to achieving overriding objectives be addressed more intensively at social, economic and environmental level. The mission-orientation mechanism must be utilised specifically for this, in line with the corresponding OECD proposals.

Recommendations concerning Goal 3: Promote knowledge, talents and skills

- **More focused development of human resources and strengthening of the tertiary education sector**

The Austrian Council recommends special focus be afforded to strengthening the tertiary education system and accelerating implementation of the related measures in the RTI Pact. The offering of STEM study subjects at universities must in particular be expanded more intensively. Entrepreneurship-promoting competencies must also be anchored in the overall education system.

- **Further development of the higher education area and improvement in the universities' performance**

For the targeted improvement in the universities' performance the Austrian Council once again, and in harmony with the government programme, recommends a strategic further development of the higher education area. Student flows must be steered more effectively for this, and the number of study places at the technical colleges in particular must be expanded faster. The required financing must be secured with systematic budgetary priorities.

Recommendations on topics not anchored in the RTI Strategy

- **Optimisation of education performance in schools as a key component for the RTI system**

In view of the social selectivity of the educational system intensified by the COVID-19 pandemic, the Council recommends the implementation of more specific measures to dismantle what is referred to as "education inheritance". A "digital education strategy" is also required. The education system must be modernised so all pupils are afforded both knowledge and 21st century skills.

- **Improvement of the universities' governance and management structures**

Based on the importance of the universities for

the Austrian RTI system's performance and the increased effectiveness with the completion of university tasks for science, economy and society, the Austrian Council once again recommends the universities' governance and management structures be improved, and especially with regard to communication processes and HR management.

- **Mobilisation of RTI activities for climate and environmental protection**

In view of the deficits and relevance of the topic, the Austrian Council recommends accelerating climate and environment-relevant RTI activities. The public R&D expenditure for



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environment and climate-relevant research (including energy research) must be raised for this to the level of the comparison countries. Specific incentives must be introduced to stimulate patent activities in the environmental and energy technologies area. The innovation diffusion must be increased through the use of existing technologies, for which the mechanism of public procurement must be utilised more effectively.

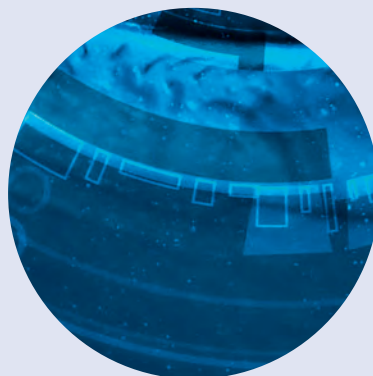
- **Increase the protection and exploitation of intellectual property rights**

Due to recent geopolitical developments, the

trade conflicts they entail and the resulting rise in IPR-related problems (especially in the USA and China), the Austrian Council recommends introducing specific measures for better protection and more effective utilisation of intellectual property rights.

- **Increase the efficiency of RTI activities**

In implementing the RTI Strategy, the Austrian Council recommends greater attention be paid to how the Austrian RTI system can better convert the high inputs into outputs and impact, in line with its advanced level, and therefore increase its system efficiency.



Background and objectives

The year gone by was almost entirely about the COVID-19 pandemic. Both the developments surrounding the pandemic events themselves and also, and especially so, the responses of the community of states are particularly extraordinary here, because with an unprecedented simultaneity, drastic measures were implemented around the globe against the new SARS-CoV-2 virus, which until just recently nobody would have believed possible – curfews were imposed, whole countries, regions and cities went into quarantine, schools and businesses closed and all events were cancelled. The result was massive economic slumps. Hardly any country wasn't or isn't affected by the pandemic and its consequences. Even in the few countries where the pandemic wasn't spreading rampantly, the effects of the lockdown were felt at least indirectly in most other states, as the globalized economy went into shock with the vastness of the closures. The movement of people, goods and services therefore broke down in 2020 to an extent never before imaginable. The result is a dramatic global recession, whose dimensions are only comparable with those of the global economic crisis of the 1930s. It is still impossible to predict how long the pandemic will continue to determine future developments. Nor can the manner in which the collateral damages seen to date will have medium to long-term impacts be predicted.

One positive aspect of the Covid-19 crisis is the rise in the importance of science observed all over the world – despite the massive scepticism of certain sections of the population

vis-à-vis science-based measures to stop the spread of infection or to produce Covid-19 vaccinations.¹ The pandemic has not only revealed to a very broad general public how key science and research are for our globally networked societies, but rather has also spread awareness of the importance of scientific findings for political decisions. It also demonstrated in real time how there was a global exchange of knowledge and research results about the SARS-CoV-2 pathogen and the essential basis to combat it was subsequently laid. Swiftly after the virus was discovered, a lively international scientific discussion developed and resulted in the virus's genome being entirely decoded within just two weeks. Thanks to international scientific cooperations and globally networked project and production structures, effective vaccines were developed and produced in vast numbers and in record time.

The simple fact of the matter is that the pandemic activated an “unprecedented mobilisation of the scientific community”, as demonstrated by the OECD in its latest “Science, Technology and Innovation Outlook 2021” report.² Although it's still not possible to estimate how high the actual expenditure for research activities connected to SARS-CoV-2 was, according to preliminary calculations by the OECD, in the first six months of 2020 alone, national research funding institutions around the globe provided more than seven billion US dollars. By the end of 2020, some 75,000 scientific publications on COVID-19 had also appeared, most of which are freely accessible via Open Access formats.

1 OECD (2021): Science, Technology and Innovation in the Time of COVID-19. OECD Science, Technology and Industry Policy Papers, No. 99, February 2021. OECD Publishing, Paris; Callaway, E., et al. (2020): COVID and 2020: An extraordinary year for science. In: Nature, 14 Dec. 2020, online: <https://www.nature.com/immersive/d41586-020-03437-4/index.html>.

2 OECD (2021): Science, Technology and Innovation Outlook 2021: Times of Crisis and Opportunity. OECD Publishing, Paris, p. 58.

Following this global research boom the OECD does, however, fear falling medium-term R&D spending, as on one hand governments must now implement tight budgets because of increased state debts, while on the other companies will wind down their R&D expenditure and innovation activities because of pandemic-related sales and profit losses.³ According to the OECD, these developments bring the risk of becoming a considerable obstacle for important research and innovation projects. This prognosis is especially worrying with regard to the required addressing of global grand challenges by science and research, because with climate change, compared with the COVID-19 crisis, comes a far more complex and more fundamental challenge for humanity.⁴

The fact that the Austrian Government recently introduced important stimuli to strengthen the Austrian RTI system and better prepare for the challenges of the future is therefore a very welcome development. This is extremely relevant, as demonstrated by the comparison with the last major economic and financial crisis in 2008: Those countries (Austria included) that focused intensively on research and innovation activities and kept their R&D expenditure constant, weathered the crisis better.⁵ It was also proven quite clearly for the corporate sector that innovative com-

panies were significantly more resistant to the effects of the economic and financial crisis, and therefore had to let considerably less staff go.⁶ Also undisputed is the fact that prioritised scientific research and innovation efforts and correlating investments in science, research and innovation are key requirements to successfully combat a crisis in the long term. The Austrian Council therefore optimistically welcomes the recently released RTI policy documents in this respect.

On 23 December 2020, the Cabinet adopted an ambitious Strategy for Research, Technology and Innovation (RTI Strategy 2030) as the key RTI policy basis for the coming decade as it begins – as basically defined in the government programme 2020-2024.⁷ With this document, the Austrian Government defines the most important strategic objectives for the RTI policy of the next ten years and defines specific areas of action for its implementation. The overriding goal here is to accelerate “Austria’s further development into a leading research, technology and innovation nation”⁸. Parallel with the RTI Strategy, the RTI Pact for the 2021-2023 period was also adopted, with which the strategy’s goals and areas of action will be operationalized and strategic RTI policy priorities will be defined.⁹

3 For this, see Reinstaller, A. (2021): COVID-19-Krise dämpft die Innovationstätigkeit österreichischer Unternehmen. Ergebnisse des WIFO-Konjunkturtests vom Dezember 2020. In: Wifo-Monatsberichte, 94(2), p. 127–138.

4 OECD (2021): Science, Technology and Innovation Outlook 2021: Times of Crisis and Opportunity. Paris, p. 71 f.

5 See Austrian Council (2020): Recommendations for the RTI policy during and after the COVID-19 crisis of 18 June 2020 The analysis of a direct causality between crisis resilience and R&D expenditure is indeed difficult; nevertheless, empirically there is a clearly positive correlation here. See, inter alia, Rammer, C. (2012): Schwerpunktbericht zur Innovationserhebung 2010. ZEW Documentation 12-03, Mannheim.

6 Dachs, B., et al. (2017): Innovation, creative destruction and structural change: firm-level evidence from European countries. In: Industry and Innovation 24, pp. 346–381.

7 Austrian Government (2020): Aus Verantwortung für Österreich. Regierungsprogramm 2020–2024. Vienna, p. 309.

8 Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 6.

9 Austrian Government (2020): RTI Pact 2021–2023. Vienna.



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This Report on Austria's Scientific and Technological Capability refers accordingly to these current developments. The first part of the report focuses on the RTI Strategy objectives. These include three overriding priority objectives with a series of specific and quantified detailed goals, which will be examined in closer detail within the scope of this report, in order to analyse their level of ambition based on development trends to date. The second part of the report provides a condensed overview of the strengths and weaknesses of the Austrian RTI system in the international comparison. Based on the results, conclusions will then be drawn for the objectives of the RTI Strategy and the prospects for their implementation, as well as priority areas of action for increasing the capability of

the Austrian RTI system on the basis of actual evidence available. An additional foundation for the activities of the responsible departments for the goal-oriented implementation of the RTI Strategy is therefore also provided.

The report's goals

1. To analyse the objectives of the Austrian Government's RTI Strategy 2030
2. To analyse the strengths and weaknesses of the Austrian RTI system in the international comparison
3. To draw conclusions and provide recommendations for the RTI Strategy's strategic objectives and priority areas of action to improve the departments' implementation activities and to increase the capability of the Austrian RTI system

Methodology

The first part of the report (“Analysis of the RTI Strategy 2030 objectives”) deals with the analysis and interpretation of the objectives of the Austrian Government’s RTI Strategy 2030. This defines three priority goal areas with a total of 17 detailed goals, of which, some address two or three goal dimensions. There are quantitative goal values for most of the objectives, to be able to measure success with the implementation of the strategy. However, not all goals can be illustrated with available data and statistics. On the whole, it is possible to identify 17 goal values which can be quantitatively traced.

Table 1 presents the priority objectives and their respective sub-goals and detailed goals for a better overview in the form of a hierarchical structure. The objectives and the respective

goal values are presented once again in the “Analysis of the RTI Strategy 2030 objectives” section.

To measure the progress with goal achievement, a table overview is created for this report (see table 2 in the “Analysis of the RTI Strategy 2030 objectives” section), in which the objectives are illustrated structured according to the three overriding goals. The last available statistic value from January 2021 is used as the starting point for the respective detailed goals (“Current value”). The 2030 goal value is presented in a second column; the ratio between these two values is the goal distance. This is an index value, which is calculated as follows: (“Current value” / “Goal value”) * 100. Achievement of the respective goal value is given with the index

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Table 1: RTI Strategy 2030 structure: Priority objectives and their goal values at a glance



Source: Austrian Government (2020) RTI Strategy 2030, Vienna, p. 6 f.; graphic: Austrian Council.

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value 100, that is, the closer this value is to zero, the greater the goal distance up to 2030. With positions (rankings, for example) the ratio is reversed, because a lower value is “better”. The values of the goal distances are shown coloured in a differentiated colour scale, based on the traffic light system.

This approach allows goal distances to be calculated and illustrated, whereby a basis for determining the level of ambition of the strategic objectives is created. Estimating the respective level of ambition of the individual goals is based on the current goal distance. Using time series, past development trends can then also be analysed in detail. These are cited by way of example for some goal dimensions. Annex 4 provides an overview of the indicators used, the precise indicator names and the statistical sources.

The analytical approach and the selection of the indicators for the strengths and weaknesses analysis in the second part of this report (“Overview of the strengths and weaknesses of the Austrian RTI system in the international comparison”), is essentially identical to the Council’s previous report the year before.¹⁰ The innovation leaders according to the European Innovation Scoreboard 2020 are generally used as a benchmark.¹¹ For some years now these have been the top-ranking countries, Denmark, Finland, the Netherlands and Sweden, recently also joined by Luxembourg. For additional illustration the average of the EU member states or the respective global top three¹² are also used regularly as comparative values.

It should be noted here that the respective indicator values are based methodically on a ra-

tio of Austria’s values relative to the EU average, to the innovation leaders and to the respective global top three countries. Colours in the figures or tables used visualise these ratio values with regard to Austrian performance, similar to a traffic light system. Green and bright green here mean Austrian performance that is above the average level of the respective comparison countries. Bright yellow shows a lower, orange and red a higher or very high distance to the average level of the comparison countries:

- Green: Value over 110
- Bright green: Value between 100 and 109
- Yellow: Value between 90 and 99
- Orange: Value between 76 and 90
- Red: Value under 75

In addition to the ratio values, Austria’s growth and the growth difference to the leading innovation nations are also shown. This is reproduced in the tables (see Annex 2), which are used for the strengths-weaknesses analysis, whereby the Austrian growth values are visualised as follows:

- Green: Value over 0.05
- Yellow: Value between -0.05 and 0.05
- Red: Value under -0.05

For country selection, essentially all available countries were considered, including globally leading innovation nations such as Israel, Japan, Switzerland, South Korea and the USA. Data availability is, however, generally better for European Union countries. Essentially, the data is based on public access databases of international organisations such as Eurostat, the OECD or the World Bank. Annex 1 presents the indicators used and their data sources, as well as the available countries and the data’s time series dimension.

10 Austrian Council (2020): Report on Austria’s Scientific and Technological Capability 2020. Vienna, pp. 6 ff.

11 EU Commission (2020): European Innovation Scoreboard 2020. Luxembourg.

12 In naming the respective top 3 in the tables (especially in Annex 2), only countries for which data is available with all individual indicators are used for the composed indicators. Austria’s ratio value for the top 3 in the composed indicators is, however, calculated based on the average of the top 3 ratio value in the individual indicators. Occasionally, there is therefore a discrepancy here between the countries named with the composed indicators and Austria’s ratio value with the top 3, which is produced from the average of the individual indicators.





analysis of the targets of the rti strategy

This section analyses and discusses the objectives of the RTI Strategy and the distances to the respective goal values of the detailed goals. Not in focus here, however, is whether or not the measures cited in the RTI Pact appear suitable to contribute to goal achievement. This is topicalised using selected examples

related to the performance of the individual areas of the RTI system (see the sections in the second part of the report, “Overview of the strengths and weaknesses of the Austrian RTI system in the international comparison”) and can also be evaluated in subsequent years on the basis of actual progress with goal achievement.

Objectives and goal values overview

The RTI Strategy includes the following three overriding priority objectives, with which the strategic orientation for the ten years ahead is specified:¹³

- **Goal 1: Join the international leaders and strengthen Austria as an RTI location**
- **Goal 2: Focus on efficiency and excellence**
- **Goal 3: Promote knowledge, talents and skills**

The Austrian Council believes these objectives address important areas, which the Council repeatedly defined as priorities in the past, and sets the appropriate priorities for the further development of the Austrian RTI system. Goal 1 addresses the priority plan of joining the leading innovation nations – as was already the case in the RTI Strategy 2020.

The Council has already emphasised the importance of this strategic orientation several times.¹⁴ It also topicalised the focus on effectiveness and excellence expressed in goal 2 several times, and¹⁵ it also referred repeatedly to the key function of education for research, technology and innovation topicalised in goal 3.¹⁶

According to the strategy document these objectives are based, “substantially on the detailed analysis of the OECD Review of Innovation Policy: Austria 2018”¹⁷ and further examinations of the status quo and current challenges. The Austrian Council has compared the corresponding recommendations from the OECD Review and the Council recommendations from the years 2015 to 2020 with the ob-

13 Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 6 f.

14 See, in particular, Austrian Council (2019): Recommendations for the RTI policy in the 27th legislative period of 16 October 2019, pp. 11 ff., and idem (2017): Recommendation on the way to the forefront of innovation of 30 November 2017.

15 For innovation efficiency see in particular, Austrian Council (2018): Report on Austria's Scientific and Technological Capability 2018. Vienna, pp. 17 ff.

For excellence orientation see in particular, Austrian Council (2018): Recommendation on increasing excellence in science and research of 16 August 2018, and idem (2018): Recommendation for the excellence programme to promote science as key for more cooperation and competition in basic and top-quality research of 22 March 2018.

16 See, in particular, Austrian Council (2016): Report on Austria's Scientific and Technological Capability 2016. Vienna, p. 15 ff.; and idem (2017): Recommendation for policy prioritisation for the tertiary education sector (especially universities) of 14 September 2017, and idem (2017): Recommendation for the further development of the technical colleges sector in the Austrian education and science system of 30 May 2017.

17 Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 5.

jectives and corresponding strategic areas of action of the RTI Strategy 2030. The result of this comparison: with two exceptions, all strategic detailed goals are based on an equivalent in the recommendations of the OECD and/or the Austrian Council (see in detail Annex 3). Based on this systematic comparison, the following topic areas are produced (in alphabetical order), for which there are Council and/or OECD recommendations, but which are not illustrated in the RTI Strategy. These topics are not addressed in RTI Pact either, or are merely mentioned on the periphery or only very vaguely:

- Education (without tertiary education)
- Crowdfunding
- Research funding database
- Frugal innovation
- Universities' governance and management structures
- RTI for climate and environmental protection
- Protection and exploitation of intellectual property rights
- Social business

The Council believes these topic areas are highly relevant for the Austrian RTI system, which is why they should form an additional RTI policy priority, complementary to the RTI Strategy. The areas of “Education (without tertiary education)”, “Governance at the universities”, “RTI for climate and environmental protection” and “Protection and exploitation of intellectual property rights” in particular should be focused on more intensively here.

School education was almost completely factored out by the RTI Strategy 2030, which, in view of the fundamental importance of this area for the RTI system must be evaluated critically. The issue of governance and management structures at the universities was actually addressed within the scope of the amended University Act; however, the Council believes it should be emphasised even more intensively in accordance with its actual importance. The situation is similar in optimising the protection and exploitation of intellectual property rights, whose key dimension for the Austrian RTI system is not illustrated in the Strategy.¹⁸ The fact that there is no individual RTI policy goal in relation to climate and environmental protection should be compensated for in other ways, however the OECD refers explicitly to Austria's corresponding catch-up requirement. The Council believes at least one input goal and a budgetary prioritisation (based on systematic reallocations) to increase R&D expenditure for energy and environment research would have been appropriate.¹⁹ At best these topics, aside from the strategic objectives of the RTI Strategy, could be included as respectively separate areas of action in the coming RTI Pact or be defined as an additional RTI policy priority and with corresponding detailed goals become part of the focus of implementation activities.

As mentioned before, with the RTI Strategy the Austrian Government intends to further develop Austria into a “leading research, technology and innovation nation”²⁰. Along with

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18 Only the RTI Pact mentions the “protection of intellectual property” issue, however without presenting a specific measure or specific RTI policy project. For this, see Austrian Government (2020): RTI Pact 2021–2023. Vienna, p. 10.

19 Even if the issue is not anchored in the strategy at goal level, it was at least addressed with the “RTI to achieve climate goals” area of action (see Austrian Government [2020]: RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 10). However, defined benchmarks and simply specific goal values to measure success with implementation are still not available.

20 Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 6.

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the three afore-mentioned priority objectives, the following 17 detailed goals are also listed in the strategy document for this, and for the greater part are equipped with specific goal values,

to enable the measurability of the goal achievement intended by the RTI Strategy. It should be noted that individual detailed goals from two or three sub-goals are composed, which in the operationalisation in table 2 results in a to-

Table 2: Result of the analysis of the distance to the RTI Strategy 2030 goal values

	Current value	Target value	Target distance
Goal 1: Join the international leaders and strengthen Austria as an			
Ranking improvement in international indices	–	–	–
European Innovation Scoreboard Index (EIS)	8	5	63
Digital Economy and Society Index (DESI)	13	5	38
Global Innovation Index	19	10	53
Acquire 5-10 new RTI-intensive leading companies and expand existing ones	No valid data available		
Increase number of permanently R&D-active companies by 20%	3,489	4,187	83
Austria's stronger positioning in European value creation chains by participating in at least three more "Important Projects of Common European Interest" (IPCEIs)	2	5	40
Utilise opportunities of digitisation for society, economy, climate protection and management for Austria and drive forward digital transformation	Composite indicator 1)		73
Goal 2: Focus on efficiency and excellence			
Steady increase in R&D expenditure measured on GDP to join the global leaders (top 5; currently 7 according to OECD ranking)	6	5	83
Expansion of the venture capital pool to raise venture capital expenditure from 0.02% to 0.1% compared to GDP	0.02	0.1	20
100% more economically successful academic spin-offs	74	148	50
Top 10 placing with European Research Council (ERC) grants (per inhabitant)	10	10	100
Strengthen participation in Horizon Europe	2.9%	Over 2.9%	na 2)
Secure top 3 place with Horizon Europe success rate (or Horizon 2020)	3	3	100
Increase the corporate sector's success rate with Horizon Europe from 18.2% to at least 20%	18.2	20	91
Goal 3: Promote knowledge, talents and skills			
Increase the percentage of science, technology, engineering and mathematics (STEM) graduates by 20% (STEM graduates)	22.8	27.4	83
Increase the percentage of women with graduates in technical subjects by 5%	27.6	29.0	95
Secure a top three place in the Institute for Management Development (IMD) World Talent Ranking (Austria currently ranks number 4)	4	2	50
Create incentives for business careers for scientists	Not suitable as an indicator		
Place two Austrian universities among the top 100 (according to Times Higher Education World University Ranking)	0	2	≤0
Increase the percentage of science and research staff applying from the abroad, especially at universities, to 45%	40%	45%	90
100% more Austrian STEM students, who complete studies or a study semester abroad via funding programmes	No valid data available		

For sources, see Annex 4.

Key: Goal achievement = 100; **green**: value over 110; **bright green**: value between 100 and 109; **yellow**: value between 90 and 99; **orange**: value between 76 and 89; **red**: value under 75.

1) The distance from the target is calculated based on the composite value for the "digitisation" aspect of the strengths-weaknesses analysis (see Appendix 2, table 11).

2) No target value specified.

tal of 21 goal areas being cited. Of these in turn, one is not suitable for use as an indicator. Two others lack valid data foundations and for one more no specific goal value is cited. A total of 17 goals or sub-goals with defined values are therefore available for the analysis of the objectives of the RTI Strategy. All objectives with the specific goal values and the respective key areas of action, which are derived from the goals, are then cited once again in detail:

● **Goal 1: Join the international leaders and strengthen Austria as an RTI location**

- Goal 1.1: Ranking improvement in international indices (European Innovation Scoreboard [EIS]: From top 8 to top 5; Digital Economy & Society Index [DESI]: From top 13 to top 5; Global Innovation Index [GII]: From top 19 to top 10)
- Goal 1.2: Acquire 5 to 10 new RTI-intensive leading companies and expand existing ones
- Goal 1.3: Increase the number of permanently R&D-active companies by 20 percent
- Goal 1.4: Austria's stronger positioning in European value creation chains by participating in at least 3 more "Important Projects of Common European Interest" (IPCEIs – currently participation in two)
- Goal 1.5: Utilise opportunities of digitisation for society, economy, climate protection and management for Austria and drive digital transformation forward

● **Goal 2: Focus on efficiency and excellence**

- Goal 2.1: Steady increase in R&D expenditure measured on GDP to join the global leaders (top 5; currently at 7 according to OECD ranking)
- Goal 2.2: Expansion of the venture capital pool (also by positioning and establishing 5 corporate venture funds in Austria), to raise

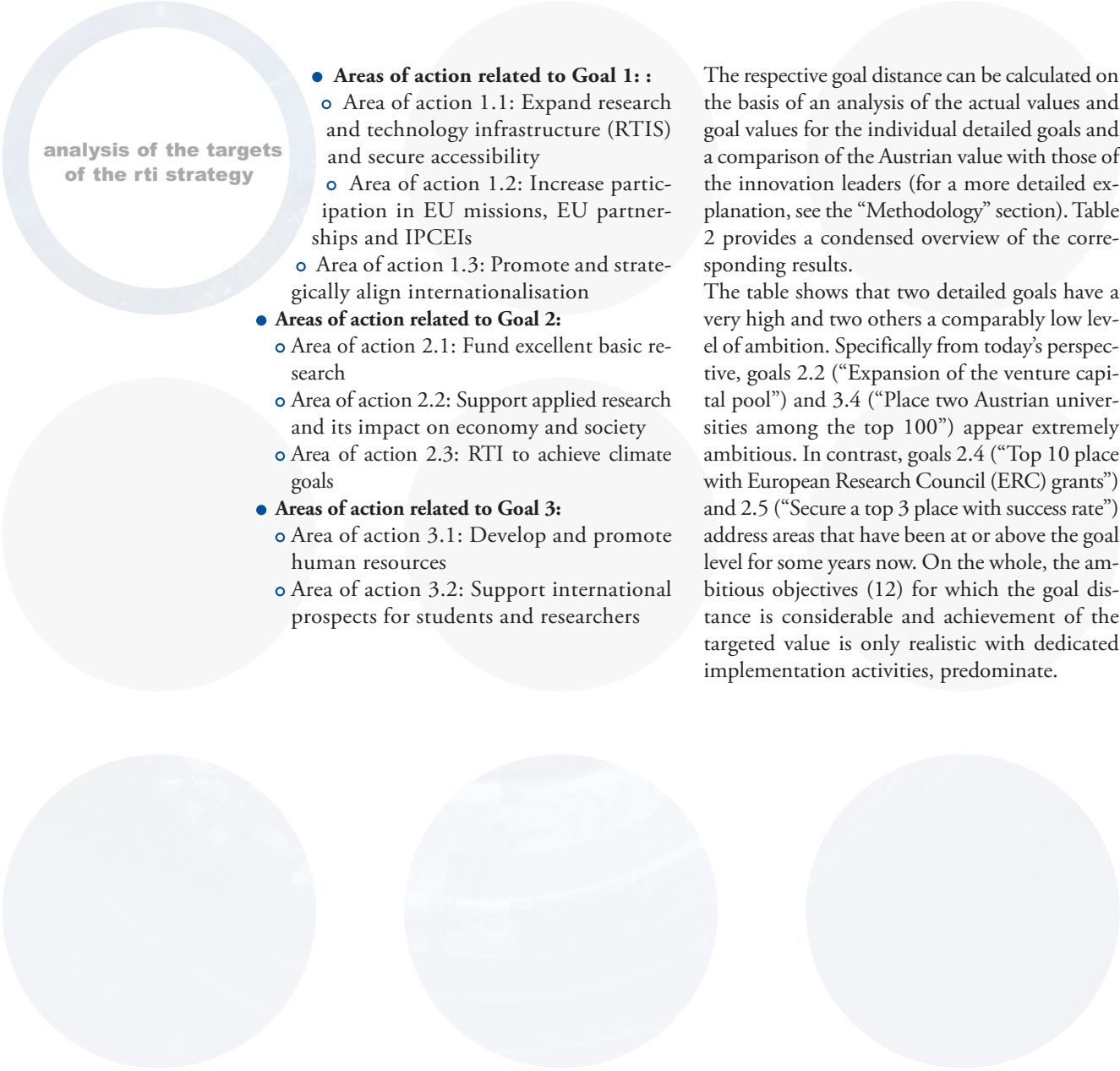
venture capital expenditure from 0.02% to 0.1% compared to GDP

- Goal 2.3: 100% more economically successful academic spin-offs
- Goal 2.4: Top 10 placing with European Research Council (ERC) grants (per inhabitant)
- Goal 2.5: Strengthen participation in Horizon Europe and secure top 3 placing with success rate
- Goal 2.6: Increase the corporate sector's success rate with Horizon Europe from 18.2% to at least 20%
- **Goal 3: Promote knowledge, talents and skills**
 - Goal 3.1: Increase the percentage of science, technology, engineering, and mathematics (STEM) graduates by 20%, increase the percentage of women with graduates in engineering subjects by 5%
 - Goal 3.2: Secure a top 3 place in the Institute for Management Development (IMD) World Talent Ranking (currently rank 4)
 - Goal 3.3: Create incentives for business careers for scientists
 - Goal 3.4: Place two Austrian universities among the top 100 (according to Times Higher Education World University Ranking currently one university among the top 200)
 - Goal 3.5: Increase the percentage of the science and research staff applying from abroad, especially at universities, to 45%
 - Goal 3.6: 100% more Austrian STEM students, who complete studies or a study semester abroad via funding programmes

For goal achievement, the following eight key areas of action were defined in the RTI Strategy, with which the respective goals were set assignable strategic priorities for the next ten years. These often mesh, interact and also contribute to achieving several goals:²¹

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21 For this, see Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 8.



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- **Areas of action related to Goal 1: :**

- Area of action 1.1: Expand research and technology infrastructure (RTIS) and secure accessibility
- Area of action 1.2: Increase participation in EU missions, EU partnerships and IPCEIs
- Area of action 1.3: Promote and strategically align internationalisation

- **Areas of action related to Goal 2:**

- Area of action 2.1: Fund excellent basic research
- Area of action 2.2: Support applied research and its impact on economy and society
- Area of action 2.3: RTI to achieve climate goals

- **Areas of action related to Goal 3:**

- Area of action 3.1: Develop and promote human resources
- Area of action 3.2: Support international prospects for students and researchers

The respective goal distance can be calculated on the basis of an analysis of the actual values and goal values for the individual detailed goals and a comparison of the Austrian value with those of the innovation leaders (for a more detailed explanation, see the “Methodology” section). Table 2 provides a condensed overview of the corresponding results.

The table shows that two detailed goals have a very high and two others a comparably low level of ambition. Specifically from today’s perspective, goals 2.2 (“Expansion of the venture capital pool”) and 3.4 (“Place two Austrian universities among the top 100”) appear extremely ambitious. In contrast, goals 2.4 (“Top 10 place with European Research Council (ERC) grants”) and 2.5 (“Secure a top 3 place with success rate”) address areas that have been at or above the goal level for some years now. On the whole, the ambitious objectives (12) for which the goal distance is considerable and achievement of the targeted value is only realistic with dedicated implementation activities, predominate.

Detailed analysis of selected objectives

Individual objectives are cited and briefly discussed by way of example in the following. The four goals mentioned with which the goal distance is especially high or especially low are addressed first here.

Objectives with especially high distance to the goal values

- Goal 2.2 “Expansion of the venture capital pool”
- Goal 3.4 “Place 2 Austrian universities among the top 100”

Objectives with especially low distance to the goal values

- Goal 2.4 “Top 10 place with ERC grants (per inhabitant)”
- Goal 2.5 “Secure a top 3 place with success rate”

The two objectives that are seen as overriding priority objectives of the Strategy are also explained in further detail.

RTI Strategy priority objectives

- Goal 1.1 “Ranking improvement in international indices”
- Goal 2.1 “Steady increase in R&D expenditure”

Goal 3.1 (“Increase in the percentage of STEM graduates”) is also analysed. This goal is highly relevant for the urgently required improvement in the digitisation area; after that of the start-up area, the performance here currently is the second worst in the entire system.

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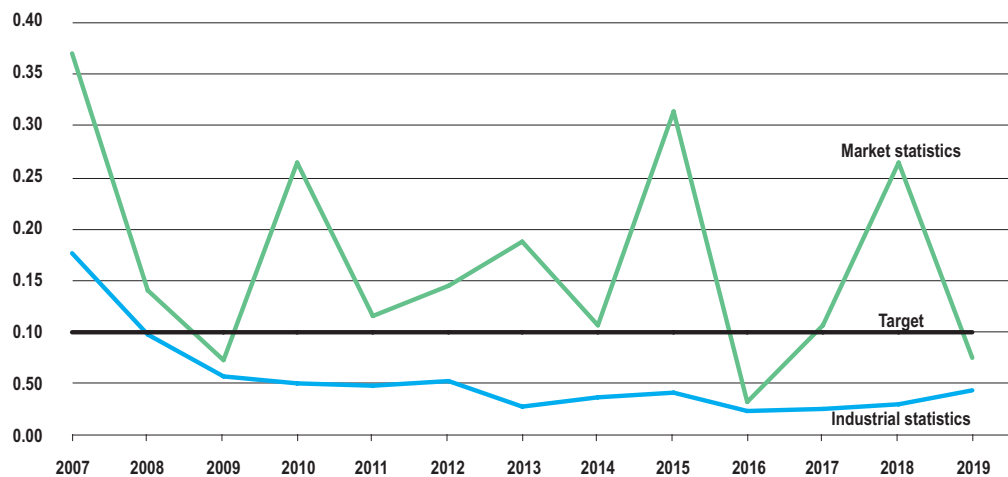
Goal 2.2 “Expansion of the venture capital pool (also by positioning and establishing 5 corporate venture funds in Austria), to raise venture capital expenditure from 0.02% to 0.1% compared to GDP”

The topic of innovative start-ups has been one of the major problem areas of the domestic RTI system for some years now. The distance to the innovation leaders remains high over the period with the corresponding indicators. The goal of a 100% increase in the number of academic spin-offs (from 74 to 148) must therefore be classified as extremely ambitious and is based in particular on the successful expansion of the risk capital pool. The corresponding objective of the RTI Strategy to raise venture capital expenditure by and large corresponds with the findings provided by the Austrian Council for some years now (see the “Start-ups” and “Location attractiveness” sections).²²

Figure 1 shows the risk capital intensity development from 2007 to 2019. For the RTI

Strategy, the investments according to industrial statistics are the basis of the goal value.²³ If we consider the cited goal value in detail, we see that only during the course of the 2008 financial crisis did this fall below the now targeted goal level of 0.1% of GDP and, in spite of a number of RTI policy initiatives, exhibited barely substantial increases in recent years. The challenge of bringing about a trend reversal therefore remains great. It should also be noted that the average risk capital intensity level of the innovation leaders is 0.6% of GDP and therefore significantly above the envisaged goal value. The increase required to achieve this level would be 2,900%. Measured on GDP 2019, Austria would have to invest EUR 2.3 billion more than it does now.

Figure 1: Venture capital intensity (investments in % of GDP) from 2007 to 2019



Source: Invest Europe, see Appendix 4.

²² See Austrian Council (2019): “Report on Austria’s Scientific and Technological Capability 2019”. Vienna, pp. 42 ff. and pp. 50 ff. See also Keuschnigg, C., et al. (2017): “Innovationsland Österreich F&E: Unternehmensentwicklung und Standortattraktivität. Studie im Auftrag des Rates für Forschung und Technologieentwicklung.” Vienna, pp. 23 ff.

²³ “Venture capital according to industrial statistics” is defined as venture capital invested in venture capital funds within Austria; “venture capital according to market statistics” is defined as the entirety of venture capital invested in Austria and includes venture capital funds abroad.

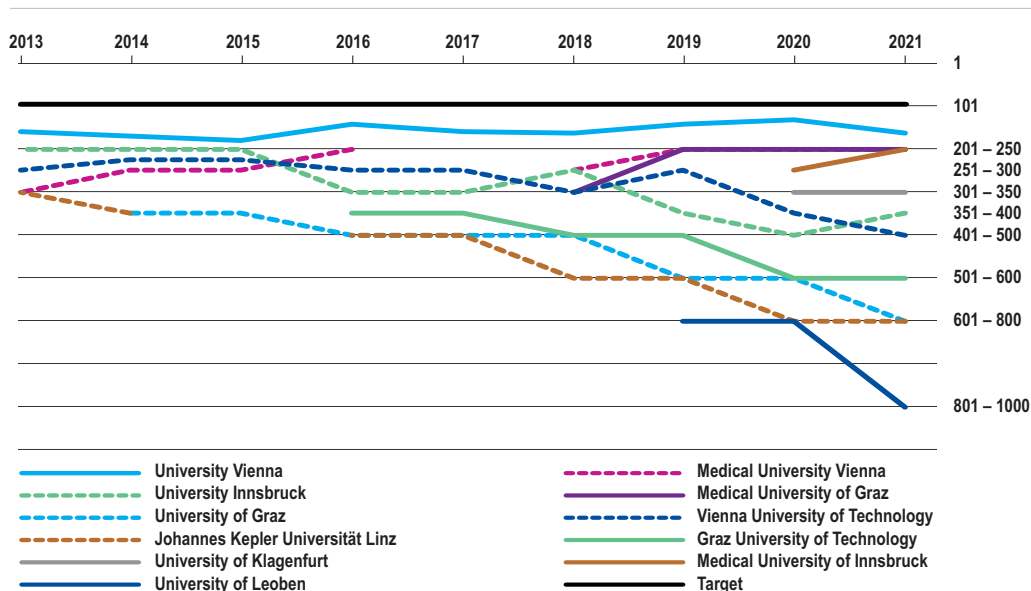
Goal 3.4 “Place two Austrian universities among the top 100 (according to Times Higher Education World University Ranking currently one university among the top 200)”

The results with regard to the performance of the Austrian universities are rather discouraging (for details, see the “Tertiary education” and “Research at universities and non-university institutions” sections). These findings are not new and the Council has emphasized to the need for a policy prioritisation for the universities and the tertiary education sector several times.²⁴ The Council believes this is highly significant because various higher education rankings are now an important indication of the universities’ international positioning and an increasingly important factor in the competition for the best brains.

The Times Higher Education World University Ranking is one of the world’s most influential rating platforms for tertiary education and research performance. As figure 2 shows, the Austrian universities do not score espe-

cially well in it. A downward trend is also seen in many instances. In individual discipline rankings, some institutions actually occupy leading positions, but to a marginal degree. On the whole, not a single Austrian university ranks among the world’s best 100. And the University of Vienna is the only one among the top 200. By comparison, all innovation leaders have at least one university among the best 100, and the Netherlands even have seven. The objective of including two Austrian universities among the top 100 therefore currently appears extremely ambitious. It can only be achieved if there is a clear positioning to promote the excellence of the highest-performing universities, which would mean a fundamentally new strategic orientation, and not only in the universities’ financing.

Figure 2: Positions of Austria’s best universities in the Times Higher Education World University Ranking (2012 to 2021)



Source: Times Higher Education World University Ranking, see Appendix 4.

²⁴ See, inter alia, Austrian Council (2017): Recommendation for policy prioritisation for the tertiary education sector (especially universities) of 14 September 2017

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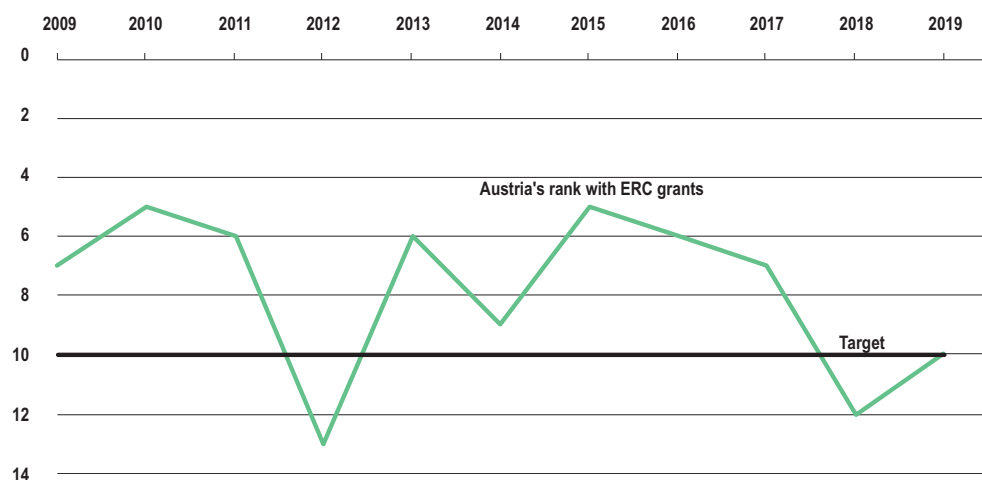
Goal 2.2 “Top 10 place with European Research Council (ERC) grants (per inhabitant)”

The number of grants acquired with the European Research Council (ERC) is now an established and important gauge for measuring research performance. The international success of a country's researchers can be illustrated well with this KPI. In the EU comparison, scientists at Austrian research institutions are above average successful over the entire period. The number of grants acquired every year also increased (see table 7 in Annex 2). Correspondingly positive is Austria's placing with regard to the overall number of conferred ERC grants in relation to the number of inhabitants.

As figure 3 shows, Austria has continuously ranked among the top 10 with two exceptions since 2009. Only 2012 and 2018 are marginal outliers in this respect. Austria was already back at tenth place in 2019. The development trend of the rankings therefore shows that the strategic objective of achieving a place among

the top 10 with ERC grants was achieved already. Based on Austria's performance to date, a substantial change is therefore not expected in the coming years. Unfortunately, it must be emphasised that, compared with the innovation leaders, Austria scores well below average and the distance to the leader group increases continuously. Compared to the top countries – Switzerland, Israel and the Netherlands –, Austrian performance is particularly poor (for details, see table 7 in Annex 2). If we are to get closer to the goal intended by the RTI Strategy of taking Austria into the group of leading innovation nations, the level of ambition with regard to the placing with the ERC would in any case have to be significantly higher. Furthermore, the framework conditions for researchers in particular would have to be improved considerably (see the “Research at universities and non-university institutions” section).

Figure 3: Austria's placing with ERC grants (Starting, Advanced and Consolidator grants) per one million inhabitants from 2009 to 2019



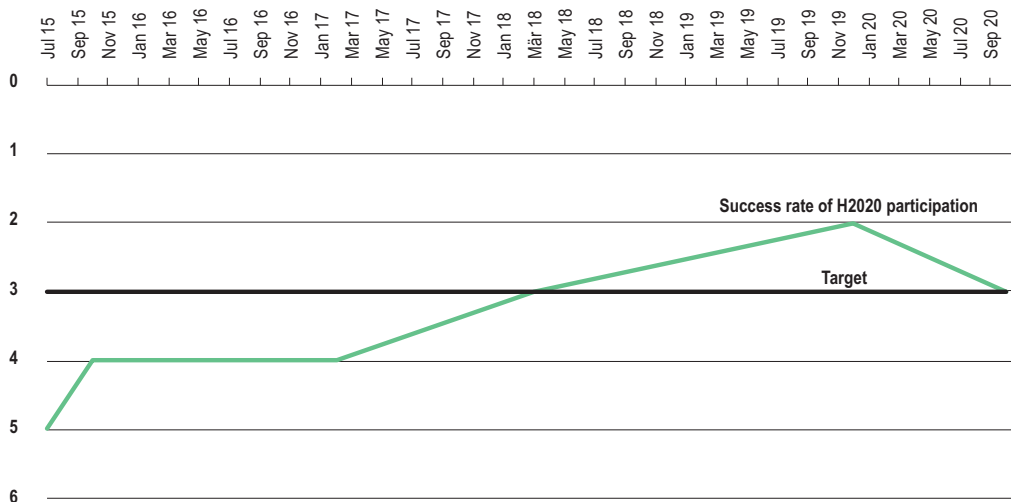
Source: European Research Council, see Appendix 4.

Goal 2.5 “Secure a top 3 place with success rate”

As a member of the EU, Austria is strongly integrated into the European research area. The EU’s research policy is therefore highly relevant for RTI location Austria and also influences the Austrian RTI landscape directly. High participation by Austria in the research framework programmes has therefore been considered an important goal for some years now. The Austrian success rate is consistently high in relation to all EU member states. As figure 4 shows, Austria’s placing in Horizon 2020 has remained constantly below the top 3 since 2018. In the past five years, Austria was never worse than rank five, which proves the long-term stability of the Austrian success rate in a highly competitive international environment. By way of comparison: With a success rate of 19.3 percent, Belgium clearly occupies

first place. At 17.91 percent, the success rate of second-placed France is only marginally higher than Austria’s at 17.87 percent. In view of the development trends to date, it is assumed that the strategic objective of securing Austria’s placing among the top 3 has an above-average high probability of success. By contrast, however, Austria’s success with Horizon measured on the return quota has been regressive for some years now. The ratio of Austria’s share of Horizon 2020 funds to Austria’s share of the EU budget is measured with this indicator. Austria’s level in this respect is significantly below that of the leading countries, and the distance increases continuously (see the “International ties” section and table 5 in Annex 2).

Figure 4: Austria's placing with success rate in Horizon 2020 from 2015 to 2020



Source: FFG Overview Reports, see Appendix 4.

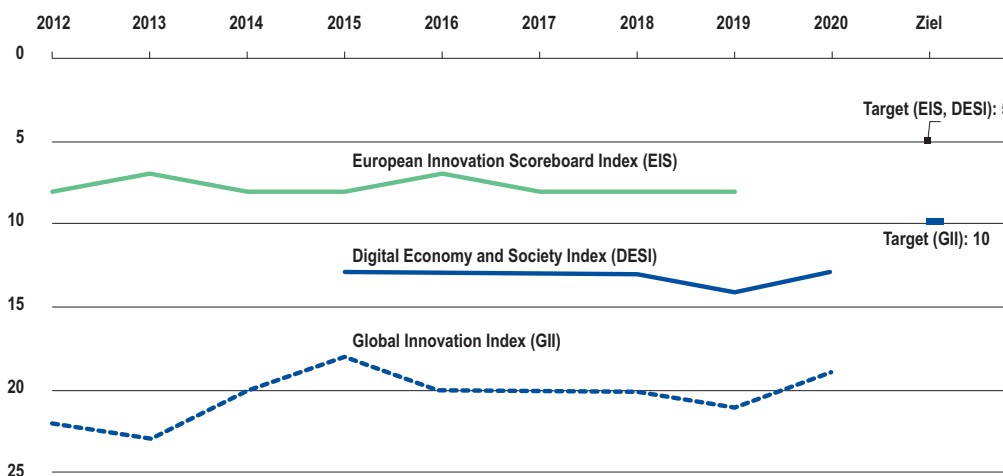
analysis of the targets of the rti strategy

Goal 1.1 “Ranking improvement in international indices (European Innovation Scoreboard [EIS]: From top 8 to top 5; Digital Economy & Society Index [DESI]: From top 13 to top 5; Global Innovation Index [GII]: From top 19 to top 10)”

The Austrian Government’s overriding goal of joining the leading innovation nations also entails the question of the international indices on which the measurement of goal achievement will be oriented. The Austrian Council has made several proposals on this in the past.²⁵ With the European Innovation Scoreboard (EIS), the Digital Economy & Society Index (DESI) and the Global Innovation Index (GII), three established indices were selected for the RTI Strategy 2030, which, with all due caution in dealing with standardised rankings, on the whole provide a valid orientation framework.²⁶ Figure 5 shows Austria’s placing in the three se-

lected rankings, as well as the respective distance to the defined goal value. In the EIS, the goal is to move from rank 8 to rank 5; in DESI, from rank 13 to rank 5; and in the GII from rank 19 to rank 10. Based on Austria’s previous performance over the period, these goal values must be classified as entirely ambitious, as with all three indices very little movement was seen in the past. At any rate, there has recently been a ranking improvement to a lesser extent with the GII and minimum movement with the DESI. With the EIS the positioning has stagnated since 2012 at 8, although the RTI Strategy 2020 also pursued the goal of making Austria the innovation leader.

Figure 5: Austria’s placing in selected international rankings (DESI, EIS, GII) from 2009 to 2020



Source: DESI 2020, EIS 2020, GII 2020, see Annex 4.

²⁵ See, in particular, Austrian Council (2020): Report on Austria’s Scientific and Technological Capability 2020. Vienna, pp. 12, and idem (2019): Recommendations for the RTI policy in the 27th legislative period – Recommendation of 16 October 2019, pp. 11 ff.

²⁶ For critical consideration of standardised rankings, see Gadner, J. / Janger, J. (2020): Monitoring national innovation performance: going beyond standardized rankings. In: fteval Journal for Research and Technology Policy Evaluation, Nr. 50/March 2020, p. 4-8.

Goal 2.1 “Steady increase in R&D expenditure measured on GDP, to join the global leaders (top 5; currently 7 according to OECD ranking)”

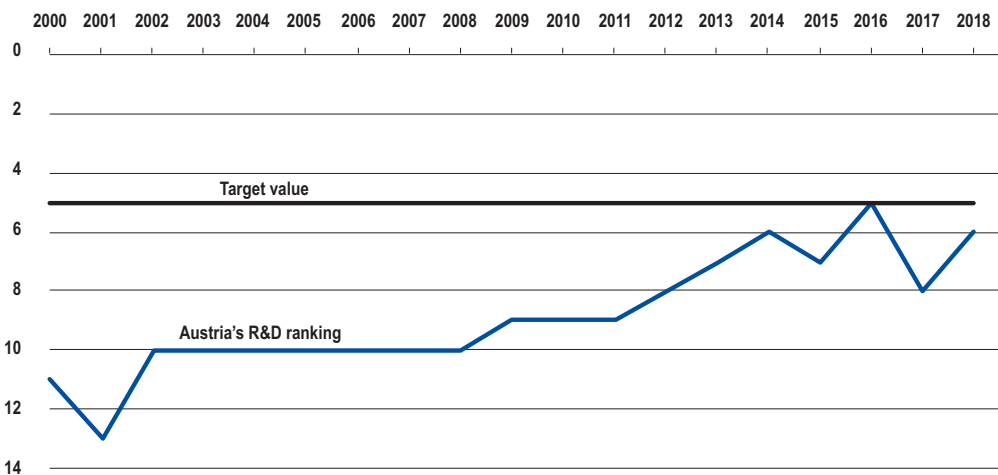
Research funding is an important cornerstone in achieving innovation leadership. The starting point for Austria is very good in this respect, as the Austrian R&D rate has grown above average in the past two decades. Austria is currently one of the most R&D-intensive countries in the EU; only Sweden shows a higher R&D rate for the comparison year, 2018 (last available year; see also the “Financing” section). And compared with all the countries recorded in the corresponding OECD ranking, since 2014 at the latest, Austria has ranked in the absolute top field, ahead even of countries such as Denmark, Finland or the USA.²⁷

The RTI Strategy’s goal of taking Austria into the top 5 with regard to R&D expenditure at global level, therefore appears realistic from

today’s point of view. If we calculate the place with the OECD rankings, Austria is at number 6. However, it remains to be seen how the Covid-19 crisis will affect its further development.

In view of the above-average development of the R&D quota, however, both the OECD and the Austrian Council have already recommended introducing a strategic refocusing and aligning the quota target with the industrial structure or replacing more input goals with output goals. The existing trends towards input-oriented steering can therefore be met and focus on the effectiveness and efficiency of RTI investments can be increased (see also the “Financing” and “Efficiency of RTI activities” sections).²⁸

Figure 6: Development of Austria’s placing with regard to R&D expenditure in percentage of GDP from 2000 to 2018



Source: OECB, see Annex 4.

²⁷ See <https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm#indicator-chart>.

²⁸ See Austrian Council (2019): Report on Austria’s Scientific and Technological Capability 2019. Vienna, p. 52 f., and OECD (2018): OECD Reviews of Innovation Policy: Austria 2018. OECD Publishing, Paris, p. 20.

analysis of the targets of the rti strategy

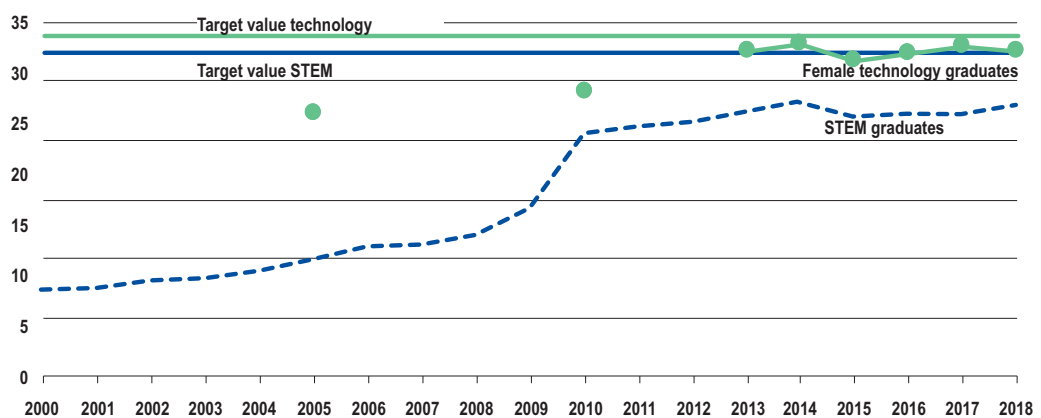
Goal 2.4 “Increase the percentage of science, technology, engineering and mathematics (STEM) graduates by 20%, increase the percentage of women with graduates in engineering subjects by 5%”

A growing number of study courses and additional study places in the areas of computer sciences, IT, data sciences etc. are being set up at both the universities and the technical colleges. Due to the existing and additional high demand for qualified workforce to be expected in this rapidly growing science and economy segment, a steady increase in the numbers of graduates is always a basic requirement to meet the increased demand caused by the COVID-19-related acceleration in digitisation.²⁹ From this point of view, the goal of the RTI Strategy 2030 of increasing the percentage of STEM graduates up to 2030 by twenty percent and raising the percentage of women in engineering subjects by five percent are logical steps. Figure 7 shows that the development is going in the right direction anyway, and that the probability of success for goal achievement is very high. Therefore and in particular, in view

of this factor’s relevance for the required performance increase in the digitisation area, the Council believes this objective could have been thoroughly ambitious.

In this context, in relation to the innovation leaders, reference is also made to the lower percentage of doctorate graduates in STEM subjects and of international doctoral students at Austrian universities. An additional expansion of the existing offering of structured doctoral programmes, especially in the technical study programmes as well, could create an improved training situation. The percentage of international doctoral students did actually increase again by three percentage points and is therefore clearly above the EU average, however it also remains significantly behind the leading innovation nations (see the “Tertiary education” section and table 6 in Annex 2 and “International ties” section and table 5 in Annex 2).

Figure 7: Development of graduate numbers in STEM and technology (per 1,000 inhabitants)



Source: Eurostat, see Appendix 4.

²⁹ For this, see Grosch, K., et al. (2020): MINT-Interesse bei Kindern steigern. IHS Project Report, Vienna.



Strengths and weaknesses of the Austrian
RTI system in the international comparison

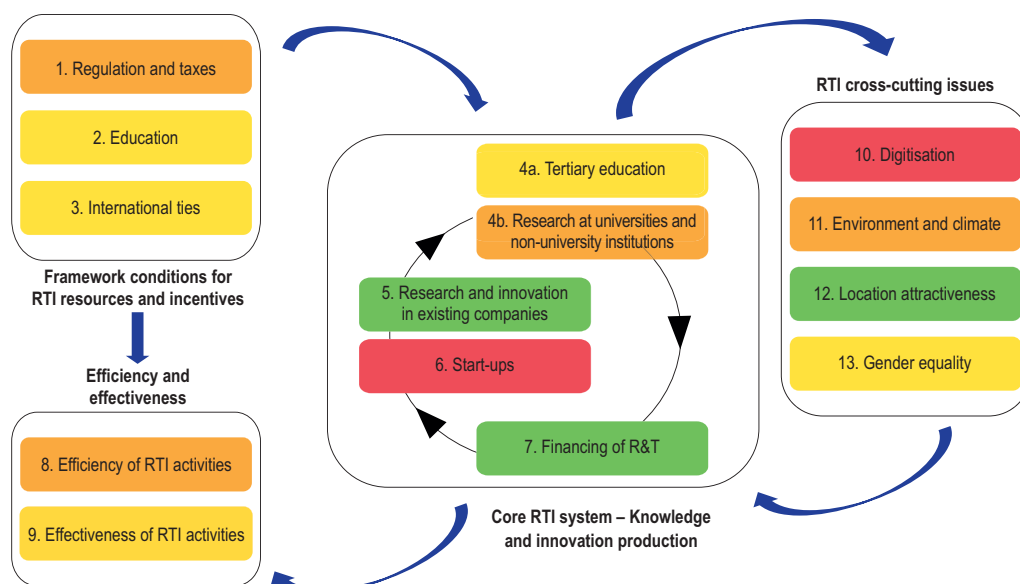
strengths & weaknesses

The second part of this report firstly provides an overview of the capability of the Austrian RTI system and then presents and discusses it in detail. The aggregated results of the strengths-weaknesses analysis enable the holistic illustration of Austria's performance in all sub-areas of the RTI system. Based on a schematic illustration of the RTI system, figure 8 provides a general overview of its specific strengths and weaknesses compared with the leading innovation nations, Denmark, Finland, Luxembourg, the Netherlands and Sweden.

At a glance, the overview shows that the Austrian RTI system exhibits some pronounced strengths and weaknesses compared with the leading innovation nations. It also shows that

the majority of the RTI system's sub-areas show a distance to the innovation leaders' level. The strengths clearly include the generally above-average level of R&D financing, the high RTI support for existing companies and their performance, and the above-average location attractiveness in relation to the comparison countries. International networking is also just about included in the strength areas, as the distance to the innovation leaders in this area on the whole is only minimal. The biggest weakness in the core RTI system clearly continues to be the area of innovative start-ups. In the cross-cutting issues area digitisation causes the greatest concern. Performance with environmental and climate protection did indeed improve, however of all analysed areas it is still the fifth worst and the distance to the

Figure 8: Aggregated strengths and weaknesses of the Austrian RTI system compared with the innovation leaders



Sources: See Annex 1 and 2, table 1.

Key: Goal achievement = 100; **green**: value over 110; **bright green**: value between 100 and 109; **yellow**: value between 90 and 99; **orange**: value between 76 and 89; **red**: value under 75.

leading innovation nations is still very high. There are also specific challenges in all sub-areas of the RTI system, as also repeatedly topicalised by the Council in previous years, which on the whole impede improved innovation performance. Especially worth mentioning here is the educational system in its full extent, the framework conditions at the universities and research performance, right through to regulation factors. And nor are the efficiency and effectiveness of RTI activities sufficient to achieve the level of the innovation leaders. On the whole therefore, in most sub-areas of the RTI system there is significant catch-up potential compared with the leading countries.

Table 3 provides a differentiated view, in which Austrian performance is compared with both that of the innovation leaders (second column) and additionally also with that of the member states of the European Union (first column), and also that of the respective three best performers worldwide (third column). The respective top 3 countries and the number of countries available for the calculation are also cited (see also the detailed explanations in the “Methodology” section). Compared with the average EU level Austria scores significantly better and almost continuously so. Only the start-up area has remained clearly below the European average in some

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Table 3: Strengths and weaknesses of the Austrian RTI system compared with the EU average, the innovation leaders and the top 3

	AT compared to ...			Top Countries	Countries for Composite Calculation
	EU	IL	Top 3*		
Framework conditions for RTI					
Regulation and taxes	92	85	46	(1) UK (2) SE (3) IE	18
Education	109	91	63	(1) FI (2) SE (3) UK	18
International ties	109	99	51	(1) LU (2) BE (3) IE	24
Core RTI system					
Tertiary education	106	94	60	(1) UK (2) SE (3) PL	23
Research at universities and non-university institutions	134	84	63	(1) CH (2) DK (3) NO	17
Corporate RTI	156	112	71	(1) AT (2) FI (3) DE	17
Start-ups	70	56	46	(1) SE (2) UK (3) NL	22
Financing	154	173	73	(1) AT (2) FR (3) BE	24
RTI efficiency and effectiveness (impact)					
Science, technology and innovation efficiency	119	88	37	(1) CH (2) US (3) MT	32
Effectiveness of FTI activities	112	92	69	(1) SE (2) IE (3) DE	23
RTI cross-cutting issues					
Digitisation	86	73	51	(1) SE (2) IE (3) DK	20
Environment and climate	105	86	37	(1) DE (2) NL (3) EL	28
Location attractiveness	137	119	75	(1) IE (2) UK (3) FI	30
Gender equality	91	95	58	(1) RO (2) LT (3) PL	28

Sources: See Annex 1.

Key: Goal achievement = 100; **green**: value over 110; **bright green**: value between 100 and 109; **yellow**: value between 90 and 99; **orange**: value between 76 and 89; **red**: value under 75.

* In naming the respective top 3 only countries for which data is available with all individual indicators are used. Austria's ratio value for the top 3 in the composed indicators is, however, calculated based on the average of the top 3 ratio value in the individual indicators. Occasionally there is therefore a discrepancy here between the countries named with the composed indicators and Austria's ratio value with the top 3, which is produced from the average of the individual indicators.



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crucial areas for some years now. Austrian start-up activity evidently shows weaknesses, even in relation to the average level of the European member states – from motivation for entrepreneurial activity to start-up regulation, through to risk capital intensity (for details see the “Start-ups” section). The digitisation area also exhibits a considerable distance to the average level of the EU countries (see the “Digitisation” section). The Austrian level is indeed below the EU average, but with a lower distance, in two further sub-areas – “regulation and taxes” and “gender equality”. All other sub-areas for the most part clearly surpass the respective levels of the comparison countries.

In relation to the respective global top 3, Austrian innovation performance scores significantly worse, rather unsurprising. From this perspective we see that Austria succeeds in only three sub-areas, “Corporate research and innovation”, “Financing” and “Location attractiveness”, to get closer to the level of the group of best performers (global), however without actually reaching it. Details are discussed in the “Research and innovation in existing companies”, “Financing” and “Location attractiveness” sections.³⁰ It is also evident that Sweden appears disproportionately often in the global top three group. Of the fourteen sub-areas examined, the Scandinavian country ranks six times at a global top position; three of these at number 1 and three at number 2.

Ireland is also in the top three six times, however only first once. The UK follows with five, and Denmark, Germany and Finland are also included three times among the top three.

Despite the distances to the leading nations, the Council believes Austria would have the potential to join the global leaders in some areas. This would, however, require dedicated implementation activities, such as those contained in the last RTI Strategy. The new RTI Strategy 2030 pursues the overriding goal of further developing Austria into a “leading research, technology and innovation nation”.³¹ Goal achievement is measured here on Austria’s placing in the European Innovation Scoreboard and in the Digital Economy & Society Index, in which the strategy strives to join the top 5; with the Global Innovation Index a placing among the top 10 is targeted as the goal value. The Austrian Government’s coalition agreement also explicitly names the areas of climate and environmental protection and digitisation as policy priorities in which Austria should play a forerunner role in Europe and the world.³²

The results of the strengths-weaknesses analysis show, however, that there are significant deficits with innovation performance, digitisation and in the climate and environment area. Accelerated efforts are therefore required to also actually achieve these goals. Basic requirements here are optimisation of the RTI system’s framework conditions and specific investments in the right areas. A budgetary

30 In naming the respective top 3 in table 3, Austria appears to be ranked number one in the “Corporate RTI” and “Financing” areas. This is the result of only using countries for which all individual indicators are available for the composed indicators. However, Austria’s ratio value for the top 3 in the composed indicators is calculated based on the average of the top 3 ratio value in the individual indicators. In such cases, there is therefore a discrepancy here between the countries named and Austria’s ratio value with the top 3, which is produced from the average of the individual indicators.

31 Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 6.

32 Austrian Government (2020): Aus Verantwortung für Österreich. Regierungsprogramm 2020–2024. Vienna, pp. 102 ff. and pp. 316 ff.

prioritisation and a systematic reallocation of available resources should therefore be reviewed with an appropriate evaluation.

The individual strengths, weaknesses and challenges compared with the leading innovation nations, Sweden, Finland, Denmark, Luxembourg and the Netherlands, are discussed in the following sections of this report. More detailed results and data tables on the individual sections

of the report and the sub-areas of the RTI system discussed therein are provided in Annex 2. It should be noted that these tables show Austria's absolute growth and the growth in relation to the innovation leaders for every indicator. This enables a detailed understanding of how Austria's distance to the leading innovation nations changes over the period.

strengths & weaknesses

Framework conditions for RTI – Resources and stimuli

Regulation and taxes

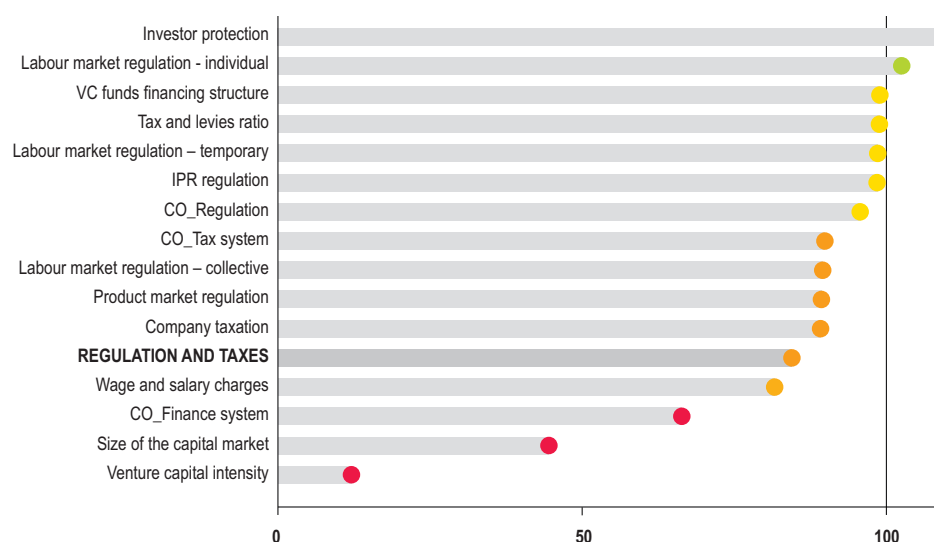
Regulation (including the finance system) and taxes are part of the relevant framework conditions for the RTI system, because they influence incentives and the resources available for innovation. Green taxes, for example, can provide innovation incentives, income taxes can influence the attractiveness for top executives and product market regulation can stimulate competition, which in turn can incentivize innovation activities.³³ In this respect however, figure 9 shows a rather below-average Austrian performance compared with the innovation leaders.

Only two of the indicators used for this area are consequently above the level of the leading nations and four are slightly below it; all others are to some extent even significantly be-

low the level of the innovation leaders. The tax system and in particular the finance system score especially badly here. With regard to the internationally observed “race to the bottom” (with the tax rate, for example), it may very well be that this has an impact on the Austria location attractiveness. In the RTI-specific context it should however be noted that further mechanisms must be considered, to complete the overall location attractiveness – the higher company taxation in Austria for R&D-active companies compared with the leading innovation nations, for example, will be over-compensated by the generous arrangement of the research premium (see the “Location attractiveness” section).

With regard to regulation, the indicators provide a mixed picture, which has deteriorated

Figure 9: Strengths and weaknesses in the regulation and taxes area compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

³³ For this, see WIFO (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung. Report 1: Rahmenbedingungen. Vienna.

somewhat compared to the previous year. Austria now only scores better than the comparison countries with investor protection. In the area of IPR regulation and the strictness of protecting intellectual property rights, compared to the innovation leaders Austria is not positioned badly; however, compared with the global top countries, Finland, Switzerland and Luxembourg, there is significant potential to improve. The Council believes this should be urgently leveraged with respect to the global developments in particular, whereby special focus must be made here on better exploitation of intellectual property rights.³⁴ It should therefore be critically noted that this issue has not been addressed in the Austrian Government's RTI Strategy (see also the "Analysis of the RTI Strategy 2030 objectives" section). The distance to the innovation leaders with the indicators for the finance system (especially risk capital intensity and capital market parameters), by and large corresponds with the findings provided by the Austrian Council for some years now. A larger capital market and more extensive financing capital with venture investments are required.³⁵ With regard to the Covid-19 crisis, the resulting structural changes and the long-term growth prospects in particular, in the years ahead special attention will have to be paid to funding future-fitter sectors. Reference to necessary regulatory and structural reforms of the Austrian capital market is made in the RTI Strategy 2030, however not with the measures for achieving the goal for higher risk capital intensity, for example.

With regard to the tax and levies ratio – where Austria scores worse than the comparison countries – international organisations such as the OECD or the IMF have repeatedly stated that the total tax and levies burden in Austria is too high.³⁶ In relation to the Covid-19 crisis, immediate tax cuts are perhaps not logical. Nonetheless, in the near future increased attention paid to making the tax and levies system future-proof and revenue-neutral. The problem of high taxation with the labour factor would also have to be addressed here, as would the low environment-related taxes.

The eco-social tax reform announced by the current government has, however, yet to be delivered.³⁷ Such a reform could relieve the labour factor and would therefore also result in increased business location attractiveness for international top executives. This would also further burden environmentally harmful activities, which at the same time could provide innovation incentives. Austria is currently still behind the leading nations with the taxation of environmentally harmful activities.³⁸ This reallocation in the form of burdening "public bads" as funding for environmentally friendly activities and specific R&D activities in the climate and environment area would also be urgently required in view of the climate problems and Austria's deficits in this respect (see the "Environment and climate" section in detail).

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³⁴ For details, see Austrian Council (2019): Recommendation for increasing the protection and exploitation of intellectual property rights of 16 October 2019.

³⁵ See Austrian Council (2019): Report on Austria's Scientific and Technological Capability 2019. Vienna, pp. 42 ff. and pp. 50 ff. See also Keuschnigg, C., et al. (2017): Innovationsland Österreich F&E: Unternehmensentwicklung und Standortattraktivität. Study commissioned by the Austrian Council. Vienna.

³⁶ OECD (2019): Economic Survey Austria 2019. OECD Publishing, Paris; IMF (2015): Staff Report for the Article IV Consultation, Washington.

³⁷ Austrian Government (2020): Aus Verantwortung für Österreich. Regierungsprogramm 2020–2024. Vienna, p. 78 f.

³⁸ An example here would be the fuel oil tax, which is still considerably below the level of the neighbouring states and therefore causes a rather high level of fuel tourism. This form of tourism is responsible for Austria's higher CO₂ emissions, which in turn cause higher climate penalty payments.

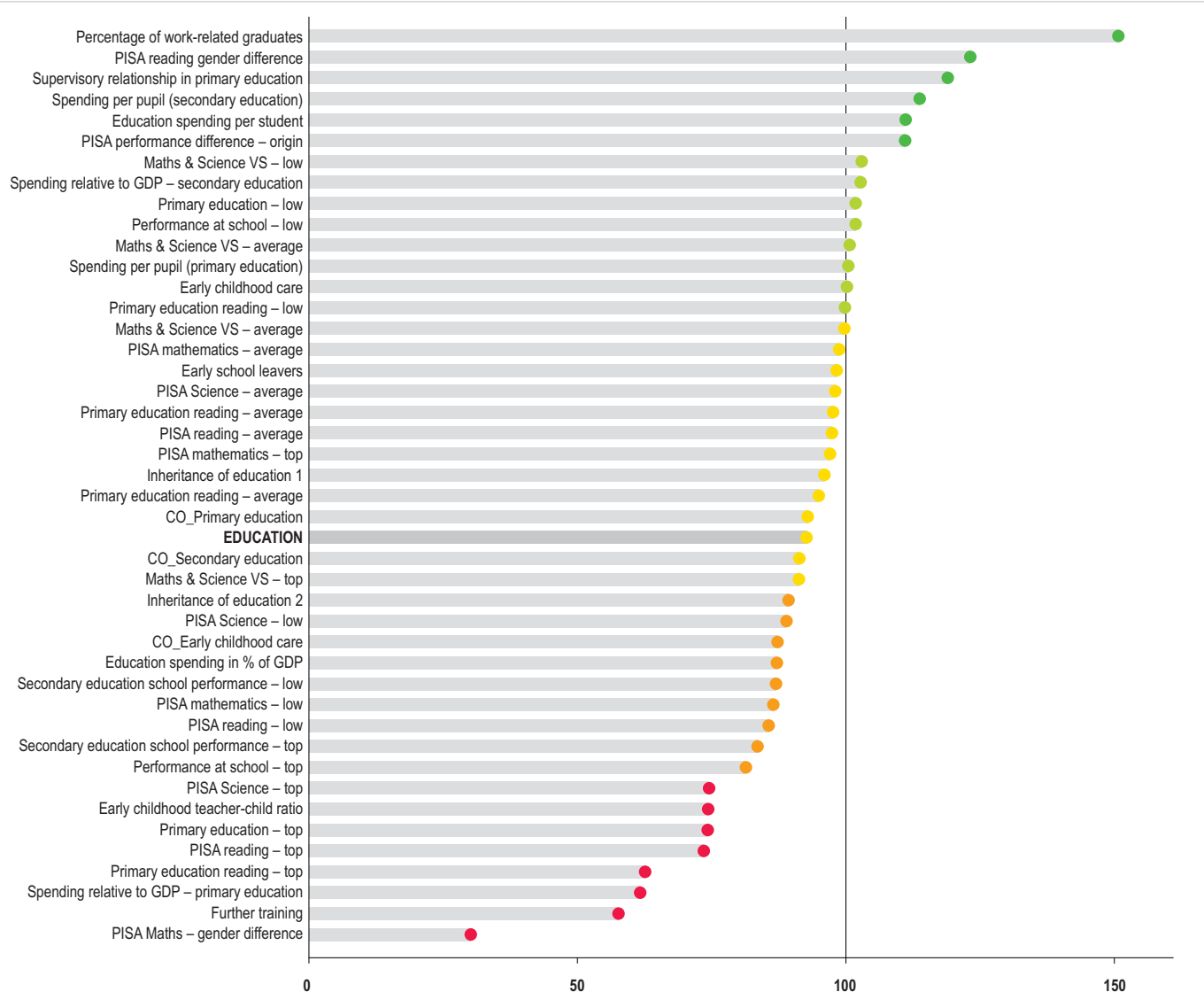


Education

The “Education (without tertiary education)” area is also part of the fundamental framework conditions for a successful RTI system. Neither research nor innovation activities can be

implemented without sufficiently qualified and creative workers. The indicators have shown a largely unchanged situation for some years now. They therefore illustrate the low development dynamic, which is why in most ar-

Figure 10: Strengths and weaknesses in the education area compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

as it has not been possible to join the leading nations, nor does this appear achievable without drastic measures. As figure 10 shows, Austria only scores better compared with the group of innovation leaders with six indicators in all; with a further eight indicators it is just above the average.

The figure also shows that the Austrian education system performs below-average with nine indicators; with a further eight indicators it is even significantly worse than the average of the group of innovation leaders. The complete absence of this area in the objectives and measures of the RTI Strategy 2030 is therefore all the more concerning (see also the “Analysis of the RTI Strategy 2030 objectives” section) – especially since a comparison with the top 3 yields even more negative results (see table 4 in Annex 2). The Austrian education system is only rated excellent here with one single indicator (“Percentage of career-oriented graduates”). At the same time, with 29 of 40 indicators it is in the dark red area and therefore lagging far behind the global best performers.

On the whole, the picture here illustrates that, despite comparatively higher education spending³⁹, pupils’ performances do not meet those of the leading countries. The performance results in the “Reading” area in particular are food for thought, as this is of course the most basic cultural skill on which education as a whole builds. If we also consider the development of reading skills over a longer period, we

see that, despite a series of reform measures⁴⁰ in Austria between 2006 and 2016, it essentially shows no improvement.

Here in particular the Covid-19 crisis could also have especially serious effects, because the latest studies indicate that long school closures could above all cause problems for children with reading difficulties. The deficits are most evident with first and second class primary education pupils, as they are at the beginning of their “reading career”. Three months without being present in class for children with reading difficulties therefore mean a performance regression of about one month, as shown by the initial results of an ongoing study.⁴²

Apart from these initial worrying findings, the medium and long-term effects of the COVID-19 pandemic on the education system on one hand, and the educational and therefore also professional career paths of the pupils affected by the lockdown, school closures and distance learning measures on the other, are not entirely foreseeable at this time. The consequences of the Covid-19 crisis and of the containment measures connected with it on the mental health of children and young people are currently just as difficult to judge⁴³ as the extent of the actual education losses is, even if it is undisputed that there will be increased funding requirement, so that children and young people can mitigate their deficits again.

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39 For this, see the “Education spending per pupil”, “Spending per pupil – secondary education”, “Spending per pupil – primary education” and “Spending relative to GDP – secondary education” indicators.

40 Reduction in the maximum number of children per class from 30 to 25 children (from school year 2007/2008); introduction of the education standards in primary education (from 2008/2009), combined with increasing competence-oriented classes; introduction of a compulsory kindergarten year from autumn 2010.

41 Austrian pupils’ reading competence in 2016 was almost exactly the same as in 2006. In between (2011) there was however a significant drop, which is why pupils’ literacy in 2016 is better than in 2011. For this, see Wallner-Paschon, C., et al. (2017): PIRLS 2016. Die Lesekompetenz am Ende der Volksschule. Erste Ergebnisse. Graz, Leykam, p. 41.

42 APA Science (8 February 2021): Lesen lernen im Lockdown: Schulschließungen sind fatal für schwache Leser. Online at: <https://science.apa.at/power-search/16071853366089411575>.

43 For this, see, for example, the preliminary results of the still ongoing “COVID-19 children study” by Innsbruck University of Medicine. Online at: <https://www.i-med.ac.at/mypoint/news/752071.html>.



strengths & weaknesses

At the same time it was seen after just a few weeks of distance learning that those weaknesses of the Austrian education system in particular, which result from the “family support options” factor and have been discussed while focusing on the “education inheritance” issue for years now, have been aggravated even further. Shifting learning from the school to the home was of course a huge challenge for all involved. Nevertheless, it must be assumed that the performance scissors between the children, who with appropriate resources and parental support get through the crisis better, and those who, for whatever reasons, are left to themselves, will spread even further.

The COVID-19 pandemic also bluntly revealed how insufficiently many schools and teachers have addressed the requirements of the digital age. Although the OECD had already identified the integration of ICT into everyday schooling as a challenge in 2005⁴⁴, a master plan for digital basic education was implemented in Austria only in 2018.⁴⁵ This “8-point plan for the digital class” considers the fact that digitisation is penetrating more and more life areas and must therefore also be integrated into education and training. As the plan is based, however, on the voluntary dis-

position of schools and teachers, at the beginning of the COVID-19 pandemic there was only very little movement on implementation, as was later clearly revealed by the experiences with distance learning in particular. And nor have the manner and form in which digital content and equipment will be integrated into the class been conclusively clarified. The availability of appropriate equipment does not automatically produce better learning results. A beneficial, logical use of ICT at schools in particular requires the right teaching methods and therefore a real “education strategy” across the board.

In view of the fact that the education system is key for a country’s innovation performance, the conclusion is: faced with significant performance differences compared with the leading nations, Austria must pay far more attention to this area. This is therefore also highly relevant because, due to the rapid growth in knowledge and the increasing complexity of our world, new competencies and skills (21st century skills⁴⁶) will be required to be more resilient on the whole. Education is the key component here and must therefore be adjusted to the requirements of both the present and the future – where foreseeable. The absence of the education area in the RTI Strategy 2030 should thus be swiftly corrected.

⁴⁴ OECD (2020): Country Note “Austria”. School education during COVID-19. Were teachers and students ready? Online at: <http://www.oecd.org/education/Austria-coronavirus-education-country-note.pdf>.

⁴⁵ <https://digitaleschule.gv.at/>.

⁴⁶ OECD (2018): Skills for the 21st Century: Findings and Policy Lessons from the OECD Survey of Adult Skills. OECD Education Working Paper No. 166. OECD Publishing, Paris.

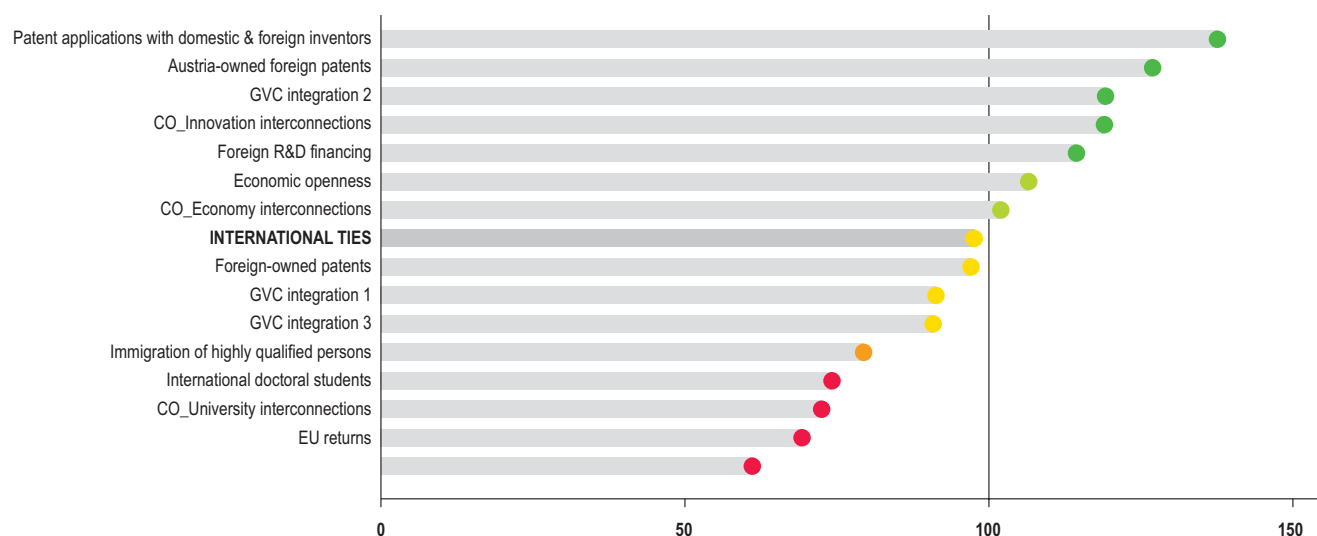
International ties

International ties are key for a small, open and highly export-oriented national economy like Austria's. But an RTI system, and here the universities in particular, must also be heavily interconnected internationally to benefit from international knowledge flows. This can happen on several levels, with research cooperations, mobility of students or researchers, corporate cooperations, immigration of highly qualified workers and economic trade relations. As figure 11 illustrates, in the international ties area Austria ranks more or less at the level of the innovation leaders. With regard to the ties in the areas of economy and innovation in particular, it is clearly ahead of the leading innovation nations here. In the globalisation index, which measures the economic, social and political dimension of the globalisation of all countries, for some

years now Austria has been steadily among the top 10 and is currently placed number 7 behind Switzerland, the Netherlands, Belgium, Sweden, the UK and Germany.⁴⁷ Both the index and the indicators used for this report show that the Austrian economy is more intensively integrated into the global market than most comparison countries are – and benefits disproportionately well from it.⁴⁸ By contrast, the Austrian level in the science international ties area is significantly below that of the comparison countries. The global best performers in this respect include Luxembourg, Belgium, the Netherlands, Denmark and Switzerland (see also table 5 in Annex 2). Austria is indeed intensively integrated into the European research area, and the “return quota”, with which participation in the re-

strengths & weaknesses

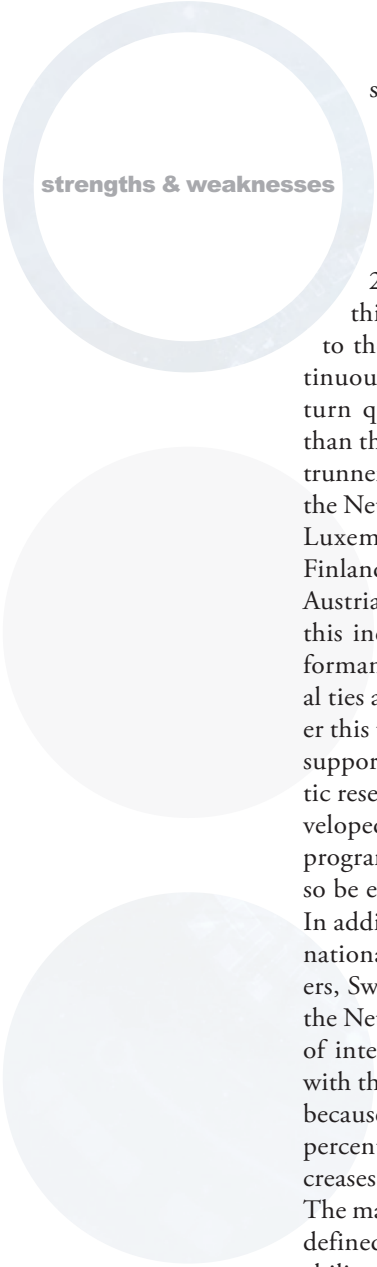
Figure 11: Strengths and weaknesses in the international ties area compared with the innovation leaders



Source: See Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

⁴⁷ <https://kof.ethz.ch/prognosen-indikatoren/indikatoren/kof-globalisierungsindex.html>.

⁴⁸ See also Bertelsmann Stiftung (2020): Globalisierungsreport 2020. Gütersloh, p. 14.



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search framework programmes is measured, has been mostly stable above the EU average for some years now. A regressive trend has, however, also been observed in recent years: The quota fell, for example, from 123 percent in 2008 to 103 percent in 2019. Due to this regressive performance, the distance to the comparison countries increases continuously, which results in the Austrian return quota being significantly lower today than that of the innovation leaders. The frontrunners in the group of innovation leaders are the Netherlands with close to 250 percent and Luxembourg with 230 percent. Denmark, Finland and Sweden are more or less at the Austrian level in 2008. This all contributes to this indicator showing by far the worst performance of all indicators in the international ties area (see table 5 in Annex 2). To counter this trend, the existing and well-established support and advisory services for the domestic research community should be further developed in all issues relating to the European programmes, and existing services should also be expanded.

In addition to the return quota and the international co-publications, where, among others, Switzerland, Denmark, Luxembourg and the Netherlands stand out, the low percentage of international doctoral students compared with the innovation leaders is also concerning, because in spite of absolute growth with this percentage, the gap to the leading nations increases sharply. The reasons are multifaceted. The main factors for international mobility are defined by the research conditions, i.e., availability of research funds, an excellent scientific community and available research infrastructure in a country of choice.⁴⁹ The offer-

ing of structured doctoral programmes, with employment relationships for students, is also an essential pull factor. However to achieve substantial progress here, the range of English-language offers (and others) would have to be massively increased. The continuous improvement with the percentage of international doctoral students does indeed show that individual correct steps have already been taken. A long-term internationalisation strategy is however required for even higher participation of international PhD students, as is also formulated as a goal in the RTI Strategy 2030⁵⁰. Additional measures, such as the expansion of dedicated international programmes, and English language ones in particular, a further increase in the research performance (to boost reputation) or the availability of funding awarded in competition are also required here, as is optimisation of the framework conditions at the universities (see the “Tertiary education” and “Research at universities and non-university institutions” sections). Active internationalisation measures must also be introduced. An increased offering of bilateral or international exchange programmes, residence grants etc. at national, international, EU and other levels, should be provided and funded more intensively to increase the desired effect of an international knowledge transfer between scientific organisations, universities and companies etc. In Austria the OeAD supports numerous incoming and outgoing programmes.⁵¹ ERASMUS⁵², the world’s biggest programme for funding student mobility, and EURAXESS⁵³, a network of more than 500 service centres for researchers in 40 European countries and worldwide, who want to continue their career in another country, are cited as international examples.

49 EU Commission (2017): MORE3 study: Support data collection and analysis concerning mobility patterns and career paths of researchers. Luxembourg, Publications Office of the European Union, 2.

50 With the RTI Strategy 2030, the goal is set to increase the percentage of science and research staff applying from abroad at universities to 45 percent, a value close to the leading research nations.

51 <https://oead.at/de/der-oead/downloads/>.

52 <https://oead.at/de/projekte/mobilitaetsprojekte-in-erasmus/>.

53 <https://www.euraxess.at/>.

Some countries, the USA, the UK and Switzerland globally, for example, and Luxembourg, Belgium, the Netherlands and Denmark in particular in the EU (see also table 5 in Annex 2), participate more intensively in knowledge circulation, or the “Brain Circulation”, and are also more successful than others. As mentioned at the beginning, attractive research conditions and possibilities to work on research projects are the primary motives cited by students and researchers in choosing a country of choice. Additionally however, other factors such as language (English language countries such as the USA, the UK, Australia or New Zealand traditionally enjoy a high level of appeal as a country of choice) or social and political stability in a country and immigration and residency regulations also have an influence on motivating researchers to migrate. With regard to the costly and com-

plex immigration criteria, there is still high catch-up potential in Austria, as the administrative processes and the authorities’ handling of people from non-EU countries cause numerous obstacles that prevent both researchers and students from moving to Austria. An improvement in these framework conditions and specific internationalisation activities is therefore required to increase Austria’s appeal and the attractiveness of its universities for foreign researchers and students. The higher education framework conditions must also be generally improved so that all researchers working at Austrian research institutions are offered the temporal and financial freedom required for a successful international cooperation, to consequently strengthen research location Austria in both the international and the European network.⁵⁴

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⁵⁴ See inter alia, Austrian Council (2017): Recommendation on the way to the forefront of innovation of 30 November 2017.

Core RTI system – Knowledge and innovation production

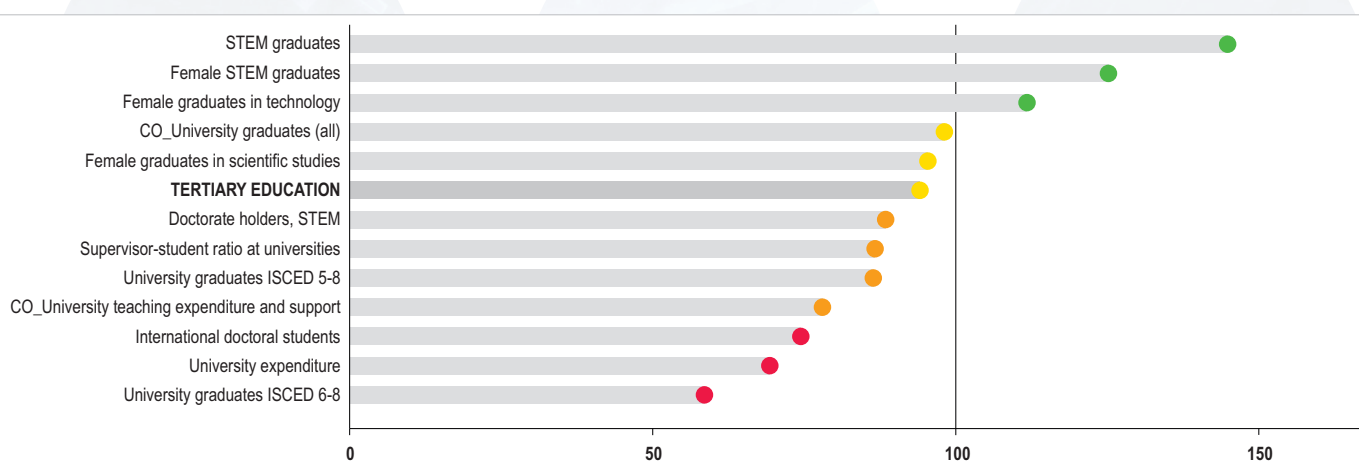
Tertiary education

Analyses on the status quo and the developments in the tertiary education sector provide the ability to estimate the future human potential in science and research. Changes in the education situation for the population are reflected here by long-term trends and therefore form robust indicators to illustrate the available potential of highly qualified specialists. For this report a total of ten indicators in two groups (“University teaching expenditure and support” and “Graduates”), which record the relative distance to the comparison countries, are used to measure performance in the area of tertiary education. The cumulative indicator for tertiary education shows that Austria continues to be slightly below the level of the innovation leaders (see figure 12). Compared with the EU countries, Austria is somewhat above the average value; it does not occupy a top 3 rank compared with the OECD countries in any area (see table 6 in Annex 2).

As already in previous years, the graduate numbers in the STEM study subjects must still be positively emphasised. Secondary technical schools make a significant contribution here. Both in the overall student comparison and in comparison with the number of female graduates, Austria is above the average value of the innovation leaders and further increased compared with the previous year (see the “Analysis of the RTI Strategy 2030 objectives” section). A slight move towards the innovation leaders’ reference value can also be seen with the STEM doctoral graduates indicator. On average, the percentages of female graduates in the sciences and engineering are also that of the innovation leaders. This trend should also be successfully continued in the years ahead.

For the discussion of the indicators for higher education graduates ISCED 5–8⁵⁵ and higher education graduates ISCED 6–8, it has already been mentioned that, due to the struc-

Figure 12: Strengths and weaknesses in the tertiary education area compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

⁵⁵ Percentage of 25 to 34 year-old university graduates in percent of the 25-34 age cohort of the population.

tural differences in the various education systems and training paths, especially the important training paths in Austria, a comparison of the indicators will be performed for vocational training and the vocational higher level schools, which will also include further considerations. A slight increase to 41.6 percent (the average for the OECD is 45 percent) is seen once again for the “Higher education graduates (ISCED 5-8)” indicator, which in addition to the universities and technical colleges, also includes graduates of vocational higher level schools. Relative to the OECD countries, Austria therefore only occupies a place in the bottom third.⁵⁶ The top countries are Ireland and South Korea with 70 percent each and Canada with 63 percent. Within a ten-year period (2009 to 2019), the percentage of higher education graduates in Austria rose on the whole by 8.2 percentage points, which more or less corresponds with the average increase of the OECD countries. The highest increases in the percentage of higher education graduates were achieved by Ireland (22.5 percent), Turkey (18.7 percent) and Slovakia (18.6 percent).

For the narrower “Higher education graduates (ISCED 5-8)” indicator the structural diversity in the different education systems mentioned at the beginning is considered, as graduations in short tertiary education offers (“short cycle tertiary”) are not included in this indicator. With a share of 27.1 percent, an increase was indeed achieved compared with previous years, however the distance to the other country groups is still very high, as shown clearly in figure 12. Especially noticeable is the fact that the percentage of adults with a bachelor education level (ISCED 6 or equivalent) as the highest attained education status is very low in Austria. Among 25 to 64

year-olds this is only 4.3 percent. Most students in Austria to date continue their studies with a masters course (ISCED 7). With a share of 13 percent of master graduates (25 to 64 year-olds), Austria is at the average level of the OECD countries. Unlike that in most OECD countries, the percentage of adults (25 to 64 years-old)⁵⁷ with an upper secondary education level graduation in Austria is the highest at 49 percent. This more or less corresponds with the ISCED classes 3 and 4, so apprenticeship diploma up to general secondary school level with vocational training or vocational schools with level 3 diploma and university courses.

On the whole, the number of graduates must therefore continue to increase to meet the increasing requirement for well-trained academic specialists. The Austrian Council believes the strategic further development of the higher education area⁵⁸ and the objectives of the RTI Strategy 2030 anchored in the government programme should therefore be pursued with greater emphasis for the “Develop and promote human resources” area of action. The universities and technical colleges must therefore be equipped with sufficient resources to align the framework conditions with the leading innovation nations with regard to financing levels, supervision ratios and infrastructure etc. Higher education spending in Austria has actually increased annually by approximately four percent and is therefore at Denmark and Finland’s level. Compared with Luxembourg, Sweden and the Netherlands, however, it is clearly lower. In their universities, Norway and Switzerland also invest significantly more money per student. A further increase in higher education spending above the current budgetary amount is therefore urgently required, if

strengths & weaknesses

⁵⁶ Education at a Glance 2020_de. Table A1.2. Development of the level of education of 25 to 34 year-olds, according to gender (2009 and 2019).

⁵⁷ Education at a Glance 2020: OECD Indicators – OECD 2020. Table A1.1. Educational attainment of 25-64 year-olds (2019)

⁵⁸ Austrian Government (2020): Aus Verantwortung für Österreich. Regierungsprogramm 2020–2024. Vienna, pp. 304 ff.



strengths & weaknesses

the quality of research and teaching is to be increased and the campaign to improve the supervisor-student ratios⁵⁹ is to be successfully continued. In view of the generally high level of RTI financing in Austria, budgetary prioritisations must therefore be reviewed and corresponding reallocations made where applicable. The competitively awarded share must also be increased with basic funding. Role models here are, for example, Denmark or Switzerland, where the universities' budget share acquired in competition is greater than it is at the Austrian universities. A further optimisation of the supervisor-student ratios at the universities will also be required to achieve the strategic objectives in the human resources area. Despite continuous improvements compared with the leading na-

tions, there is nevertheless still catch-up requirement in this respect. The continuation of the positive development with regard to the supervisor-student ratios at Austria's universities can, however, only be achieved with a further increase in the number of scientific employees or with stricter access management. The effects of the changing framework conditions (capacity-oriented study place financing, increase in the number of scientific employees, regulation of the places for study beginners), can only be gauged and evaluated in a few years. The same applies for the effects of the COVID-19 pandemic on study courses. Irrespective of this, further improvements are however also required, as with the exception of some KPIs, the growth rates are behind those of the innovation leaders (for details see table 6 in Annex 2).

Research at universities and non-university institutions

The key tasks and objectives of the RTI policy in Austria include basic research funding at universities and non-university institutes at the level of the leading research nations. The RTI Strategy objectives must therefore also consistently address the improvement of the corresponding framework conditions. Specific priorities for the RTI policy of the coming decade will be consistently set with the key areas of action, "Fund excellent basic research" and "Support applied research and its impact on economy and society". This is urgently required in particular to strengthen research performance when we consider Austria's performance compared with the leading innovation nations shown in figure 13. Notable here is the fact that the input indicators are relatively better than the output indicators, that is, in the research performance area Austria scores especially badly, while with some financing indicators in particular, the Austrian level achieves

or surpasses that of the innovation leaders (see also the "Efficiency of RTI activities" section). The situation must, however, be considered differentiated.

With an R&D quota increase to about 3.2 percent of GDP up to 2019, there was a remarkable catch-up process with R&D expenditure, whereby Austria advanced to the countries with the highest research quotas in the world. The effect of these high investments has not (yet) been measured. The indicators of the strengths-weaknesses analysis for research at universities and non-university institutions clearly show that previously implemented measures have not had the desired effect.

This was also the conclusion drawn in the OECD Review, which, with its "From Inputs to Impact" announcement, defined the general impact direction of the Austrian RTI policy.⁶⁰ A visible coming closer to the innovation leaders was not achieved. The shaping of ef-

⁵⁹ For the performance agreement period (PA 2019-2021), stronger focus was made on improving the supervisor-student ratios and increasing scientific staff, to create an additional 360 scientific job opportunities and professorships.

⁶⁰ OECD (2018): OECD Reviews of Innovation Policy: Austria 2018. OECD Publishing, Paris, p. 13.

fective and efficient framework conditions for research at universities and non-university research institutions therefore continues to be an essential goal of RTI policy intervention.⁶¹

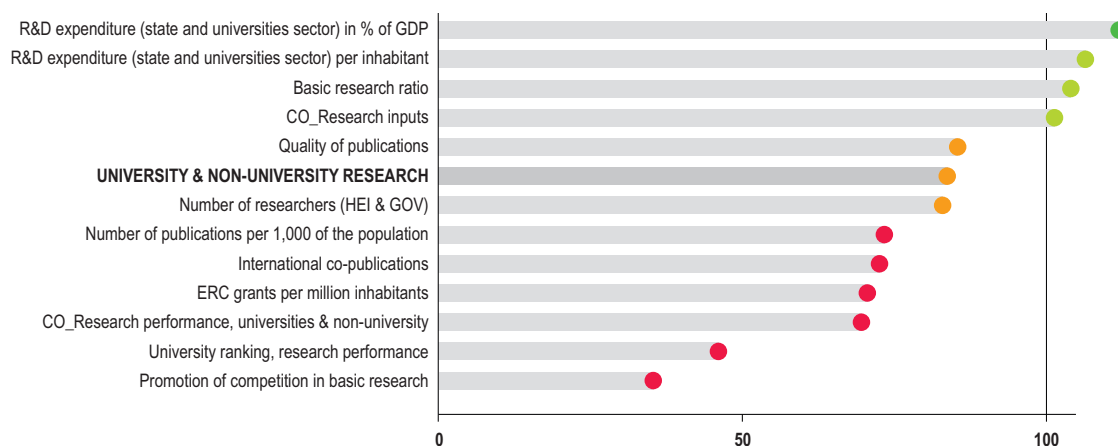
It should be positively emphasised that the values of both R&D expenditure input indicators (state sector and higher education), both presented in percentage of GDP and per inhabitant, are above-average. With expenditure of 0.94 percent of GDP, Austria is clearly above the average value of the innovation leaders (0.84 percent); however, it also clearly ranks behind the top countries, Denmark (1.07 percent) and Norway (1 percent) and Germany (0.97 percent). The comparison of the R&D expenditure per inhabitant also shows a slight lead with respect to the set reference value. Ultimately, the basic research quota is also disproportionately high, however with a constant value of 0.54 percent of

GDP, Austria is ranked fourth in the OECD ranking. Only Switzerland with 1.40 percent, South Korea with 0.86 percent and Denmark with 0.56 percent are ahead of Austria.

By contrast, however, there is another fall in the share of funds for competitive basic research funding, which is an essential driver of excellence in research. Shifted to the number of inhabitants, the leading nations Switzerland and Luxembourg invest about four times as much as Austria, Finland three times as much, and Sweden and the Netherlands twice as much in competitive funding for basic research. The corresponding indicator in figure 13 shows the overall greatest distance to the innovation leaders in the entire area. The loss of funding by the National Foundation for Research, Technology and Development in the current year of EUR 100

strengths & weaknesses

Figure 13: Strengths and weaknesses in the universities and non-university institutions area compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with "CO_" prefix (= "Composite").

⁶¹ See Austrian Council (2017, ed.): Zukunft und Aufgaben der Hochschulen: Digitalisierung – Internationalisierung – Differenzierung. LIT Verlag, Münster-Vienna.



strengths & weaknesses

million, additionally increases the pressure here on the funding agencies and on researchers. Equipped with a tender volume of EUR 150 million for the 2022-2024 period, the start of the excellence initiative is actually an improvement. However, this is still clearly below the proposed volume.⁶² The ambitious objective of the RTI Strategy 2030 to place two Austrian universities in the top 100, will hardly be achieved without significantly more competitive funding. The universities' below-average financing situation also has an overall negative effect (see figure 12 in the "Tertiary education" section) on the universities' performance.

Research performance, among other factors, suffers here with the number of acquired ERC grants (see also the "Analysis of the RTI Strategy 2030 objectives" section) or the quality and number of publications, for example. Despite annual increases, measured on the number of publications per 1,000 inhabitants, the distance to the innovation leaders in Austria has not been reduced.⁶³ A circumstance that allows us to conclude that the research conditions at Austrian universities and non-university research institutes limit researchers' options. Possible causes range from success rates that are too low with the acquisition of third party funds at national level (the FWF is lack-

ing some EUR 60 million for financing excellent-rated research projects), partially high teaching responsibilities of doctoral students, through to limited access to the most modern research infrastructure, especially in cost-intensive technical and scientific research disciplines.

The access to European and international major research institutions in particular plays an essential role here. Austria currently participates in a total of 15 ESFRI projects/landmarks and in further international research infrastructures. On the whole approximately EUR 100 million are provided annually for participation in international organisations and research infrastructures.⁶⁴ Some 75 per cent of this goes to the CERN nuclear research centre, the European Southern Observatory (ESO), the European Molecular Biology Conference (EMBC) and the European Molecular Biology Laboratory (EMBL). At a level similar to Switzerland, in the international comparison Austria therefore invests very intensively in memberships in multinational large-scale research infrastructures. Approximately CHF 100 million flow annually into eight international research agencies, partially based in Switzerland, plus several million more into further memberships with ESFRI, to enable researchers to access and use international research infrastructures.⁶⁵

⁶² Androsch, H. / Loprieno, A. / Nowotny, H. (2019). Exzellenzinitiative – Eine Zukunftsoffensive für den Forschungsstandort Österreich. Expert paper commissioned by the Federal Ministry of Education, Science and Research.

⁶³ However it is also pointed out that, with regard to public-private co-publications per million inhabitants, Austria ranks fifth behind Switzerland, Iceland, Sweden and Denmark (see EIS 2020, Annex C: Current performance. 3.2.2. Public-private co-publications. pp. 82 f.). This is certainly also due to the very intense cooperation between science and economy (see also the, "Research and innovation in existing companies" section).

⁶⁴ For this, see BMF (2020): R&D supplement. Overview acc. to § 42 para. 4 item 5 BHG 2013. March 2020, p. 19.

⁶⁵ See Swiss roadmap for research infrastructures with regard to the ERI dispatch 2021–2024. Swiss State Secretary for Education, Research and Innovation (SBFI) (2019).

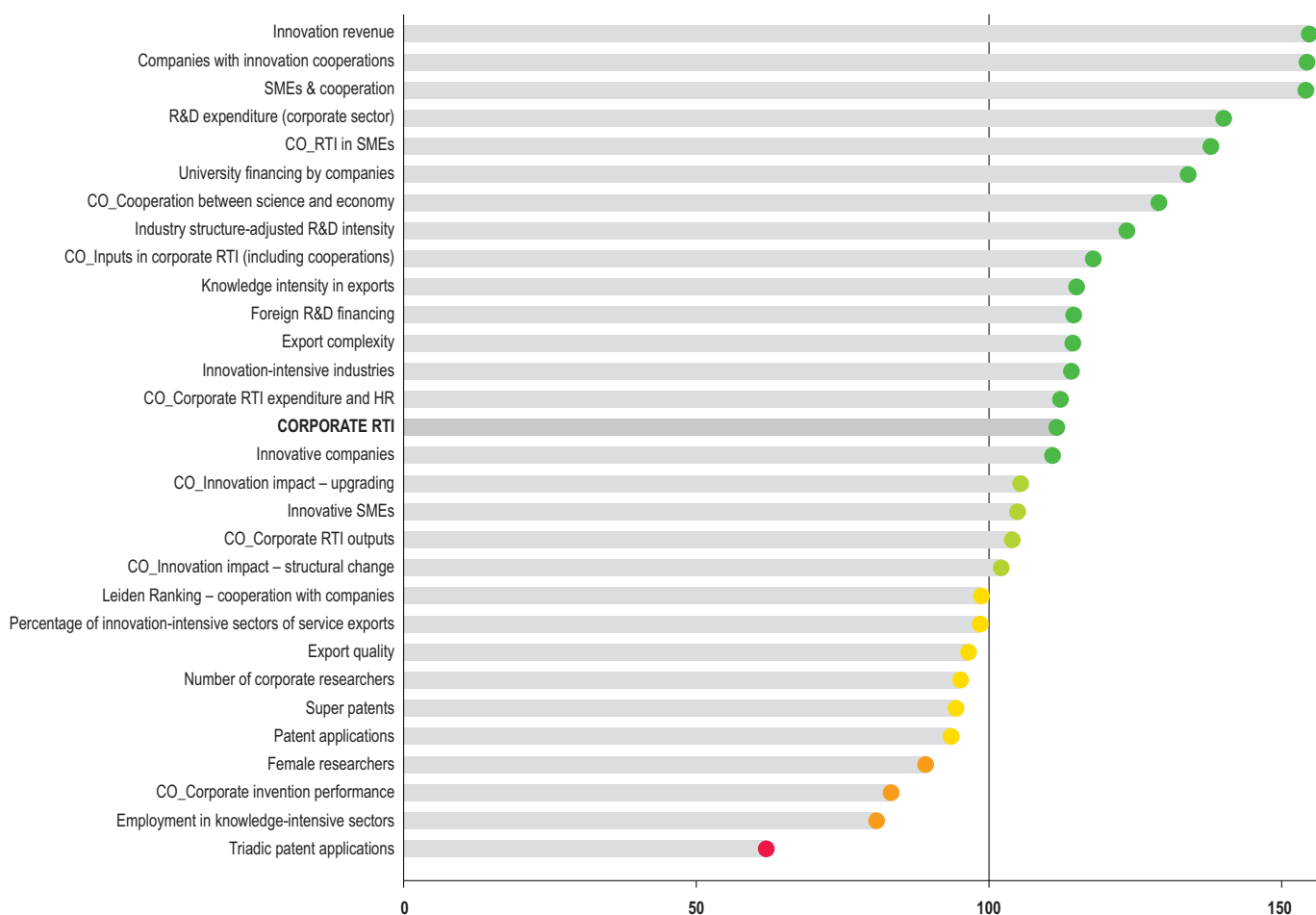
Research and innovation in existing companies

In addition to basic scientific research, applied research, technological development and innovations are also key for advanced national economies and modern societies.⁶⁶ The importance of innovation and R&D-active companies for the technological transition and the

sustainable transformation of economy and society is therefore also emphasised in the RTI Strategy 2030 and explicitly addressed with the key area of action, “Applied research and its impact on economy and society”.⁶⁷ The

strengths & weaknesses

Figure 14: Strengths and weaknesses in the corporate research and innovation in existing companies area compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

⁶⁶ See Austrian Council (2015): Designing the Future. Economic, Societal and Political Dimensions of Innovation. Echo-media, Vienna.

⁶⁷ Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation, Vienna, pp. 4 and 9 f.

European Commission also again and again stresses the key function of applied R&D and innovation in companies in particular for what's known as the, "twin transition", in the context of its industry strategy published in 2020, for example.⁶⁸

In the area of corresponding activities, the Austrian innovation system also performs especially well in the international comparison. As figure 14 shows, Austria is above the innovation leaders' average with the majority of the indicators used. The propensity of companies to cooperate with one another, but also with research institutions and universities, is excellent at international level. Added to this are the companies' generally high R&D intensity and the percentage of knowledge-intensive products in exports. The situation with regard to companies' R&D expenditure (BERD) and the percentage of innovation-active companies and SMEs is comparatively very good. This is, however, due to the fact that Austria applies as one of the countries with especially high research funding for companies (see also the "Location attractiveness" section). In comparison the corresponding overall performance of the Austrian SMEs, which, due to the dominance of small and medium-sized enterprises in the Austrian economic structure, produces an overall positive result, must also be emphasised here.

With an already very good starting basis, the Austrian position has partially even improved once again (For this, see in detail table 8 in Annex 2). This has various causes. Austrian companies' sales with innovations, which is now far ahead of the innovation leaders, can be attributed to the fact that the data collected is based on survey results from the Community Innovation Survey and is therefore highly volatile. The Austrian value is indeed relatively stable, however the innovation leaders' values have fallen recently. Caution is

therefore recommended when interpreting the data. In contrast, the growth in the area of export complexity, so in the technology content of Austrian exports, is the result of a real improvement for Austria – with a simultaneous deterioration with the comparison countries. Nevertheless, in view of the overall excellent positioning, it must also be said that with the outputs of the innovation system in some areas, Austria continues to be behind the innovation leaders and did not achieve any significant improvements. This applies just as much to the export quality as it does to the effects of innovations on the structural transformation of the Austrian economy. With the number of patent applications, Austria's innovation system is actually clearly above the EU average. Despite slight improvements, however, it is still below the level of the innovation leaders. And compared with the global top three, Switzerland, Sweden and Germany, it is positioned far worse. The situation is similar with inventions that have far-reaching technological consequences, which not only keep pace with the technological transition, but rather also decisively drive it forward and enable corresponding competition benefits for companies. With regard to such "triadic patent applications" (applications to patent offices in Japan, the USA and Europe) or "super patents" (patents for revolutionary inventions), Austria is below the level of the European innovation leaders – and even significantly so with triadic applications. Austria scores even worse in the comparison in this respect with the global frontrunners, Germany, Finland, Japan, the Netherlands, Sweden or Switzerland (see also table 8 in Annex 2). In addition to more specific public and private R&D expenditure, investments in excellent basic research are especially important for strengthened innovation system output in terms of patents that are key for technology development (see the "Research at universities

⁶⁸ EU Commission (2020): A new industry strategy for Europe. Commission's Communication of 10 March 2020, Brussels.

and non-university institutions” section). The results in the research and innovation in existing companies area show an overall strong position for Austria, which, however, continues the already known weaknesses with the technology outputs (see also the “Efficiency of RTI activities” section). This is further heightened, for example, by the fact the patents topic is not considered in the RTI Strategy (see the “Analysis of the RTI Strategy 2030 objectives” section). All future measures and arrangement activities for improving the innovation system should therefore not explicitly address the weaknesses alone, but rather also

that the strengths, if these are essentially due to a relative deterioration in the comparison countries and are not used as arguments for structural inertia. It should also be noted that significant requirements for the performance of innovation-active companies are found in basic research work activities or in the availability of highly qualified R&D staff and high-performance research infrastructures (see also the “Education”, “Tertiary education” and “Research at universities and non-university Institutions” sections).

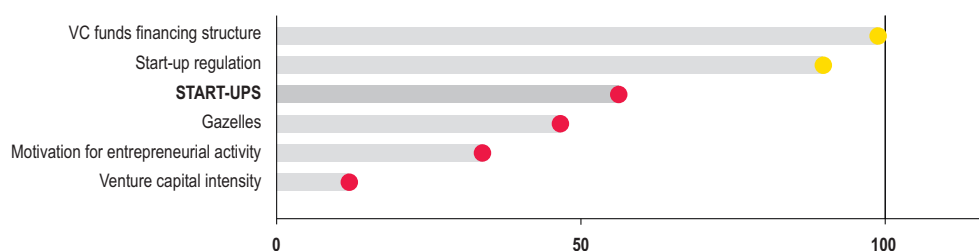
strengths & weaknesses

Start-ups

In times of socio-economic crises, new, innovative and knowledge-intensive companies with given growth potential and appropriate growth plans are also and especially essential for structural change, technological transition and on the whole the dynamic development of modern national economies. Start-up activities and development options of especially rapidly growing companies and start-ups, in particular because of the COVID-19 pandemic, are therefore at the core of the RTI and economic

policy.⁶⁹ The start-up area is thus one of the key areas of action for Goal 2, “Focus on efficiency and excellence”, of the RTI Strategy 2030.⁷⁰ The 2020-2024 government programme also addresses the issue of framework conditions to provide the appropriate attention to start-ups. The topics here range from the acceleration and simplification of start-ups to making corporate enterprise law more flexible, through to better incentives for private risk capital.

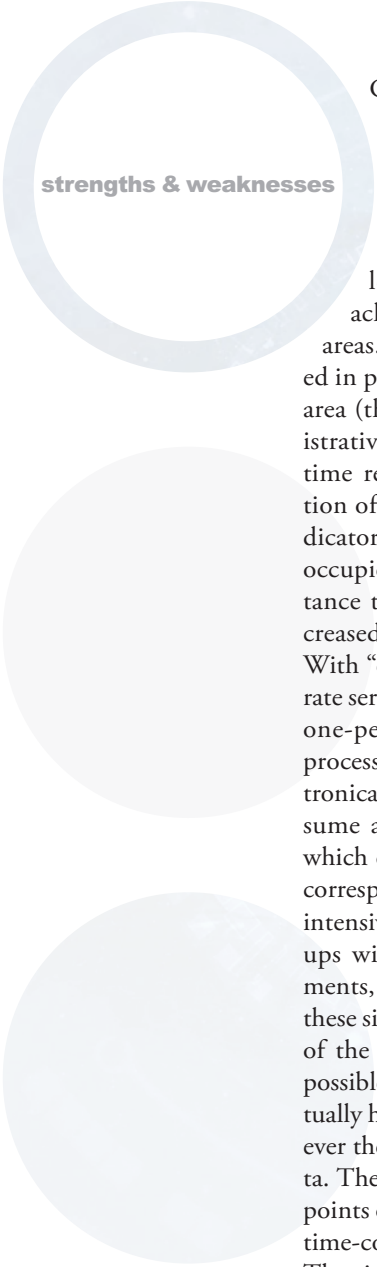
Figure 15: Strengths and weaknesses in the start-ups area compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

⁶⁹ AIT (2021): Austrian Startup Monitor 2020. Vienna.

⁷⁰ Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation, Vienna, p. 9.



strengths & weaknesses

Corresponding regulatory measures are neither anchored in the RTI Strategy nor in the RTI Pact (see also the “Analysis of the RTI Strategy 2030 objectives” section).

As figure 15 shows, at the moment the level of the innovation leaders is not achieved in any of the start-up topic sub-areas. In spite of some measures implemented in previous years in the start-up regulation area (the reduction in the number of administrative steps required for a start-up and the time required for a start-up or the digitisation of some start-up processes), with the indicators⁷¹ available for this, Austria once again occupies one of the lower places, and the distance to the innovation leaders has even increased further.

With “eGründung” (e-start-up) via the corporate service portal, essential start-up steps (with one-person companies the entire start-up process in fact) can now be performed electronically; in certain cases, we can therefore assume a quicker and easier company set-up, which could also be positively reflected in the corresponding rankings. However technology-intensive start-ups in particular are team start-ups with more complex regulation requirements, which is why they do not benefit from these simplifications. The automatic allocation of the UID number required for a start-up, possible since the beginning of 2021, could actually have medium-term positive effects, however these are not illustrated in the current data. The WKO (Austrian Economic Chamber) points out that tax offices lately perform rather time-consuming checks before allocation.⁷²

The situation in the area of risk capital availability, the most relevant factor for heavily

growth-oriented and technology-intensive start-ups, has for years now been the greatest challenge with regard to start-up activity in Austria. In spite of a risk capital offering structure comparable with other countries (that is, private and state providers), the results concerning start-up financing with the aid of risk capital are especially negative. The distance to the leading nations, but also to the EU average, has only fallen insignificantly (for details see table 9 in Annex 2).

Concerning reasons for a start-up, the distance to the leading innovation nations has even increased. The percentage of company founders that start a company out of necessity and not driven by their own initiative as such, is above the EU average. The planned acceleration of start-up motivation in the universities area, which will be implemented over the course of the performance agreement period 2022–2024, is to be welcomed.

The negative effects on the average growth rate and the growth possibilities of Austrian start-ups connected with the two greatest weaknesses outlined in the start-ups area can also be seen in Austria’s unfavourable position with the number of rapidly growing companies in the knowledge-intensive sectors, and the corresponding employment effects. The development with regard to the distance to the innovation leaders and the respective leading nations is even negative here. In relative terms, on the whole the start-ups area is therefore still one of the greatest weaknesses in the Austrian innovation system.⁷³

This finding is substantiated by the results of the “Austrian Startup Monitor” (ASM)⁷⁴ run with the cooperation of the Austrian Council. According to the ASM, the effects of the

71 See Annex 1 for details on the indicators used.

72 WKO (1 February 2021): Start-up entrepreneurs (especially small enterprises) and UID numbers – considerations on business creation, on small business regulation and on awarding UID numbers. Online at: <https://www.wko.at/service/steuern/UnternehmensgruenderInnen-und-UID-Nummern.html>.

73 See Austrian Council (2019): Report on Austria’s Scientific and Technological Capability 2019. P. 42 ff.

74 AIT (2021): Austrian Startup Monitor 2020. Vienna.

COVID-19 pandemic are also already apparent, because even if Austrian start-up activity has remained largely unchanged for the moment, a good deal of the surveyed start-ups see themselves confronted with negative effects – some with massive sales losses and a worse funding situation. Start-ups from the digital technologies area on the other hand saw significant gains in places.

Analyses show that the situation in the Austrian innovation system with regard to start-up activity and the growth options of start-ups in the comparison continue to show significant improvement potential. The longer-term effects of the pandemic-related crisis on start-ups and company growth are as yet unforesee-

able. For a long-term improvement of the situation, the implementation of the start-up activities in Austria recommended by the Council⁷⁵ and announced in the current government programme, and also simplifications in the start-up process which are not included in the RTI Strategy 2030 and in the accompanying package and very generally in company law, are still extremely important.⁷⁶ A swift implementation in this respect of company law funding reforms through to the development and introduction of a new corporate form for start-ups and innovation-intensive SMEs would therefore be especially welcome.

strengths & weaknesses

Financing

The area of RTI financing is the sub-area of the RTI system that shows Austria's by far best performance compared with the innovation leaders. This can be attributed to the generally high inputs and continuing slight surplus of the public funding share relative to the innovation leaders. At the same time, it must be stressed that Austria still has a problem with these high inputs to achieve appropriate results at the level of the leading nations (see the "Efficiency of the RTI activities" section).

With regard to the financing indicators used for this report, Austria scores above-average well with very few exceptions. Figure 16 shows that almost two thirds of the indicators used for the financing area are above the level of the innovation leaders. The direct and indirect mechanisms for funding corporate research in particular score especially well here. The public share of the R&D financing and the R&D

quota are classified as high relative to the innovation leaders. The development in the private R&D quota, which has improved by almost nine percent per year since 2010 and is now even above the goal level of 66 percent, should also be emphasised here.⁷⁷ This is rated as extremely positive, even if the corresponding indicator shows a low distance to the innovation leaders; these usually show a public funds vs private funds ratio of 30% to 70% respectively here.

Only three of the indicators used for the financing area are below the level of the leading innovation nations. With the EU return quota, competitive basic research funding and higher education financing, we can therefore see a significant distance and partially also a negative development dynamic (see in detail the "International ties" section and table 5 in Annex 2 and the "Research at universities and

⁷⁵ Austrian Council (2018): Recommendation for the improvement of the framework conditions for starting innovative companies in Austria of 22 March 2018.

⁷⁶ Austrian Government (2020), RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 31 f and p. 89 f.

⁷⁷ Austrian Government (2011): Der Weg zum Innovation Leader. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 46.

strengths & weaknesses

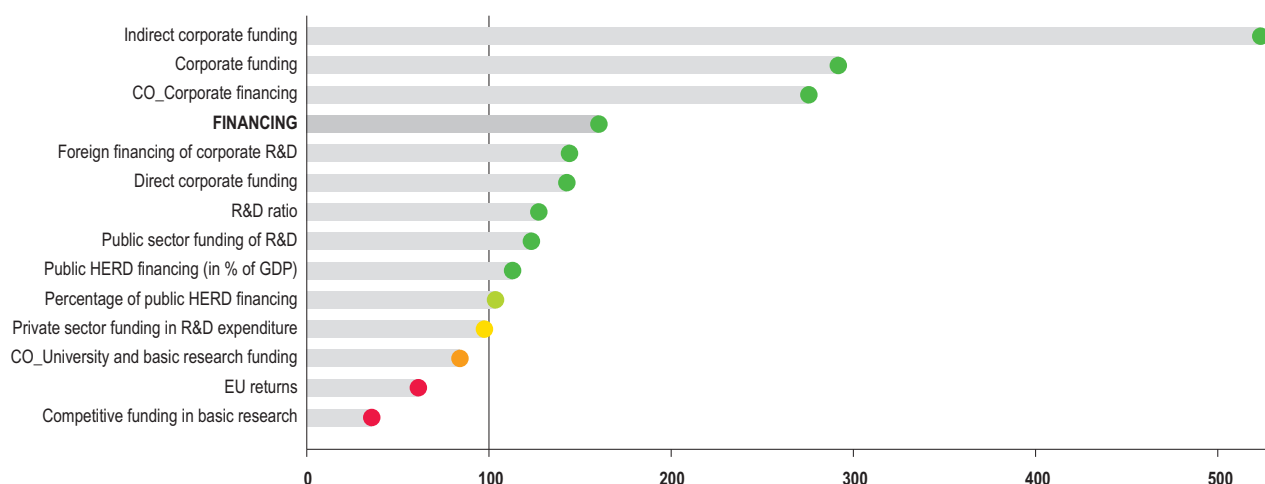
non-university Institutions” section and table 7 in Annex 2). Indeed, in view of the negative results in the areas named, on the whole we can also see that Austria, in relation to R&D funding in the international comparison, has begun an impressive catch-up process, which is clearly reflected in this ranking.

In spite of this overall very positive actual situation, in the near future and especially having weathered the Covid-19 crisis, more attention will have to be paid to RTI financing quality and efficiency. The RTI Strategy 2030 pursues the goal of further increasing R&D expenditure, to join the global leaders (see the “Analysis of the RTI Strategy 2030 objectives”

section). This objective must be critically examined, as Austria’s targeted placing among the global top 5 is only conditionally relevant, to mitigate the deficits with the Austrian RTI system’s performance and to further increase its capability. As illustrated in the “Efficiency of the RTI activities” section and already topicalised several times by the Council⁷⁸, the Austrian system is not lacking in input, but rather in outputs and impacts appropriate for this high input.

A recommendation repeated once again by the Council is therefore the reformulation of the quota target, which is oriented on the Austrian industrial structure.⁷⁹ Even if the RTI Strategy 2030 no longer defines an explicit

Figure 16: Strengths and weaknesses in the governance and financing area compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

⁷⁸ See Austrian Council (2018): Report on Austria’s Scientific and Technological Capability 2018. Vienna, pp. 19 ff.

⁷⁹ The R&D quota target could be defined, for example, with an R&D quota adjusted to the industrial structure, or an adjusted quota could specify ranges for the unadjusted R&D quota. The basic principle would be an objective targeting high R&D intensity in the existing structures, that is, a high R&D intensity that, for example, supports competitiveness in the steel industry, but does not demand that the steel industry achieve the degree of R&D that characterizes the pharmaceutical industry. See Janger, J. / Kügler, A. (2018): Innovationseffizienz: Österreich im internationalen Vergleich. Study commissioned by the Austrian Council. WIFO, Vienna, p. 40.

quota target, the “Steady increase in R&D expenditure measured on GDP” goal is intended to join the global leaders⁸⁰ (top 5; see also the “Analysis of the RTI Strategy 2030 objectives” section). The Council believes, in view of the above-average development of the R&D quota, it would be advisable to introduce a strategic refocusing. Input goals should be successively replaced by output goals, to counter the existing trends towards input-oriented steering and to focus even more on the effectiveness and efficiency of R&D invest-

ments (see also the “Efficiency and effectiveness of RTI activities” section). Furthermore, with regard to fighting the COVID-19 pandemic and the structural changes it entails, special attention should be afforded to specific funding of future-proof sectors. Ultimately, the mix of mechanisms and aids and the ratio between direct and indirect research funding should also be re-evaluated – as emphasised time and again by the Austrian Council and the OECD.⁸¹

strengths & weaknesses

80 Austrian Government (2020), RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 7.

81 Austrian Council (2019): Report on Austria’s Scientific and Technological Capability 2019. Vienna, p. 53; see also OECD (2018): OECD Reviews of Innovation Policy: Austria 2018. OECD Publishing, Paris, p. 19.

strengths & weaknesses

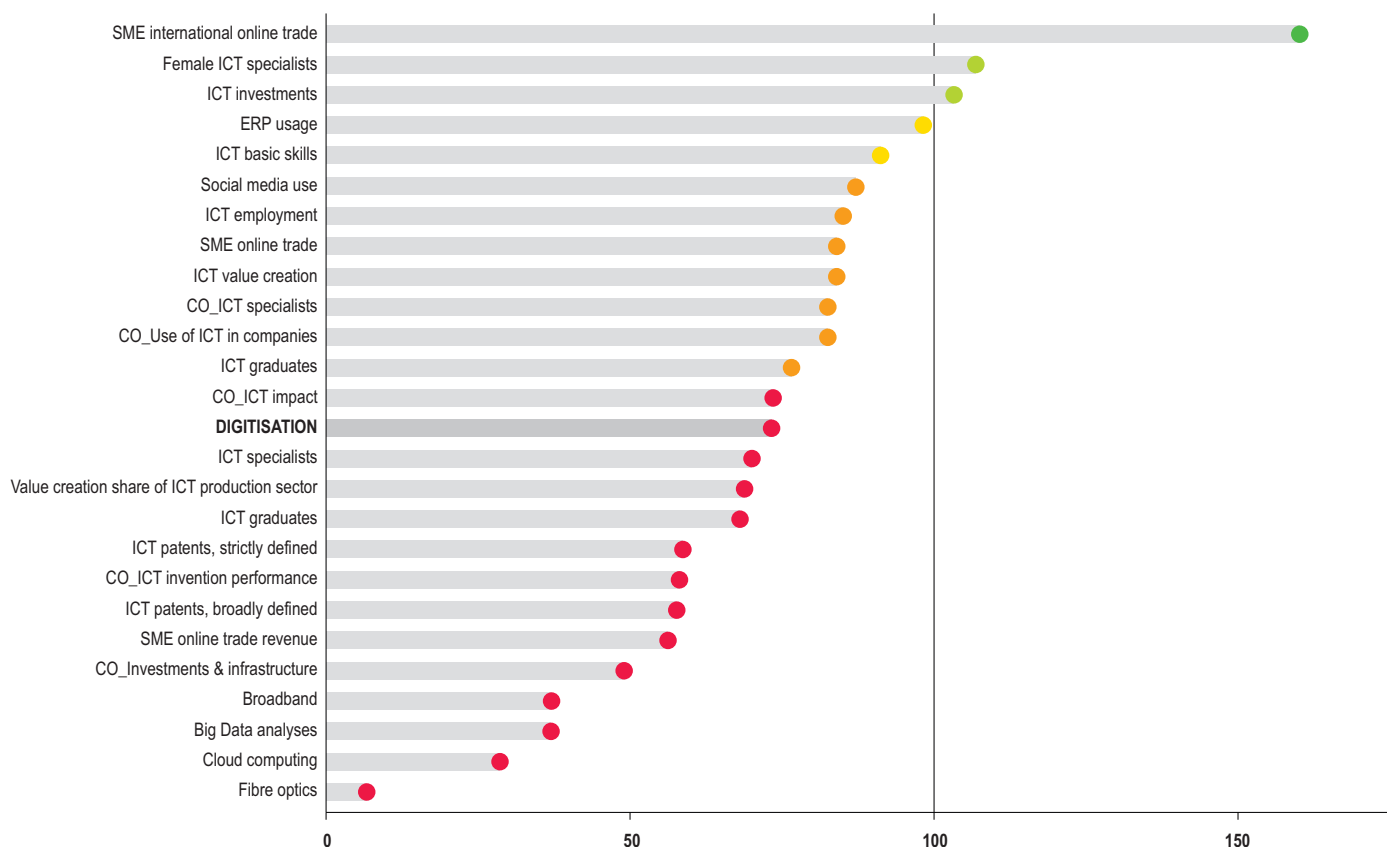
RTI cross-cutting issues

Digitisation

Digitisation and digital infrastructures are the key pillars of all digital business models and therefore extremely important for the further development of modern national economies.⁸² The COVID-19 pandemic has given digitisation a massive boost. Teleworking and e-commerce

in particular have been utilised to further enable entrepreneurial activity. Educational services at schools and universities were also kept going with distance learning (see specifically the “Education” and “Tertiary education” sections).⁸³ A conclusive evaluation of the pandemic effects has actually yet to be delivered,

Figure 17: Strengths and weaknesses in the digitisation area compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

⁸² Austrian Council (2019): Recommendation for the establishment of a holistic industry and technology policy strategy for platform economy in Austria of 6 June 2019.

⁸³ OECD (2020): Digital Economy Outlook 2020, OECD Publishing, Paris.

but as the comparison countries have also taken pandemic-related digitisation steps, the data provides information about Austria's performance during the crisis.⁸⁴ The result of this strengths-weaknesses analysis is therefore sobering: After the “start-ups” areas, the future-oriented “digitisation” area shows by far worst the performance of all RTI system sub-areas. As figure 17 illustrates, most of the indicators used for this area show high catch-up requirement compared to the innovation leaders.

Of the 20 indicators, only three rank above the level of the innovation leaders, and two are just below. The majority show a distance, and ten even show a significant distance. The biggest problem area here is the “Investments and infrastructure” area. The objectives to expand the digital infrastructure and improve the framework conditions for digitisation in the government programme are therefore to be welcomed, and are an important foundation stone for progress with the digital transformation.⁸⁵ These announcements must also be followed by an efficient implementation, whereby specific stimuli must be provided with regard to combatting the Covid-19 crisis in particular.

Austria also has considerable catch-up requirement with regard to “invention performance”. The country is far behind both the innovation leaders and the EU average with both the narrower and broader definition of ICT patents. Austria is one of the cross-sector leading nations around the world here, when we consider the patent applications per million inhabitants with the European Patent Office.⁸⁶ One reason here may be found in the dominance of globally-active European ICT companies based outside Austria, but the contact and

connection must not be further lost here under any circumstances. Austria is, however, not especially well positioned in this respect: The economic impact of ICT, resulting in particular from the value creation and employment situation, is below-average weak, and shows a slightly regressive trend relative to the comparison values.

Austria also scores badly with regard to the impact indicators for the digitisation area. In relation to the economic effects of digitisation, none of the indicators in this respect come even close to achieving the level of the leading nations. And, as shown in table 11 in Annex 2, this also applies to the comparison with the EU average, and (unsurprisingly) especially with the respective global top 3 as well. The situation here shows how Austria is not keeping up accordingly with the global trends with the digital transformation and cannot exploit the resulting potential. However, the growth rates certainly point to extensive stagnation. It remains to be seen whether a continuation of the pandemic and the resulting digitisation steps will cause any substantial change here. With regard to the effects of the COVID-19 pandemic, we also see the potential of digitisation in trade. Failings in the past have a direct effect on competitiveness and clearly reflect the respective deficits. Austrian companies' shortfalls with digitisation now result in effects that are correspondingly more serious and economically more severe.

Also negative here is the fact that for some years now Austria has been only just above the EU average in the Digital Economy and Society Index (DESI).⁸⁷ This is even more concerning, as is the below-average medium-term development trend: In the 2015-2020 period,

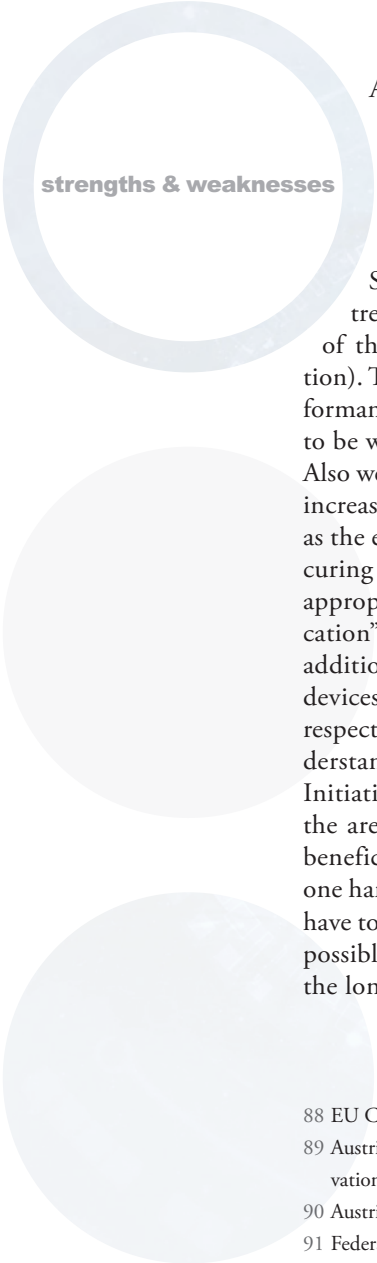
strengths & weaknesses

⁸⁴ It should be noted that some indicators are only available updated on the survey side in the next year at the earliest.

⁸⁵ Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 317 f.

⁸⁶ European Patent Office (2020): Patent Index 2019. Statistics at a glance.

⁸⁷ EU Commission (2020): Index for the digital economy and society (DESI). Country report, 2020, Austria, p. 3.



strengths & weaknesses

Austria only increased by 34 percent, while the leading countries in particular improved well above-average and the EU average even increased by 35 percent.⁸⁸ The RTI Strategy objective of moving up to 5th place in the DESI⁸⁹ must therefore be described as extremely ambitious (see also the “Analysis of the RTI Strategy 2030 objectives” section). The measures for improving digital performance named in the RTI Pact are therefore to be welcomed.⁹⁰

Also welcome in this respect is the announced increase in resources for the education area,⁹¹ as the education system plays a key role in securing young talent and specialists with the appropriate 21st century skills (see the “Education” and “Tertiary education” sections). In addition to equipping with digital terminal devices or the digitisation of teaching, in this respect it is in particular about enhancing understanding of how technology functions.⁹² Initiatives to expand university education in the area of the digital competencies are also beneficial here, even if it is questionable on one hand if an independent institution would have to be created for this. On the other hand, possible positive effects would only be seen in the long term.

Lastly, the fact that Austrian SMEs continue to be strong in cross-border online trade is also positive. Austria can position itself well above-average here compared to the innovation leaders. Austria is more or less on a par with the innovation leaders with regard to the use of Enterprise Resource Planning (ERP) systems, the share of investments in Information and Communication Technologies (ICT), the percentage of women among ICT specialists and the ICT percentage in gross fixed capital formation. And even if ICT use in companies is unsatisfactory on the whole, in spite of some relative strength areas, it must be emphasised that Austrian companies are on the upturn, and relative to the top 3 even caught up within this indicator category.

Public procurement can be an important driver for the digitisation of the Austrian corporate landscape, and therefore also a stimulant for innovative start-ups and product developments.⁹⁴ Steering effects can emerge here, both with regard to products to be procured and with regard to the technical requirements with potential customers, by accelerating electronic document exchanging, for example. The increased and strategically logically oriented use of innovation-promoting public procurement⁹⁵ should therefore be part of the consid-

88 EU Commission (2020): Index for the digital economy and society (DESI). Complete data set, own calculations.

89 Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 7.

90 Austrian Government (2020): RTI Pact 2021–2023. Vienna, p. 6 f.

91 Federal Ministry of Education, Science and Research (2020): Digital Schools – Digital Learning (Devices Initiative), Manual.

92 For this, see Spitzer, M. (2020): Digitales Unbehagen. myg Verlag, Munich, and Spitzer, M. (2018): Die Smartphone-Epidemie: Gefahren für Gesundheit, Bildung und Gesellschaft. Klett-Cotta, Stuttgart.

93 Federal Ministry of Education, Science and Research (2020): Eine neue technische Universität in Oberösterreich. Press meeting.

94 In 2015, the state sector's entire procurement volume was EUR 61.7 billion, which is roughly 18 percent of Austria's GDP. For this, see, Bröthaler, J. / Plank, L. (2017): Öffentliche Vergaben in Österreich. Methodische Grundlagen und empirische Ermittlung des gesamten Beschaffungsvolumens und öffentlicher Auftragsvergaben. Endbericht. TU Wien.

95 Federal Ministry for Digitization and Business Location, Federal Ministry of Climate Protection, Environment, Energy, Mobility, Innovation and Technology, Bundesbeschaffung GmbH (2020): IOB practical guide for the implementation of innovation-promoting public procurement.

erations for the modernisation (and therefore part of the digitisation) of Austrian companies, research institutions and administrative agencies.

On the whole it must be ensured that the objectives of the RTI Strategy in the digitisation

area and the planned RTI Pact measures this entails, are pursued and implemented highly prioritised, in order to specifically exploit the available catch-up potential in this key topic area.

strengths & weaknesses

Climate and environment

Before the COVID-19 pandemic attracted almost the full attention of society and the body politic, climate change was one of the top issues in the focus of public debate. The global climate change humanity has caused continues, and the issue has in the meantime now also reached the levels of political decision-making. In this respect, the European Commission introduced the European “Green Deal”, which, along with sustainability and environmental protection aspects, at its core targets the elimination of all net greenhouse gas emissions by 2050.⁹⁶ The Austrian Government has set itself even more challenging goals with its plans to already achieve climate neutrality by 2040.⁹⁷

In contrast to this ambitious objective, Austria’s current performance in the areas of climate and environmental protection is, however, rather unsatisfactory on the whole (see figure 18 and table 12 in Annex 2). Austria only scores below-average compared with both the innovation leaders and the top three. Of the three topic areas considered in more detail, “R&D energy and climate”, “Use” and “Effect”, primarily the R&D area is worrying, as the R&D expenditure in both the environment and the energy area is subcritical relative to the comparison countries. This is especially problematic with respect to the below-average

performance with invention capacity, which must be urgently addressed.

With regard to the use of environmental technologies and innovations, Austria cannot move closer to the level of the innovation leaders either – with the exception of the “usage rate of reusable materials”. Austria can only keep up to some degree in the economic effects area. This, however, is solely attributable to the above-average high export rate with environmental products (which also include wood, for example, whereby Austria benefits from its forests), where Austria ranks among the global top three. The other indicators, and especially resource productivity here, are only below-average compared with the innovation leaders.

This below-average performance is a problem with resource productivity in particular, as the indicator is an important benchmark for technological progress and indicates how efficient resources are used to generate value creation.⁹⁸

In this respect, Austria only ranks in the EU at tenth place⁹⁹. Austria has actually further increased its resource productivity since 2000, however relative to the EU it increased slower and fell again in recent years. With regard to an absolute reduction in resource consumption, Austria has to date shown no significant successes. To bring about a turnaround in re-

⁹⁶ EU Commission (2019): The European Green Deal. Commission’s Communication to the European Parliament, the European Council, the Austrian Council, the European Economic and Social Committee and the Committee of the Regions. COM(2019) 640 final.

⁹⁷ Austrian Government (2020): Aus Verantwortung für Österreich. Regierungsprogramm 2020–2024. Vienna, p. 73.

⁹⁸ See Hawken, P., et al. (2008): Natural Capitalism: Creating the Next Industrial Revolution. Little, Brown and Company, Boston-New York-London.

⁹⁹ For details, see BMK (2020): Resource Use in Austria. Volume 3: Key Messages. Vienna.

strengths & weaknesses

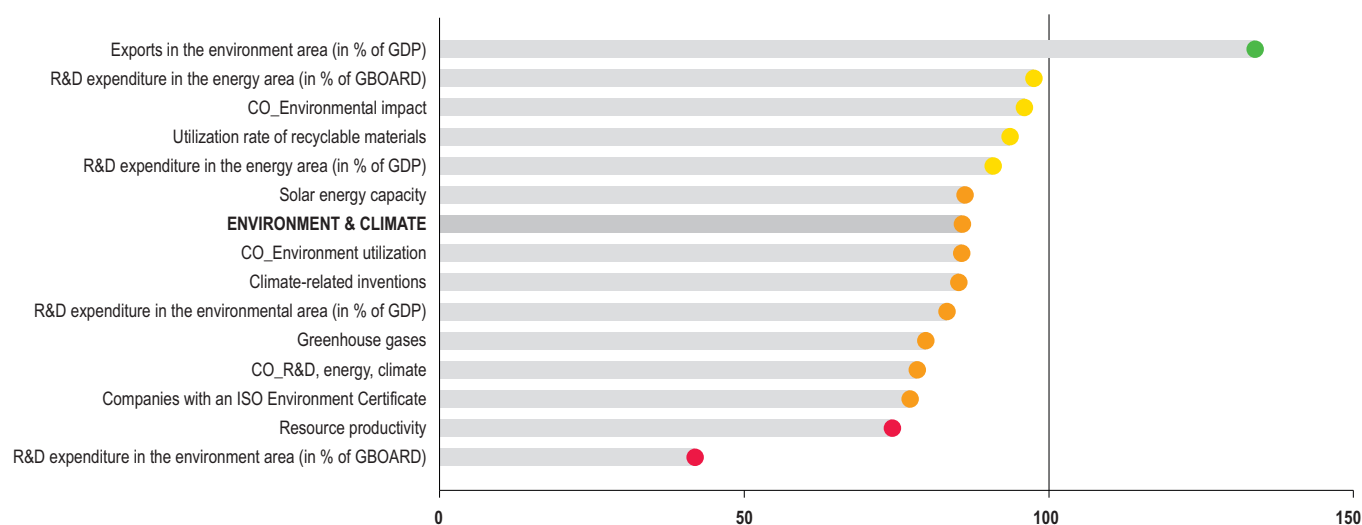
source consumption, the required “re-structuring of our social stocks towards fixed, low-maintenance, multifunctional and long-life infrastructures”¹⁰⁰ must be supported with appropriate environmental technologies and innovations.

In order to achieve the climate neutrality targeted by the Austrian Government for 2040, in the coming years Austria should, generally speaking, find itself in the lead group once again with regard to the reduction of greenhouse gas emissions. This position has yet to be achieved, and relevant indicators do not indicate this will change significantly in the near future. Austria is therefore once again

not expected to achieve the EU targets to reduce greenhouse gas emissions; the improvements in 2020 are only the result of the effects of the economic slump caused by the pandemic.¹⁰¹

This means Austria is also only positioned in the lower places in various national and international rankings for climate and environmental protection. The Climate Change Performance Index (CCPI) therefore rated Austria’s climate protection efforts as “bad”. Of 57 countries,¹⁰² Austria lags behind Greece and Belarus again at 35; the EU as a whole, by comparison, was placed at number 16.¹⁰³ Per capita energy consumption is rated especially bad here. Austria ranks in this respect at 48

Figure 18: Strengths and weaknesses in the environment and climate area compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

100 BMK (2020): Resource Use in Austria. Volume 3: Key Messages. Vienna, p. 9.

101 Anderl, M., et al. (2020): Climate protection report 2020. REP-0738, Umweltbundesamt GmbH. Vienna, p. 58.

102 The CCPI considers 57 countries plus the EU. The first three places are not allocated, in order to show that no country makes sufficient efforts to prevent climate change. Places 4 to 61 are therefore allocated.

103 Burck, J., et al. (2020): CCPI 2021 – Die wichtigsten Ergebnisse – Klimaschutzbemühungen von 57 Ländern plus EU – Abdeckung von 90 % der globalen Treibhausgasemissionen.

and far behind Germany (21) and Switzerland (8).¹⁰⁴ In the “Wie geht’s Österreich?” (“How is Austria doing?”) analysis issued by Statistik Austria, the key indicators for the environment area in particular are, for the most part, clearly in the negative area.¹⁰⁵

To compensate for the RTI Strategy objective not included in the climate and environmental protection area, the key “RTI to achieve climate goals” area of action¹⁰⁶ must be addressed with greater emphasis. Corresponding measures from the RTI Pact, such as stronger mission orientation, a climate-relevant prioritization with ongoing funding programmes or the support of key technologies must be substantiated and specifically implemented here.

Location attractiveness

The question as to how attractive a location is for innovation-intensive companies plays a major role for small, open national economies like Austria’s in particular, which are intensively integrated into global value creation chains. A country’s location attractiveness is measured here on factors such as political stability and rule of law, research-intensive academic institutions and well-trained graduates, as well as promotional framework conditions for companies, especially funds, taxes and regulations (see in particular the “Regulation and taxes”, “Education”, “Tertiary education” and “Research at universities and non-university institutions” sections).¹⁰⁷

Clear benchmarks and specific goal values should also be defined to be able to measure implementation success. As in the digitisation area, the acceleration of innovation and sustainability-promoting public procurement could contribute to providing necessary stimuli to improve performance in the climate and environment area. The ecological tax reform outlined in the government programme in particular would have to be used to produce more incentives for environmental innovations and to promote specific R&D activities in the climate and environment area (see also the “Regulation and taxes” section).

strengths & weaknesses

Figure 19 shows that all things considered, Austria is a very attractive location. On the whole, the location attractiveness is significantly higher than that of the innovation leaders, and most areas show a solid growth trend – and this both absolutely and relative to the comparison countries (see also table 13 in Annex 2). With five of the ten indicators used, Austria is above or more or less at the level of the innovation leaders.

It is not, however, among the global top three in any of the addressed areas and its above-average overall performance is very much the result of disproportionately high corporate funding compared with the innovation leaders.

104 Burck, J., et al. (2020): CCPI 2021 – Results – Climate Mitigation Efforts of 57 Countries plus the EU. Covering 90 % of the Global Greenhouse Gas Emissions.

105 Statistik Austria (2020): Wie geht’s Österreich? (How is Austria doing?) 2020. Indicators and analyses, plus COVID-19 outlook. Vienna, pp. 101 ff. and pp. 144 ff.

106 Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 10.

107 See, for example, Keuschnigg, C., et al. (2017): Innovationsland Österreich. F&E, Unternehmensentwicklung und Standortattraktivität. Study commissioned by the Austrian Council. Vienna, p. 67 ff., as well as Hölzl, W., et al. (2017): Österreich 2025 – Wettbewerbsfähigkeit, Standortfaktoren, Markt- und Produktstrategien österreichischer Unternehmen und die Positionierung in der internationalen Wertschöpfungskette. In: WIFO monthly reports, 90(3), 2017, pp. 219-228.

strengths & weaknesses

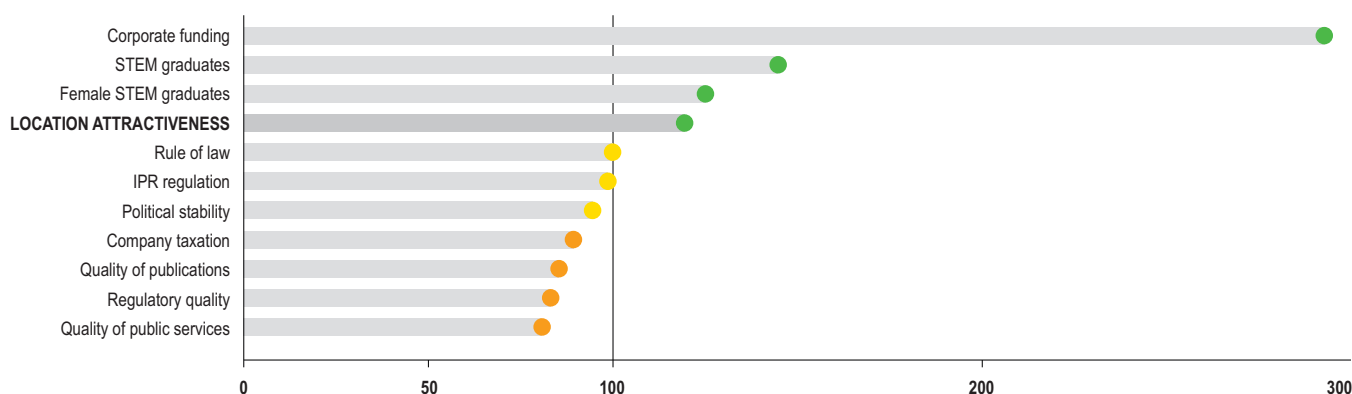
Some deficits are also clearly identified, which the Austrian Council already topicalised in its previous report. The regulation quality and the quality of public services, with which Austria also deteriorated over the period, must in particular be negatively emphasised here (for details see table 13 in Annex 2).¹⁰⁸

In addition to well-trained graduates and specialists, with which Austria scores excellently with regard to STEM graduates in particular, primarily excellent university and non-university research institutions are highly relevant for a location's attractiveness and for setting up R&D units and companies.¹⁰⁹ Improvement potential can be exploited here in all areas, as shown by the results of the

strengths-weaknesses analysis in the relevant parts of the RTI system (see in detail the "Tertiary education" and "Research at universities and non-university institutions" sections).

Finally, it should be noted that, in international location competition the increase in Austria's attractiveness for risk capital investors is an important goal, which is also addressed by the RTI Strategy. The objective of raising venture capital expenditure to 0.1 percent of GDP is extremely ambitious, and its achievement will depend on the accelerated implementation of correspondingly effective measures, which, however, are neither anchored in the strategy nor in the package. For specific details, see the "Analysis of the RTI Strategy 2030 objectives" and "Start-ups" sections.

Figure 19: Strengths and weaknesses in the location attractiveness area compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with "CO_" prefix (= "Composite").

¹⁰⁸ The quality of work performed for the general public evaluates the perception of the quality of public services, the quality of civil service work and the level of its independence from political pressure, the quality of policy formulation and implementation, as well as the credibility of the government's commitment to such a policy. For this, see the World Bank's Worldwide Governance Indicators (WGI) and Annex 2.

¹⁰⁹ For this, see ifo (2006): Determinanten der Standortwahl von Unternehmen – ein Literaturüberblick. Dresden; WIFO (2017): Human resources are the most important location factor. Vienna; wwtf (2019): Motives for establishing R&D units in Vienna – a comparison of selected locations with Vienna. Vienna.

Gender equality

The indicators for the “Gender equality” area also show that Austria could exploit still more important potential to join the leading innovation nations by increasing the participation of women in innovation activities (see figure 20). Special attention should be paid here to the reality of the very high gender difference in mathematics, known for some years now, and in particular because of the PISA tests. Girls in this country achieve significantly worse results in maths than boys of the same age, which is why, with the same indicator Austria once again lags far behind compared with both the innovation leaders and the EU. Positive, on the other hand, is the fact that the number of female STEM graduates is at the level of the EU; with female engineering graduates it is just below it, however both are clearly above the level of the innovation leaders (see also the “Tertiary education” section). The two objectives from the RTI Strategy in this respect correspondingly appear thorough-

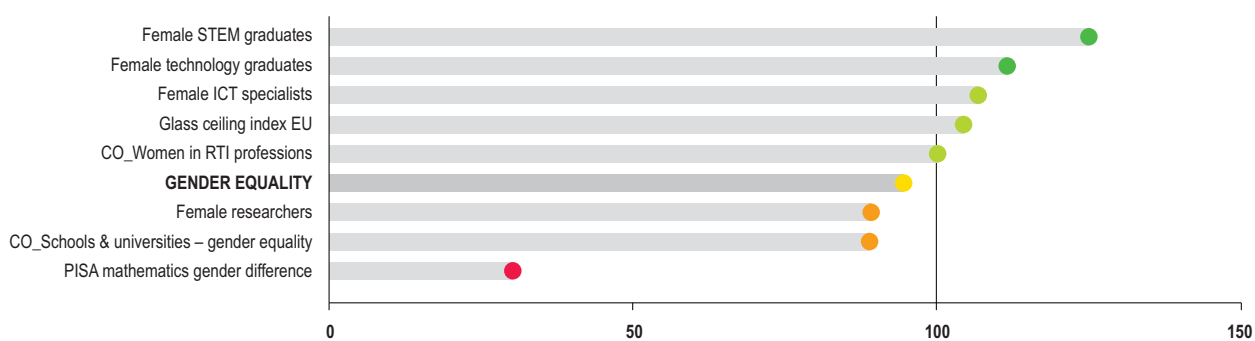
ly achievable (see the “Detailed analysis of selected objectives” section). Compared with the top three, there are however also significant deficits here.

Also welcome is the fact that with the glass ceiling index¹¹⁰ and with the number of female ICT specialists, Austria is above the EU average and more or less at the same level as the innovation leaders. At the same time, however, the percentage of female researchers is significantly below-average. Austria is significantly behind both the innovation leaders and the EU average here.

The effects that the COVID-19 pandemic will have on gender equality in the RTI area should also be observed further and any countermeasures required should be taken. There is already a certain evidence that the pandemic has further intensified inequalities and created additional challenges for women, especially those with children, who are struggling

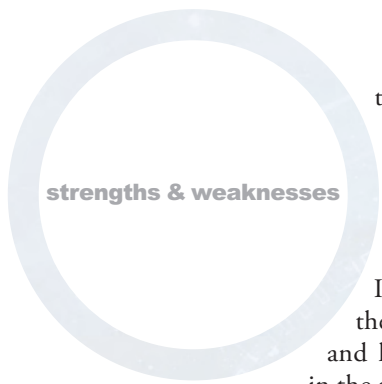
strengths & weaknesses

Figure 20: Strengths and weaknesses in gender equality compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

¹¹⁰ The glass ceiling index is the ratio of the percentage of women on scientific staff at universities to the percentage of women with professorships.



to maintain their research productivity.¹¹¹ Appropriate monitoring to continuously observe the developments at the universities, non-university institutions and research funding agencies, should be introduced for this.

In conclusion, it is clear that, along with the improvement in individual education and life-shaping opportunities for women in the gender equality area, from an RTI-specific point of view, among other issues, this is

about being able to exploit all the potential of the available talent for innovation activities. Much can still be done here with female pupils' maths performances and with the percentage of female researchers in the corporate area in particular. A comprehensive equality policy, which incorporates all sectors and is oriented on European requirements, is required to achieve medium to long-term advances in this area. A specific plan of action must be developed for implementation.

111 For this, see Langin, K. (2021): Pandemic hit academic mothers especially hard, new data confirm. Online at: https://www.sciencemag.org/careers/2021/02/pandemic-hit-academic-mothers-especially-hard-new-data-confirm?utm_source=Nature+Briefing&utm_campaign=c029bf9fcd-briefing-dy-20210212&utm_medium=email&utm_term=0_c9dfd39373-c029bf9fcd-43673901.

Efficiency and effectiveness of RTI activities

Efficiency of RTI activities

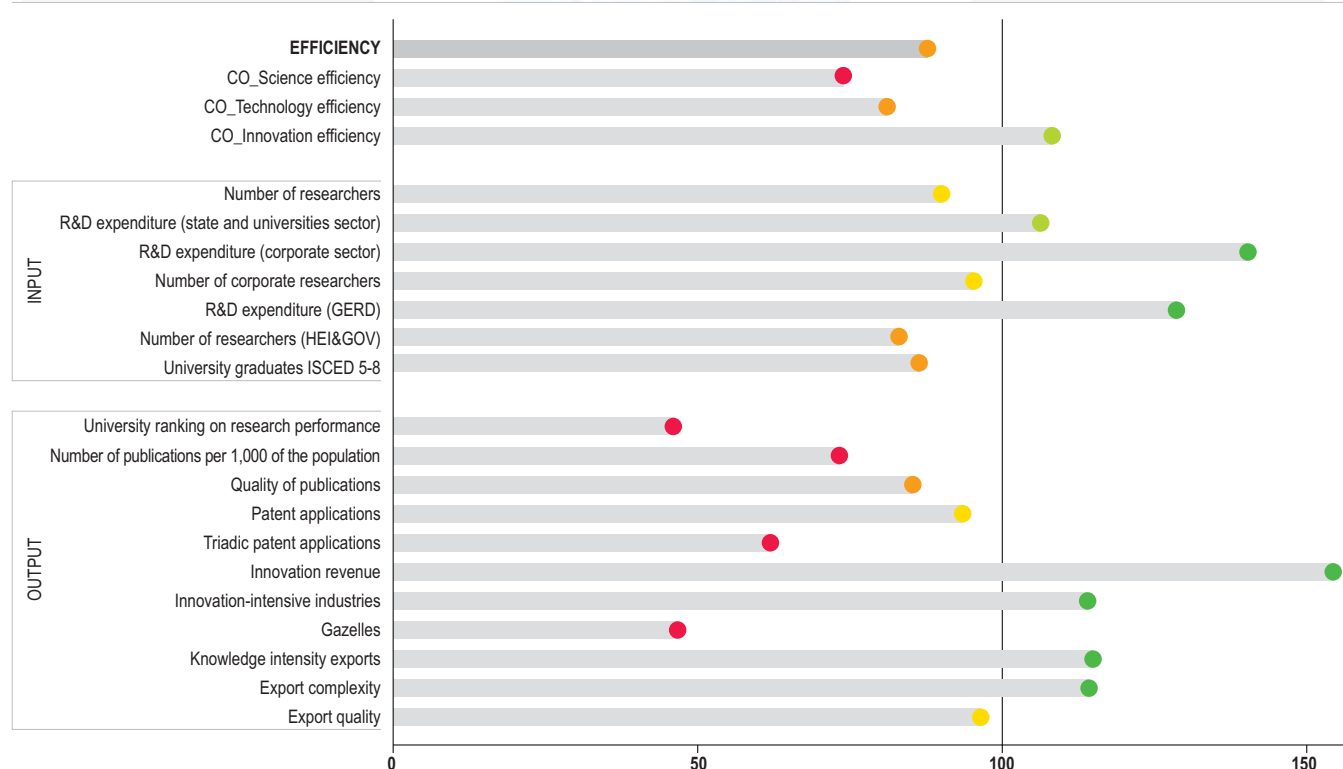
Compared to the leading innovation nations, there is still improvement potential with regard to the efficiency of RTI activities. This finding is not new and the Austrian Council has already analysed it in detail.¹¹² The relevant databases, which corroborate the known result even more, were updated and expanded for this report. Figure 21 shows that on the whole,

the efficiency of the Austrian RTI system is clearly below the level of the innovation leaders.

The figure also illustrates how the Austrian RTI system in the “Innovation” area is slightly above the level of the innovation leaders due to the above-average funding and the solid performance of companies – in par-

strengths & weaknesses

Figure 21: Efficiency of Austria's RTI activities compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

¹¹² For details, see Austrian Council (2018): Report on Austria's Scientific and Technological Capability 2018. Vienna, pp. 18 ff.

strengths & weaknesses

particular the knowledge-intensive, high-export sectors here (for more details, see the “Research and innovation in existing companies” section). It is also clear that Austria is significantly less efficient than the leading innovation nations in the areas of “Technology” and “Science” in particular. Despite the comparably high inputs, only moderate outputs are achieved in both of these areas. The number of scientific publications and their quality, but patent activity as well, especially in relation to the technologically more demanding triadic patents, are to some extent even significantly below the level of the innovation leaders (for this, see the “Research at universities and non-university institutions” and “Research and innovation in existing companies” sections).

The efficiency analysis shows that three input and four output indicators are above the level of the innovation leaders. Significantly more output indicators, however, show a massive distance to the leading innovation nations. Austria does actually score better relative to the

European average in almost all areas – the only exceptions are employment in rapidly growing new companies and the universities’ research performance. In contrast here, however, relative to the respective global top three, Austria ranked almost consistently worse – the only exceptions being the two “R&D expenditure (GERD)” and “Export quality” indicators, with which Austria’s distance to the global top three is marginal. For details on these findings, see table 15 in Annex 2.

On the whole, the situation has improved slightly compared with the Austrian Council’s report last year. This is illustrated by the fact that clear growth is seen with almost all indicators analysed. Austria also reduced the distance to the innovation leaders with the greater part of the indicators (see also table 15 in Annex 2). In contrast to these positive development trends, however, the OECD’s findings still apply, whereby the innovation efficiency of the Austrian RTI system is indeed solid, but recently could also be increased significantly.¹¹³

Effectiveness of RTI activities

The importance of research, technology and innovation for today’s society and the modern economy is undisputed.¹¹⁴ The issue of the specific effect of RTI activities is given fresh impetus¹¹⁵ here because of the COVID-19 pandemic and, for example, has also become a key topic in relation to combating climate change. The European Commission, for example, just recently proposed a mission, which,

based on specific RTI activities, will contribute to shaping a climate-resilient Europe.¹¹⁶ The analysis of the effects of RTI activities on overriding political, ecological, social and economic objectives is therefore highly relevant. The Austrian Council has already discussed this in detail in the past.¹¹⁷

The indicators used for this area of the report cannot perhaps illustrate any direct causal re-

113 OECD (2018): *Reviews of Innovation Policy: Austria 2018*. OECD Publishing, Paris, p. 17 ff.

114 See Austrian Council (2015): *Designing the Future. Economic, Societal and Political Dimensions of Innovation*. Echo-media, Vienna.

115 For this, see, inter alia, OECD (2021): *Science, Technology and Innovation Outlook 2021: Times of Crisis and Opportunity*. OECD Publishing, Paris, p. 15 ff.

116 EU Commission (2020): *A Climate Resilient Europe: Prepare Europe for climate disruptions and accelerate the transformation to a climate resilient and just Europe by 2030*. Luxembourg, Publications Office of the European Union.

117 For details, see Austrian Council (2017): *Report on Austria’s Scientific and Technological Capability 2017*. Vienna, pp. 18 ff.

lation between RTI activities and their effects at economic, ecological and social level, however they do provide indications of how effectively RTI activities impact on the named areas, and where there is a special need for action with regard to the performance level of impact indicators. As figure 22 shows, on the whole Austria is perhaps slightly, but nonetheless behind the leading innovation nations. Of the three dimensions examined, “Economy and social”, “Health” and “Environment”, the first two show a low distance to the top group, and the last one a significant distance to the top group (see also table 16 in Annex 2).

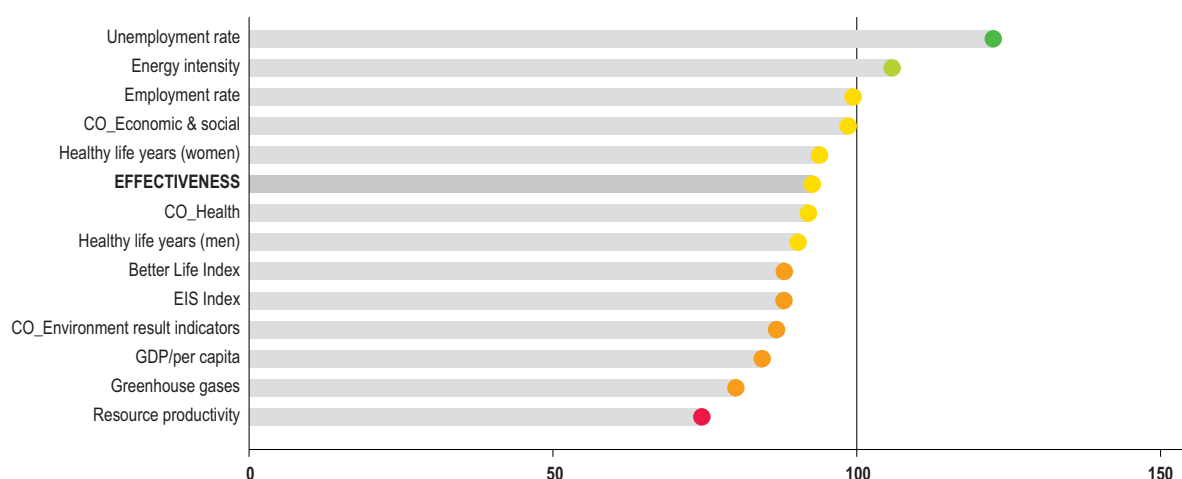
The performance in the environment area is therefore interesting because, with greenhouse gas emissions and especially with resource productivity, by far the worst values were achieved here; at the same time, above-average performance continues to be delivered with energy intensity¹¹⁸. While with regard to resource pro-

ductivity and energy intensity Austria increased again as it did in previous years, the performance in the area of greenhouse gas emissions deteriorated again for the second time in a row. Also remarkable here is Austria’s poor value compared with the other EU member states. The result is that Austria increasingly scores worse in most international environment rankings (see also the “Environment and climate” section).

In the “Economy and social” area, Austria continues to be at the level of the comparison countries. With the unemployment rate in particular Austria also continues to score significantly better than the comparison countries. The country’s worse positioning shown in figure 22 with the per capita GDP indicator is attributed to Luxembourg’s joining the group of innovation leaders, and not to the effects of the Covid-19 crisis. A conclusive eval-

strengths & weaknesses

Figure 22: Effectiveness of Austria’s RTI activities compared with the innovation leaders



Source: see Annex 1. Indicator names in bold map the composed indicators across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

¹¹⁸ The energy intensity indicator measures the development of energy efficiency mostly induced by technology, that is, the energy consumed with a national economy’s annual production output.



strengths & weaknesses

uation of the effects of the pandemic on unemployment and the economic KPIs is however still pending, as the latest available comparison data do not yet consider 2020, and all available data show an especially serious pandemic-related economic slump for Austria.¹¹⁹ The overall effects on economic performance may nevertheless not be so severe that, with regard to per capita GDP, which relative to the EU and to the innovation leaders with the exception of Luxembourg continues to be above-average high, it will produce substantial shifts.

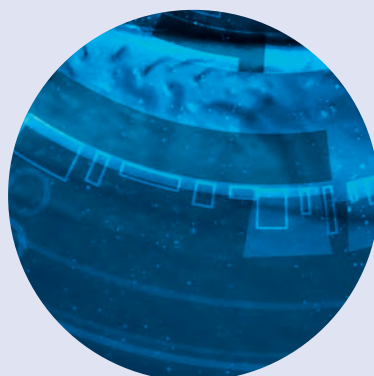
For the healthcare area, we can see a significantly negative dynamic, which, however, is not attributed to the effects of the COVID-19 pandemic. How the events of the pandemic will affect life expectancy in particular remains to be seen here. Statistik Austria's preliminary

data shows that life expectancy in Austria in Covid year 2020 has fallen by half a year compared with 2019.¹²⁰ It is however assumed that life expectancy will return in the medium term to the previous growth trend after the pandemic has been weathered.

On the whole, the results of the strengths-weaknesses analysis also show significantly greater potential effectiveness of Austria's RTI activities compared with the EU average, as well as consistently lower potential effectiveness compared with the global top three. The innovation leaders appear disproportionately frequently here. Sweden and the Netherlands both rank at least three times at the global top; Denmark and Luxembourg rank twice. Switzerland is the frontrunner, even appearing four times among the global top three (for details see table 16 in Annex 2).

119 For this, see OECD (2020): OECD Economic Outlook, December 2020. OECD-Publishing, Paris.

120 Statistik Austria (2021): More than 90,000 people in Austria died in 2020; life expectancy drops during the pandemic. Press release of 14 January 2021.



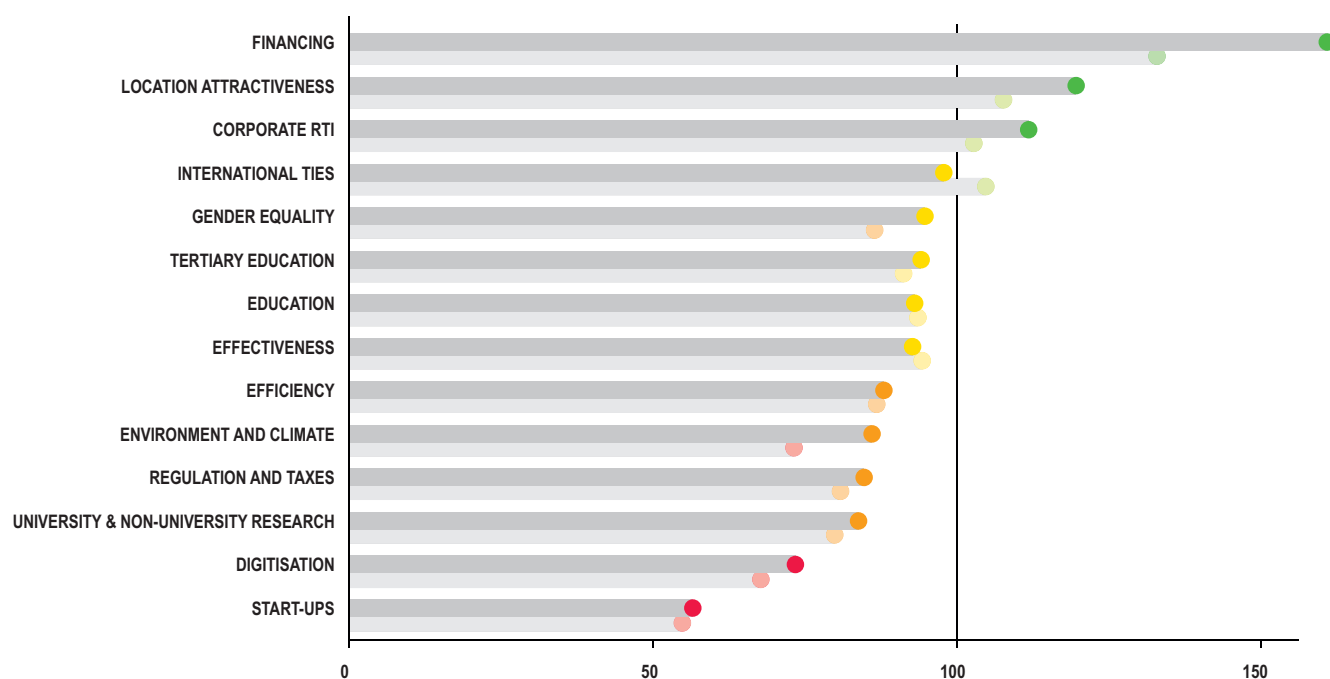
summary and recommendations

In the international comparison, the Austrian RTI system has shown a stable however patchy performance for some years now, with some strengths and significant weaknesses at the same time. The challenges for the RTI policy are therefore still great – both with the framework conditions for RTI, in the core RTI system, and with the efficiency and effectiveness of RTI activities. Figure 23 presents the most important results of the underlying strengths-weaknesses analysis at a glance. An even more detailed overview is provided in table 2 in Annex 2.

While three clear strength areas can be identified compared with the leading innovation

nations, Denmark, Finland, Luxembourg, the Netherlands and Sweden, those areas in which Austria now even shows a significant distance to the innovation leaders predominate. The RTI system's familiar strengths include the generally above-average level of R&D funding, the high RTI support and performance of existing companies and the attractiveness of the business location. Austria also performs well in the area of international networking – the distance to the leading nations is minimal here. The greatest weakness in the core RTI system is the area of innovative start-ups. In the cross-cutting issues area the biggest problem areas are in particular the two global megatrends, digitisation and climate and environmental

Figure 23: Overview of Austria's strengths and weaknesses compared with the innovation leaders (light grey bars show previous year's values)



For sources, see Annex 1.

Key: Goal achievement = 100; **green**: value over 110; **bright green**: value between 100 and 109; **yellow**: value between 90 and 99; **orange**: value between 76 and 89; **red**: value under 75.

protection, which both the EU Commission and the Austrian Government declared were priority areas of action. There are also specific challenges in all sub-areas of the Austrian RTI system, which have been impeding a significant improvement in innovation performance for some years now. Worthy of mention here are problem areas of the Austrian RTI system that the Austrian Council has already addressed several times in its reports on Austria's scientific and technological capability, beginning with parts of the education system, on to the framework conditions for the universities and research performance, and through to the regulation and taxes area.

The RTI Strategy largely refers directly to these challenges and specifically addresses some of the relevant weaknesses of the RTI system by focusing on all problem areas illustrated – as outlined in the “Analysis of the RTI Strategy 2030 objectives” section. The majority of the strategic objectives also have a direct equivalent in the recommendations of the OECD and the Austrian Council. Key areas are therefore addressed, which were defined time and again as priorities by the OECD in its Review of Innovation Policy: Austria 2018¹²¹ and by the Austrian Council itself. The Council believes the right priorities for further developing the Austrian RTI system are set with the overriding objectives of the RTI Strategy. The specific focus on effectiveness and excellence and on the key function of education (tertiary) for research, technology and innovation must in particular be emphasised here.

The detailed analysis of the RTI Strategy 2030 objectives produces a heterogeneous picture. While individual goal values have already been achieved, further objectives show a distance

between targeted and actual value that is so high that goal achievement must be rated as unrealistic or overambitious or only to be achieved with massive efforts in implementing the measures of the RTI Pact. Figure 24 provides an overview of the respective distance to the goal values. The figure also shows that two detailed goals have a very high and two others a comparably low level of ambition. On the whole, the ambitious objectives for which the goal distance is considerable predominate. Of the 17 objectives allocated a defined value, based on the Council's analysis, 12 are rated as very ambitious; achievement of the targeted value only appears realistic with dedicated implementation activities. From today's perspective, the intended expansion of venture capital investments to 0.1 percent of GDP and the objective of placing two Austrian universities into the top 100 in particular appear over-ambitious. By contrast, the goal values in relation to a top ten placing with the ERC grants were already achieved, as was the top three placing with the Horizon Europe success rate.

Ultimately, with its analysis, the Austrian Council also identified relevant topic areas, which the strategy document does not cover at the objectives level. To be named here in particular are the areas of “Education (without tertiary education)”, “Governance at universities”, “RTI for climate and environmental protection” and “Protection and exploitation of intellectual property rights”, which the Council believes are significantly important for the further development of the Austrian RTI system intended by the Austrian Government. However, no goals set were set in the RTI Strategy to reflect the importance of these areas.

summary and recommendations

121 Austrian Government (2020): RTI Strategy 2030. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 5.

summary and recommendations

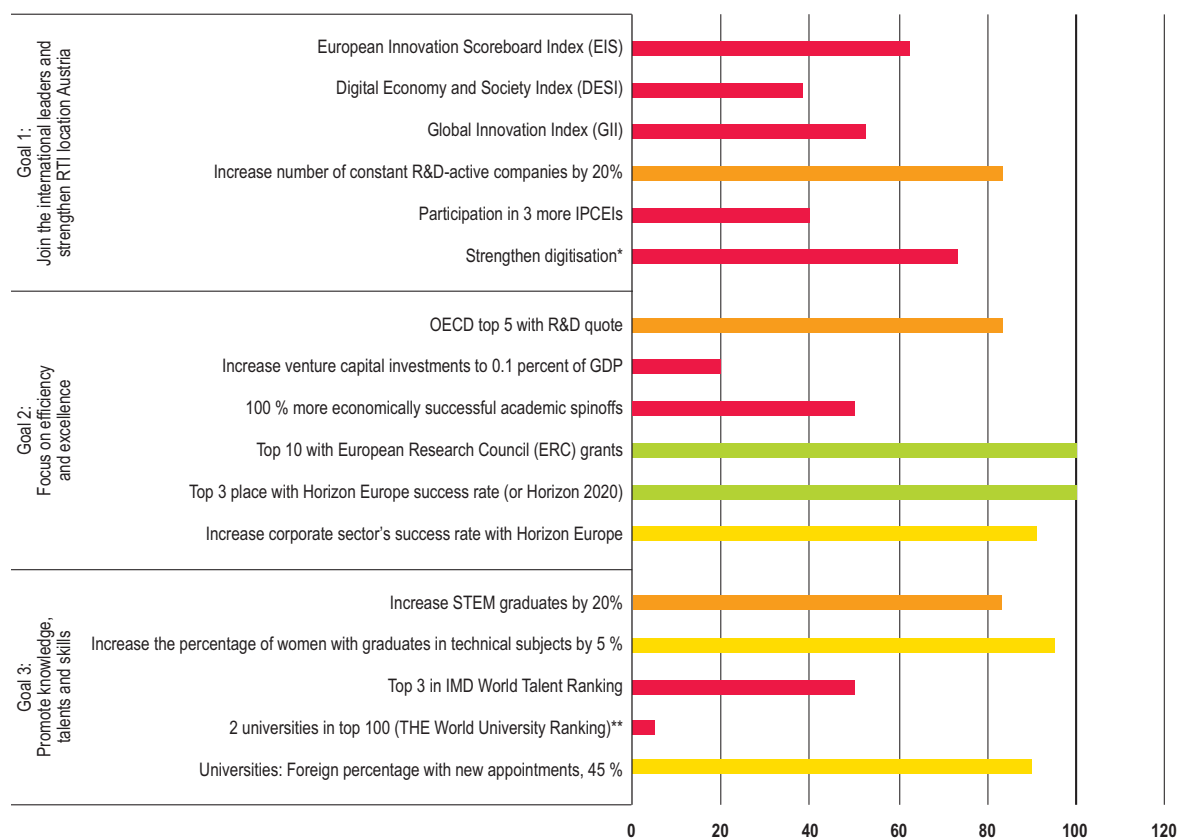
The essential conclusions delivered by the results of the of the strengths-weaknesses analysis of the Austrian RTI system in the international comparison and the objectives of the RTI Strategy 2030 are:

- The RTI Strategy 2030 objectives address the correct topic areas to improve the RTI system's performance. To achieve the goals, however, key areas require ambitious steps to implement the measures defined in the RTI Pact.

- As part of the implementation activities, the two greatest weaknesses of the RTI system in particular (start-up activity and digitisation) and the socially extremely relevant area of environment and climate protection must be afforded the highest priority, to ensure the connection with international trends is not lost.

- Two areas that are especially important for the RTI system's performance (the education system from primary to tertiary level and the higher education area), whose per-

Figure 24: Overview of distance to target values of the RTI Strategy 2030



For sources, see Annex 4.

Key: Goal achievement = 100; **green**: value over 110; **bright green**: value between 100 and 109;

yellow: value between 90 and 99; **orange**: value between 76 and 89; **red**: value under 75.

* The distance from the target is calculated based on the composite value for the "digitisation" aspect of the strengths-weaknesses analysis (see Appendix 2, table 11).

** Current value = 0; the bar was adapted in order to show the value.

formance shows significant weaknesses in the most diverse sections, must also be specifically addressed to improve the overall performance.

- At the same time, the existing strength areas of the RTI system must be further supported to also generate positive results in the future.
- Efficiency and effectiveness must also be increased further in all RTI system sub-areas (as indeed intended by the RTI Strategy).

For a small, open economy like Austria's, a successful RTI system is an essential basic requirement to remain competitive in the future. As this report shows, Austria is well positioned in this respect. It is evident, however, that in all areas of the RTI system there is distinct improvement potential in places. It is also clear that the development dynamic has not been achieved in recent years to actually reach the level of the leading nations in the majority of the RTI system's areas, especially, however, in

the core RTI system. On the whole, there is therefore still a distance to the leading European innovation nations, Denmark, Finland, Luxembourg, the Netherlands and Sweden, but also Switzerland.

Achieving the overriding objective of the RTI Strategy 2030 of joining the group of leading innovation nations and therewith the economic development to also secure social well-being and quality of life and the environment, therefore requires accelerated implementation efforts of the measures outlined in the RTI Strategy and in the RTI Pact. The results of the strengths-weaknesses analysis presented in this report form an evidence-based foundation for defining priority areas of action for specific implementation activities and recommendations derived from them. These address the three overriding objectives and the respective key areas of action of the RTI Strategy.

summary and recommendations

Recommendations concerning Goal 1: Join the international leaders and strengthen Austria as an RTI location

- **Re Goal 1 / Goal 1.1:**

- Strengthen international competitiveness / Ranking improvement in international indices**

To increase the location attractiveness and international competitiveness intended by the RTI Strategy and achieve a ranking improvement in the international indices, the Austrian Council recommends policy prioritisation be focused on science, research, technology and innovation, and particularly during the Covid-19 crisis.¹²² The further development of the higher education area merits special attention here to, on one hand increase research performances, and on the other to boost the availability of well-trained graduates and specialists. Furthermore, the entirety of all start-up activity should also be

optimised, the digital transformation should be accelerated and the area of climate and environment protection specifically addressed.

- **Re Goal 1.5:**

- Accelerate digital transformation**

To enable Austria's move in the DESI from rank 13 to 5 and to increase competitiveness in the area of digital value creation, the Austrian Council recommends implementing the measures specified in the RTI Pact with greater emphasis. The Council also recommends active cooperation on shaping the European framework conditions for ICT and adopting a national plan of action to develop the ICT sector. The focus here should in particular be on infrastructural measures

¹²² See Austrian Council (2020): Recommendations for the RTI policy during and after the COVID-19 crisis of 18 June 2020.

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to create the basic conditions for using digital, networked services. Broadband and fibreglass expansion, where Austria is lagging in the international comparison, in particular must be accelerated for this and the production of the corresponding building connections must be supported. The “Platform Infrastructure Austria 2030” task force presented a promising first step here at the beginning of March 2021. With regard to digitisation in particular, stronger focus should also be made on the potential of innovation-promoting public procurement in this respect. Furthermore, it is also recommended measures be introduced to counter the insufficiency of ICT specialists, whereby particular attention should be paid here to the previously under-represented female ICT professionals. Finally, the Austrian Council also recommends an advisory, diffusion and support programme to specifically support SMEs with the digital transformation.

- **Re Area of Action 1.1:**

- Swift expansion of data infrastructures and guaranteed data access for research**

With regard to the highly restrictive access to available register and open government data or Statistik Austria data compared with many other countries, the Council recommends the expansion of data infrastructures and management envisaged by the RTI Strategy be implemented as swiftly as possible. The Council believes the creation of a new micro data centre at Statistik Austria outlined in the RTI Pact should begin immediately and the funding required should be provided to improve access for the science

world to micro and register data. Existing restrictions in the scientific research of relevant social developments or the evidence-based evaluation of the effect of political measures can then be removed – especially those that have evidently been created by the COVID-19 pandemic.

- **Re Goal 1.4 / Goals 2.4 – 2.6 / Area of action 1.2:**

- Increased participation in European initiatives**

To maintain the high level of participation in European RTI initiatives such as Horizon Europe or ERC, the Council recommends the measures to activate stakeholders, to support the RTI community and to reinforce national future topics at EU level be swiftly implemented. The Council also recommends the retention and intensification of RTI policy activities in the European context in this respect, not only to achieve the goal of participation in the five “Important Projects of Common European Interest (IPCEIs)” defined in the RTI Strategy, but also as a very conscious investment in Europe’s and Austria’s technology-based future viability and technology sovereignty. The Council believes the specific use of the national reconstruction plan plays a key role here for financing participation in the three IPCEIs currently being prepared for the topics of hydrogen, microelectronics and low CO2 emissions industry. Austria should also use every opportunity to co-shape the European industrial policy discourse and to achieve active participation in defining possible further IPCEIs (in the life sciences area, for example).

Recommendations concerning Goal 2: Focus on efficiency and excellence

● Re Goal 2 / Area of action 2.1:

Targeted funding of excellent basic research

Since Austria shows a very high and growing distance to the leading research nations with regard to competitively awarded funds for excellent basic research, the Austrian Council recommends this issue be afforded special priority with implementation of the RTI Strategy and the measures of the RTI Pact. Since in Switzerland invests about four times as much (per inhabitant) in funding competitive research, the Council recommends a significant increase in the funds awarded in competition to at least the average level of the leading nations. The planned excellence initiatives must be initiated as a priority as quickly as possible for this. Following the first financing phase from 2022 to 2024, the Council recommends significantly increasing the funds for the excellence initiatives to at least the amount of that proposed by the committee of experts set up for this¹²³. The percentage of the funds awarded via the FWF must also be raised massively to cover the sharply growing requirement for funds awarded in competition to fund basic research. Corresponding potential for budgetary reallocation from other areas must be exploited here.

● Re Goals 2.2 – 2.3:

Improvement in innovative start-up activity

To achieve the objectives from the RTI Strategy to increase the start-up dynamic, the Austrian Council recommends swiftly implementing the measures required to increase Austria's attractiveness for risk capital

investors. The structural reforms recommended by the Council, which, however, are not included in the RTI Strategy, must be implemented for this.¹²⁴ The equity capital discrimination vis-à-vis loan capital must be ended, company law must be reformed to the extent that a legal form that is clear for international risk capital investors and which makes their investments attractive is installed, and insolvency law should be reorganised with creditor protection in mind with the urgently required possibilities for a new start (and therefore the much cited culture of failure). Compensatory for the low foreign venture capital activity in Austria, the conditions for a corresponding commitment by institutional investors, such as pension funds, should also be put in place. Finally, the Austrian Council recently recommended minimising the administrative requirements of the start-up process and accelerating the required process steps.¹²⁵

● Re Goal 2 / Areas of action 2.2 – 2.3:

Increase the effectiveness of RTI activities

The Council recommends increased focus on the intended RTI Strategy contribution to achieving overriding objectives at social, economic and ecological level. In line with the corresponding proposals of the OECD¹²⁶, this requires a specific expansion of the mission orientation to increase the quality and speed of progress in areas such innovative business and society, health, quality of life, digitisation, and climate and environmental

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123 Androsch, H. / Loprieno, A. / Nowotny, H. (2019). Exzellenzinitiative – Eine Zukunftsoffensive für den Forschungsstandort Österreich. Expert paper commissioned by the Federal Ministry of Education, Science and Research.

124 Austrian Council (2019): Recommendation for the mobilisation of risk capital to secure sustainable innovation and growth financing of 16 October 2019.

125 For details, see Austrian Council (2018): Recommendation for the improvement of the framework conditions for starting innovative companies in Austria of 22 March 2018.

126 OECD (2018): OECD Reviews of Innovation Policy: Austria 2018. OECD Publishing, Paris, p. 39 ff.

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protection in particular. Measures to achieve a more efficient implementation and application of research results and innovations must be focused on here to exploit the potential to meet the grand challenges that exists in Austrian research institutions and companies on a greater level and more systematically than has previously been the case. The corresponding methods in the RTI Pact must be

specified and implemented as quickly as possible. With regard to the “RTI to achieve climate goals” strategic area of action in particular, the Council recommends pursuing the intended “acceleration of cross-sector co-operations” and the “implementation of holistic solutions” as priorities. The mechanism of innovation-promoting sustainable procurement must also be applied more intensively for this.

Recommendations concerning Goal 3: Promote knowledge, talents and skills

● Re Area of Action 3.1:

More focused development of human resources and strengthening of the tertiary education sector

The Council recommends on the whole focusing on improving the tertiary education system. Implementation of the measures envisaged in the strategy and in the package must be accelerated for this. The offering of STEM study courses at universities and technical colleges must be expanded more intensively and quicker beyond the scope of the RTI Strategy’s objective, on one hand to cover the sharply increasing requirement for specialists in the STEM sectors, especially in the areas of computer sciences, IT, data sciences etc., and on the other to increase the opportunities for Austrian researchers and companies to take a stronger hold in this segment among the European leaders. Entrepreneurship-promoting competencies must also be systematically anchored in the Austrian education system.¹²⁷

● Re Goal 3.4 / Area of action 3.2:

Further development of the higher education area and improvement in the universities’ performance

Where university rankings reflect research performance, the ranking numbers of Austrian universities are concerning, now that research performance is closely related with economic and social impact, with patent applications or spin-off start-ups, for example.¹²⁸ The Council therefore recently affirmed its recommendation for the strategic further development of the higher education area, and this in harmony with the government programme.¹²⁹ Student flows must be steered more effectively for this, and the number of study places at the technical colleges in particular must be increased quicker, to improve higher education teaching on one hand, and relieve the burden at the universities and therefore steer free capacities into research on the other. The intended attractiveness and visibility of the research and innovation location can thus be improved. The required financing must be secured with systematic budgetary priorities.

¹²⁷ See Austrian Council (2019): Recommendation for the establishment of entrepreneurship-promoting competences in the Austrian education system of 16 December 2019.

¹²⁸ See Janger, J. / König, T. (2020): Forschungspolitik in Österreich. Zentrale Ansatzpunkte für eine Leistungssteigerung in der Grundlagenforschung. Research Policy in Austria. Wien, Wifo-IHS; Janger, J. / Streicher, G. (2018): Ökonomische Effekte von Universitäten. In: Wifo-Monatsberichte, 91(8), p. 565–574.

¹²⁹ Austrian Council (2017): Recommendation for the further development of the technical colleges sector in the Austrian education and science system of 30 May 2017.

Recommendations on topics not anchored in the RTI Strategy

The Austrian Council in particular recommends the following topics, which are not included in the RTI Strategy, be afforded greater attention. It proposes that, aside from the objectives of the RTI Strategy, these also be addressed as separate areas of action and included in the coming RTI Pact at the latest.

- **Optimisation of school-level education performance as a key component for the RTI system**

In view of the social selectivity of the education system intensified still further by the COVID-19 pandemic, the Council once again recommends the implementation of more specific measures to dismantle what's referred to as, "education inheritance". Since digital competencies will be as important in the future as traditional skills such as "reading, writing and calculating", a "digital education strategy" that goes beyond the scope of the current master plan for digitisation in the educational system will also be required. On the whole, the education system must be modernised, so that all pupils are afforded both knowledge and the required competencies and 21st century skills. Corresponding steps to improve gender equality must also be taken here.

- **Improvement of the universities' governance and management structures**

Based on the eminent importance of the universities for the Austrian RTI system's performance and to increase effectiveness with the completion of university tasks for science, business and society, the Council once again recommends the universities' governance and management structures be improved, and especially with regard to communication processes and HR manage-

ment. For details, please see the corresponding Austrian Council recommendation and the recently adopted statement on the University Act.¹³⁰

- **Mobilisation of RTI activities for climate and environmental protection**

In view of the topic's relevance, the Council recommends significantly accelerating climate and environment-relevant RTI activities. The public R&D spending for environment and climate-relevant research, including energy research, must first be raised for this to the level of the comparison countries and existing initiatives such as setting priorities related to the climate and stimulus package in particular, must be continued and expanded. Additionally, increased incentives to stimulate patent activities in the area of environment and energy technologies should also be provided. The projects intended by the RTI Pact must be substantiated and specifically implemented for this, and already implemented measures, connected with impact orientation, for example, must also be consistently continued. The Council additionally recommends innovation diffusion be increased with the use of already available technologies, for which the mechanism of innovative and sustainable public procurement must be applied with greater emphasis.

- **Increase the protection and exploitation of intellectual property rights**

Due to recent geopolitical developments, the trade conflicts they entail and the resulting rise in IPR-related problems (especially in the USA and China), the Austrian Council

¹³⁰ Austrian Council (2015): Recommendation of the Austrian Council for university governance and management structures of 3 March 2015; idem (2021): Statement on the drafting of a federal law, which would amend the University Act (UG; 2002), the University Quality Assurance Act (HS-QSG), and the Higher Education Act (HG; 2005) of 15 January 2021.



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recommends introducing specific measures for better protection and more effective utilisation of intellectual property rights. See the corresponding Council recommendation for details.¹³¹

- **Increase the efficiency of RTI activities**

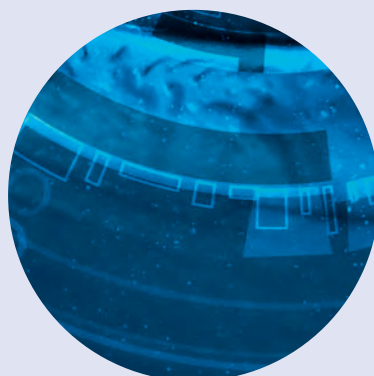
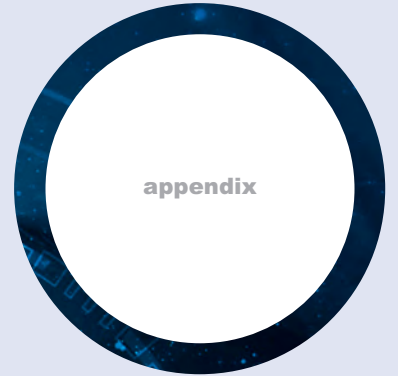
In implementing the RTI Strategy the Austrian Council recommends greater attention be paid to how the Austrian RTI system can better convert the high inputs into outputs and impact than has previously been the case, in line with its advanced level, and therefore increase its system efficiency. The efficient use of existing resources and the im-

portance of social challenges in achieving the goal of developing Austria into a top RTI location should also be considered in greater detail here than has previously been the case. Particularly worthy of mention here are the improved performance of the universities, a more efficient steering of the student flows and increase in the share of competitively awarded funds in research funding. The Austrian Council has made several proposals in this respect in the past¹³², and in its Review of Innovation Policy, the OECD also points to the existing potential to increase efficiency.¹³³

131 Austrian Council (2019): Recommendation for increasing the protection and exploitation of intellectual property rights of 16 October 2019.

132 Austrian Council (2017): Recommendation on the way to the forefront of innovation of 30 November 2017; Austrian Council (2018): Report on Austria's Scientific and Technological Capability 2018. Vienna, pp. 32 ff.

133 OECD (2018): OECD Reviews of Innovation Policy: Austria 2018. OECD Publishing, Paris, p. 17 ff.



Annex 1: Indicator set for strengths-weaknesses analysis

	Indicator (long name)	Short name
Regulation and control		
Total	Composed indicator	Regulation and taxes
Regulation	Composed indicator	Regulation
	Strictness of labour market regulation – individual terminations of normal employment contracts	Labour market regulation – individual
	Strictness of labour market regulation – collective dismissals	Labour market regulation – collective
	Strictness of labour market regulation – temporary contracts	Labour market regulation – temporary
	Strictness of product market regulation	Product market regulation
	Strictness of the regulation of intellectual property rights	IPR regulation
Finance system	Composed indicator	Finance system
	Size of the capital market	Size of the capital market
	Minority investor protection	Investor protection
	Financing structure for VC funds	VC funds financing structure
	VC investments in % of GDP	Venture capital intensity
Tax system	Composed indicator	Tax system
	Effective tax burden on companies	Company taxation
	Overall wage costs burden (in % of wage costs)	Wage and salary charges
	Tax and levies ratio (in % of GDP)	Tax and levies ratio

Input/ Output	Source	Explanation
Input		Average of all individual indicators in the regulation and taxes area
Input		Average of all individual indicators in the regulation sub-area
Input	OECD Employment Protection Database	This indicator is a summary indicator consisting of eight indicators dealing with individual dismissals.
Input	OECD Employment Protection Database	This indicator is a summary indicator consisting of four indicators dealing with collective redundancies.
Input	OECD Employment Protection Database	This indicator is a summary indicator consisting of four indicators dealing with collective redundancies.
Input	OECD indicator for product market regulation	The indicator describes the strictness of product market regulation – the higher the value, the stricter the product market regulation
Input	World Economic Forum	WEF indicator 1.15, Intellectual property protection Answer to the survey question, "How much is intellectual property protected in your country?" [1 = Not at all; 7 = Extensively]
Input		Average of all individual indicators in the finance system sub-area
Input	World Bank; World Development Indicators	Capital market size (market capitalisation, loans and bonds in % of GDP)
Input	World Bank, Doing Business	The indicators for minority investor protection measure the level of protection of minority shareholders against the misuse of company assets by directors for their personal gain, as well as the shareholder rights, the protective measures for management and the requirements for the company's transparency, which can reduce the risk of misuse.
Input	Invest Europe	Private equity funds according to type of investor – share of PE funds that is not invested by banks/government agencies
Input	Invest Europe	This indicator measures the venture capital intensity based on the total amounts invested in Austria by domestic and foreign funds relative to GDP (market statistics).
Input		Average of all individual indicators in the tax system sub-area
Input	Eurostat/OECD	Effective average tax rates, non-financial sector, %
Input	Eurostat/OECD	Average overall wage costs burden (in % of gross earnings)
Input	Eurostat/OECD	Tax and levies ratio (in % of GDP)

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	Indicator (long name)	Short name
Education		
Overall system	Composed indicator	Education
	Education spending in the pre-tertiary area, in % of GDP	Education spending in % of GDP
	Education spending in the pre-tertiary area, per student	Education spending per student
	School performances – percentage of students with high competence	School performances – high competence
	School performances – percentage of students with low competence	School performances – low competence
Early childhood care	Composed indicator	Early childhood care
	Early childhood care (pupils between four years old and the mandatory school age, in %)	Early childhood care
	Early childhood care ratio (number of children per carer) in ISCED 02	Early childhood teacher-child ratio
Primary education	Composed indicator	Primary level
	Spending per pupil (primary education)	Spending per pupil (primary education)
	Spending relative to GDP – primary education	Spending relative to GDP – primary education
	Pupil-teacher ratio (number of children per teacher)	Supervisory relationship in primary education
	Composed indicator – percentage of pupils with high competence	Primary education – top
	Composed indicator – percentage of pupils with low competence	Primary education – low
	Primary education reading literacy (PIRLS) – percentage of pupils with high/very high competence	Primary education reading – top
	Primary education reading literacy (PIRLS) – percentage of pupils with average competence	Primary education reading – average
	Primary education reading literacy (PIRLS) – percentage of pupils with low competence	Primary education reading – low
	Primary education reading literacy (PIRLS) – average	Primary education reading – average

Input/ Output	Source	Explanation
		Average of all individual indicators in the education area
Input	OECD	Education spending in the pre-tertiary area (in % of GDP)
Input	OECD	Education spending in the pre-tertiary area (in US dollars for purchasing power parities per pupil)
Output	PISA, TIMSS, PIRLS	Average value of the percentage of students in TIMMS, PIRLS and PISA with high competencies
Output	PISA, TIMSS, PIRLS	Average value of the percentage of students in TIMMS, PIRLS and PISA with low competencies
Input		Average of all individual indicators in the early childhood care sub-area
Input	Eurostat	The percentage of the population between four years old and the beginning of the mandatory school age, attending early childhood care.
Input	OECD	The pupil-teacher ratio (measured in FTEs) is given by dividing the number of pupils of a specific education area by the number of teachers (not assistants) of the same education area and similar educational institutions
		Average of all individual indicators in the primary education sub-area
Input	Eurostat	Primary education spending (in € per pupil for full-time equivalents)
Input	Eurostat	Primary education spending (in % of GDP)
Input	Eurostat	The pupil-teacher ratio (measured in FTEs) is given by dividing the number of pupils of a specific education area by the number of teachers of the same education area and similar educational institutions.
Output	PIRLS, TIMSS	PIRLS/TIMMS average value of pupils with high/very high competence
Output	PIRLS, TIMSS	PIRLS/TIMMS average value of pupils with high/very high competence
Output	PIRLS	Percentage of pupils that achieve very high or high competency levels with the international PIRLS test.
Output	PIRLS	Percentage of pupils that achieve average competency levels with the international PIRLS test.
Output	PIRLS	Percentage of pupils that achieve low competency levels with the international PIRLS test.
Output	PIRLS	Average of the test results of pupils with the international PIRLS test.



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	Indicator (long name)	Short name
Education		
Primary education	Primary education maths and sciences competence (TIMSS) – percentage of pupils with high/very high competence	Maths & Science VS – top
	Primary education maths and sciences competence (TIMSS) – percentage of pupils with average competence	Maths & Science VS – average
	Primary education maths and sciences competence (TIMSS) – percentage of pupils with low competence	Maths & Science VS – low
	Primary education maths and sciences competence (TIMSS) – average	Maths & Science VS – average
Secondary level	Composed indicator	Secondary level
	Spending per pupil (secondary education)	Spending per pupil (secondary education)
	Spending relative to GDP – secondary education	Spending relative to GDP – secondary education
	Composed indicator – percentage of pupils with high competence	Secondary education school performances – top
	Composed indicator – percentage of pupils with low competence	Secondary education school performances – low
	Literacy among 15-year-olds (PISA) – percentage of pupils with high competence	PISA reading – top
	Literacy among 15-year-olds (PISA) – percentage of pupils with low competence	PISA reading – low
	Literacy among 15-year-olds (PISA) – average	PISA reading – average
	Literacy among 15-year-olds (PISA) – performance difference according to gender	PISA reading gender difference
	Literacy among 15-year-olds (PISA) – performance difference according to origin	PISA performance difference – origin
	Maths competence among 15-year-olds (PISA) – percentage of pupils with high competence	PISA mathematics – top
	Maths competence among 15-year-olds (PISA) – percentage of pupils with low competence	PISA mathematics – low
	Maths competence among 15-year-olds (PISA) – average	PISA mathematics – average
	Maths competence among 15-year-olds (PISA) – performance difference according to gender	PISA mathematics gender difference

Input/ Output	Source	Explanation
Output	TIMSS	Percentage of pupils that achieve very high or high competency levels with the international TIMSS test.
Output	TIMSS	Percentage of pupils that achieve average competency levels with the international TIMSS test.
Output	TIMSS	Percentage of pupils that achieve low competency levels with the international TIMSS test.
Output	TIMSS	Average of the test results of pupils with the international TIMSS test.
		Average of all individual indicators (career-oriented graduates not included) in the secondary education sub-area
Input	Eurostat	Secondary education spending (in € per pupil for full-time equivalents)
Input	Eurostat	Secondary education spending (in % of GDP)
Output	PISA	Average of all indicators in secondary education on the percentage of pupils with high competence
Output	PISA	Average of all indicators in secondary education on the percentage of pupils with low competence
Output	PISA	This indicator shows the upward scattering of school performances, so the percentage of pupils with very good results
Output	PISA	The indicator provides information on the percentage of pupils of the total studied population, which is rated at competence level 1 of the corresponding PISA scale at the most, on the basis of its test result. It must be assumed that low competencies in these three basic areas result in considerable drawbacks in private and social life.
Output	PISA	Average of the test results of pupils with the international PISA test in the reading area.
Output	PISA	Difference between the averages of the test results of pupils with the international PISA test in the reading area.
Output	PISA	Difference between the averages of the test results of pupils with and without migrant backgrounds with the international PISA test in the reading area.
Output	PISA	Percentage of pupils that achieve high competency levels with the international PISA test in the maths area.
Output	PISA	Percentage of pupils that achieve low competency levels with the international PISA test in the maths area.
Output	PISA	Average of the test results of pupils with the international PISA test in the maths area.
Output	PISA	Difference between the averages of the test results of pupils with the international PISA test in the maths area.



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	Indicator (long name)	Short name
Education		
Secondary level	Sciences competence among 15-year-olds (PISA) – percentage of pupils with high competence	PISA Science – top
	Sciences competence among 15-year-olds (PISA) – percentage of pupils with low competence	PISA Science, low
	Sciences competence among 15-year-olds (PISA) – average	PISA Science, average
	Influence of socio-economic background on literacy (gradients)	Inheritance of education 1
	Influence of socio-economic background on literacy (variance)	Inheritance of education 2
	School drop-out ratio	Early school leavers
	Percentage of students in vocational training courses from all students	Percentage of work-related graduates*
Further training and lifelong learning	Participation in further training	Further training

Input/ Output	Source	Explanation
Output	PISA	Percentage of pupils that achieve high competency levels with the international PISA test in the sciences area.
Output	PISA	Percentage of pupils that achieve low competency levels with the international PISA test in the sciences area.
Output	PISA	Average of the test results of pupils with the international PISA test in the sciences area.
Output	PISA	The average difference with pupils' performances in literacy, accompanied by an increase of one unit on the PISA index of economic, social and cultural status, is denoted as an increase of the socio-economic gradient. The higher the average difference, the higher the influence of the pupils' socio-economic background on their literacy. The socio-economic background is measured by the PISA index of economic, social and cultural status and is based on the pupils' information about their parents' education status and occupation and specific objects in the parental home, such as desk for studying and number of books, for example. Statistical fluctuation margins are considered in this assessment.
Output	PISA	The strength of the correlation between reading performance and socio-economic background is measured by the percentage of the variance of pupils' performances, which are explained by differences with the pupils' socio-economic background. The higher the percentage of the explained variance, the higher the influence of the socio-economic background.
Output	Eurostat	"Early school and training leavers" are people aged 18 to 24 who meet the following criteria: The highest level of general or vocational training achieved corresponds with ISCED 0, 1, 2 or 3c (so lower secondary level), and those surveyed must not have participated in any general or vocational training activities during the four weeks prior to the survey.
Output	Eurostat	Indicator for the level of an educational system's vocational education basis – possible trade-offs, early job specialisation & low youth unemployment with tertiary & broadly trained specialists & high labour force participation when older
	Eurostat	Participation in lifelong learning is an official goal of the ET-2020 strategy (education and training).

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	Indicator (long name)	Short name
International ties		
Overall system	Composed indicator	International ties
Labour market interconnections	Immigration of (highly qualified) specialists	Highly-qualified immigrants
University interconnections	Composed indicator	University interconnections
	International co-publications (EIS)	International co-publications
	International doctoral students	International doctoral students
	Returns from EU research vs domestic budget share	EU returns
Innovation interconnections	Composed indicator	Innovation interconnections
	Percentage of foreign owners from patents with inventors residing in the country	Foreign-owned patents
	Domestic owners with foreign inventions	Austria-owned foreign patents
	International cooperation with inventions	Patent applications with domestic and foreign inventors
	Foreign R&D financing	Foreign R&D financing
Economy interconnections	Composed indicator	Economy interconnections
	Austrian economy openness	Economic openness
	Percentage of domestic value creation induced by foreign demand	GVC integration 1
	Semi-finished products in exports	GVC integration 2
	Semi-finished products in imports	GVC integration 3
Tertiary education		
University teaching	Composed indicator	Tertiary education
Inputs	Composed indicator – inputs in teaching	University teaching expenditure and support
	University expenditure per student	University expenditure
	Supervisor-student ratio at universities	Supervisor-student ratio at universities

Input/ Output	Source	Explanation
Input		Average of all individual indicators in the international ties area
Input	Eurostat	The indicator reflects the qualification structure of immigration. Those born abroad with a residence permit and at least three months residence are recorded; a university degree is a qualification criterion.
		Average of all individual indicators in the university interconnections sub-area
Input	European Innovation Scoreboard	International scientific co-publications can be interpreted as an indication of the quality of scientific research, as international cooperation generally increases scientific productivity. (EIS indicator 1.2.1)
Input	Eurostat	Percentage of foreign doctoral students from all doctoral students
Input	EU-Budget, WIFO-Berechnungen	Ratio of Austria's share of H2020 funds to Austria's share of the EU budget
		Average of all individual indicators in the innovation interconnections sub-area
	PATSTAT, autumn 2020; WIFO calculation	This indicator maps the checks of foreign players with inventions that were made by inventors living in the country. It therefore shows the percentage of patents with at least one domestic inventor and applicants living abroad only from all patents of domestic inventors.
	PATSTAT, autumn 2020; WIFO calculation	Percentage of patents with at least one domestic inventor and at least one domestic applicant from all patents with at least one domestic applicant
Input	PATSTAT, autumn 2020; WIFO calculation	Percentage of patents with at least one domestic and at least one foreign inventor from all patents with at least one domestic inventor
Input	OECD MSTI	Share of GERD financed by the rest of the world, in percent
Input		Average of all individual indicators in the economy interconnections sub-area
Input	AMECO	Total of exports and imports relative to GDP
	OECD	A gauge for integration into global value creation chains – percentage of domestic value creation, which is mapped in foreign final demand
	World Bank	A gauge for integration into global value creation chains – percentage of intermediate products in total exports
	World Bank	A gauge for integration into global value creation chains – percentage of intermediate products in total imports
		Average of all individual indicators in the tertiary education area
		Indicator composed of the following two individual indicators
Input	OECD Education at a Glance	University expenditure (ISCED 6-8) per student complements the GDP rate by incorporating different variables of the tertiary sector in different countries. All other things being equal, a tertiary sector with a 50% graduate rate will require significantly more resources than a sector with a 25% graduate rate.
Input	Eurostat	The indicator shows the supervisor-student ratios at universities. It is calculated, where possible, on the basis of full-time employees.

appendix

	Indicator (long name)	Short name
Tertiary education		
Graduates	Composed indicator – Teaching outputs	Graduates
	Percentage of 25 to 30-year-old university graduates in % of the 25-34 age cohorts of the population	University graduates, ISCED 5-8
	University graduates, ISCED 6-8	University graduates, ISCED 6-8
	STEM graduates (male/female)	STEM graduates
	Female STEM graduates	Female STEM graduates
	Graduates in scientific studies	Female graduates in technology
	Graduates in technical-engineering studies	Female graduates in technology
	Doctorate holders, STEM	Doctorate holders, STEM
	International doctoral students	International doctoral students
Research performance, universities & non-university institutions		
Research	Composed indicator	University research Non-university
Inputs	Composed indicator – Inputs average	Research inputs
	Researchers in FTE in the university and state sector, per 1,000 of the population	Number of researchers (HEI&GOV) per 1,000 of the population
	R&D expenditure in the state and universities sector, in US dollars and purchasing power parities, per FTE researcher	R&D expenditure (state and universities sector) per researcher
	R&D expenditure in the state and universities sector, in % of GDP	R&D expenditure (state and universities sector) in % of GDP
	Basic research (expenditure as a percentage of GDP)	Basic research (expenditure as a percentage of GDP)
	Competitive funding of basic research (FWF indicator, sister organisations comparison)	Competitive funding of basic research
Research performance	Composed indicator – Output indicators average	Research performance
	Aggregation of Leiden university ranking, relative to population	University ranking, research performance

Input/ Output	Source	Explanation
		Average of all individual indicators in the teaching outputs sub-area
Output	OECD	This is an Austrian Europe 2020 core indicator and reflects successful participation in tertiary education. With the adjustment in the ISCED classification, the two last age groups of BHS are now included in the tertiary sector (ISCED 5, previously ISCED 4a).
Output	OECD/Eurostat	This indicator uses a stricter definition for university graduates, essentially from bachelor level (ISCED 6, previously ISCED 5).
Output	Eurostat	Tertiary graduates in technological fields and the sciences (ISCED 5-8) per 1,000 of the population aged 20 to 29.
Output	Eurostat	Tertiary graduates in technological fields and the sciences (ISCED 5-8) per 1,000 of the population aged 20 to 29.
Output	Eurostat	This indicator measures the percentage of women in STEM graduates (ISCED 6-8), who are integrated into technological innovation processes.
Output	Eurostat	This indicator measures the percentage of women in STEM graduates (ISCED 6-8), who are integrated into technological innovation processes.
Output	Eurostat	Tertiary graduates (ISCED 8) in technological fields and the sciences per 1,000 of the population aged 25 to 34.
Output	Eurostat	Percentage of foreign doctoral students from all doctoral students (similar to indicator 1.2.3).
		Average of all individual indicators in the research at universities and non-university institutions area
Input		Average of all individual indicators in the input sub-area
Input	OECD MSTI	Number of researchers for full-time equivalents in the two sectors, state and higher education, per 1,000 of the population.
Input	OECD MSTI	Expenditure for research and development in the state and higher education sectors, in US dollars for purchasing power parities (per 1,000 inhabitants)
Input	OECD MSTI	Expenditure for research and development in the state and higher education sectors, in % of GDP
Input	OECD MSTI	Basic research spending as defined by the OECD Frascati Manual
Input	Funds' Annual Reports	The "Competitive funding of basic research" indicator is calculated based on the Annual Reports of the Funds (a sister organization of FWF).
		Average of all individual indicators in the research performance sub-area
Output	CWTS Leiden Ranking, WIFO calculation	The indicator shows how Austrian universities position themselves in terms of international research performance. It shows the number of Austrian universities in broad ranking groups (1-50, 51-100, 101-200, 201-300) in international university comparisons (currently only Leiden ranking) relative to the size of the country (number of universities per 10 million inhabitants), whereby the number of universities is weighted with the ranking groups (the better the ranking group, the higher the weighting). This indicator also shows whether a country has only a single leading institution or a broader range.

appendix

	Indicator (long name)	Short name
Research performance, universities & non-university institutions		
Research performance	Number of citable publications per 1,000 of the population	Number of publications per 1,000 of the population
	Number of publications among the most cited 10% worldwide	Quality of publications
	ERC grants per inhabitants	ERC grants
	International co-publications	International co-publications
Corporate research and innovation in existing companies		
Overall system	Composed indicator	Corporate RTI
	Composed indicator – Inputs in corporate RTI	Inputs in corporate RTI (including cooperations)
	Composed indicator – Outputs from corporate RTI	Corporate RTI outputs
SMEs	Composed indicator	RTI in SMEs
	Percentage of innovative SME's	Innovative SMEs
	Innovation revenue	Innovation revenue
	SMEs with innovation cooperations	SMEs & cooperation
Inputs for RTI in companies	Composed indicator	Input for RTI in companies
	R&D expenditure in the corporate sector (in US dollars and purchasing power parities, per 1,000 of the population)	R&D expenditure (corporate sector)
	Innovative companies	Innovative companies
	Foreign-funded R&D	Foreign R&D financing
	Researchers in FTE in the corporate sector, per 1,000 of the population	Number of corporate researchers
	Share of female researchers	Female researchers
	Industry structure-adjusted R&D intensity	Industry structure-adjusted R&D intensity

Input/ Output	Source	Explanation
Output	Scimago, World Bank, WIFO calculation	Number of publications (per 1,000 of the population), which are included in the bibliometric databases (Scimago).
Output	European Innovation Scoreboard	The indicator is a gauge for the quality of the respective scientific publications, so for the quality of the research. (EIS indicator 1.2.2)
Output	European Research Council	The indicator reflects the success with the application for ERC funds, which require strict quality assessment, and are only awarded for top international research. The indicator is calculated on the basis of data published annually by the ERC.
Output	European Innovation Scoreboard	International scientific co-publications can be interpreted as an indication of the quality of scientific research, as international cooperation generally increases scientific productivity. (EIS indicator 1.2.1)
		Average of all individual indicators in the existing companies area
Input		Average of all input indicators in the existing corporate area
Output		Average of all output indicators in the existing corporate area
		Average of all individual indicators in the SMEs sub-area
Output	European Innovation Scoreboard	The indicator describes the percentage of SMEs with innovative activity, so it gauges innovative scope. (EIS indicator 3.1.1)
Output	European Innovation Scoreboard	The indicator reflects the economic importance of innovations, which are new for both the company and the market, and whose level of innovation is therefore especially high. It is therefore an impact indicator for innovation.
Input	European Innovation Scoreboard	This indicator measures the degree to which SMEs participate in innovation cooperations. Complex innovations often depend on the ability to draw on various information sources and knowledge, or to cooperate with the development of an innovation. This indicator measures the flow of knowledge between public research institutions and companies, and between companies and other companies. The indicator is limited to SMEs, as almost all big companies participate in innovation cooperations. (EIS indicator 3.2.1.)
		Average of all individual indicators in the inputs for RTI in companies sub-area
Input	OECD MSTI	R&D expenditure in the corporate sector (in US dollars and purchasing power parities, per 1,000 of the population)
Input	Eurostat CIS	Companies that have either introduced an innovation or perform some kind of innovation activity, as a percentage of all companies.
Input	OECD MSTI	Austria's research expenditure in the international comparison is financed above-average from abroad. This is an indicator for the location quality, while at the same time increasing the fragility of research work in Austria. It is therefore not necessary that the share of foreign financing continue to increase, but nor should it fall drastically either.
Input	OECD MSTI	Number of researchers in full-time equivalents (FTEs) in the corporate sector (per 1,000 of the population)
Input	OECD MSTI	This indicator measures the percentage of women in scientific research staff.
Input	Eurostat, OECD	The R&D intensity can be interpreted as a measure of knowledge intensity. However, the average R&D intensities vary greatly depending on the sector and an adjustment of the industry structure is necessary in order to make an internationally comparable statement on the R&D intensity of the corporate sector.

appendix

	Indicator (long name)	Short name
Corporate research and innovation in existing companies		
Cooperation between science and economy	Composed indicator	Cooperation between science and economy
	Companies with university/research institution innovation cooperations	Companies with innovation cooperations
	Leiden Ranking – cooperation with companies	Leiden Ranking – cooperation with companies
	University financing by companies	University financing by companies
Invention quality and quantity	Composed indicator	Corporate invention performance
	Patent applications at the EPO according to the inventor's place of residence, per 1,000 of the population	Patent applications
	Patent applications to the EPO, JPO and USPTO according to the inventor's place of residence, per 1,000 of the population	Triadic patent applications
	"Super patents" – revolutionary inventions	Super patents
Innovation impact – upgrading	Composed indicator	Innovation effect – upgrading
	Percentage of medium-high to high technology intensity exports from total exports	Export quality
	Complexity score of exported products	Export complexity
Innovation impact – structural change	Composed indicator	Innovation impact – structural change
	Percentage of exports in the high price segment from all exports	Knowledge intensity exports
	Percentage of innovation-intensive sectors in value creation	Innovation-intensive industries
	Employment percentage of knowledge-intensive sectors	Employment in knowledge-intensive sectors
	Percentage of innovation-intensive sectors measured on service exports	Innovation-intensive service exports

Input/ Output	Source	Explanation
Input		Average of all individual indicators in the science and economy cooperation sub-area
Input	Eurostat CIS	Percentage of companies that cooperate in innovation projects with universities or non-university research institutions
Input	CWTS Leiden	The indicator aggregates the individual ranking positions of the universities with regard to the percentage of all publications of co-publications with companies into an overall score – the number of universities is weighted within a ranking group (1-100, 101-200, etc.) with the number of the co-publications; the ranking group is then weighted again and the total is mapped across all ranking groups
Input	OECD MSTI	R&D in the university sector that has been financed by the corporate sector
		Average of all individual indicators in the invention quality and quantity sub-area
Output	PATSTAT, autumn 2020, World Bank, WIFO calculation	Patent applications at the EPO according to the inventor's place of residence (per 1,000 of the population)
Output	PATSTAT, autumn 2020, World Bank, WIFO calculation	Patent applications at the patent offices of the European Union (EPO), Japan (JPO) and the USA (USPTO) according to the inventor's place of residence (per 1,000 of the population)
Output	PATSTAT, autumn 2020, World Bank, WIFO calculation	Calculation is relative to the EU
		Average of two subsequent indicators
Output	Eurostat	The indicator measures the percentage of medium-high to high technology intensity exports from total exports and can therefore also be considered a gauge for the knowledge intensity of the export structure.
Output	BACI, WIFO calculation	This is about what we call a, "product space indicator" (see Hausmann – Hidalgo, 2011; Hidalgo – Hausmann, 2009; Caldarelli et al., 2012), which measures the technological development level of a product line on the basis of the complexity of the underlying knowledge bases. As this complexity cannot be observed directly, this information is acquired with a network analysis. The underlying network connects product lines with countries and extracts this information with a specific process based on the uniqueness of the product lines, as well as the diversification profiles of the countries that export these product lines.
		Average of all individual indicators in the innovation impact – structural change sub-area
Output	Eurostat, UN COMTRADE	The export quality can be interpreted as a gauge for the improvement of the product structure
Output	OECD, Eurostat, WIFO calculation	The indicator measures the weighting of innovation-intensive sectors in the overall value creation of a country
Output	European Innovation Scoreboard	The indicator shows the employment weighting of sectors that employ an especially high amount of university graduates in the international comparison, and are therefore assessed as especially knowledge-intensive.
Output	Eurostat	The indicator shows the export weighting of service sectors with high innovation intensity and can therefore also be considered a gauge for the knowledge intensity of the export structure. Due to Austria's specific assets (the Alps, cultural cities), in the international comparison Austria achieves a by far above-average tourism share of service exports, so this is therefore not considered.

appendix

	Indicator (long name)	Short name
Start-ups		
Overall system	Composed indicator	Start-ups
Regulation, financing and promotion	Start-up regulation	Start-up regulation
	VC investments in % of GDP	Venture capital intensity
	Financing structure for VC funds	VC funds financing structure
	Ratio of people that act entrepreneurial on their own initiative to people that act entrepreneurial due to the lack of alternatives	Motivation for entrepreneurial activity
Foundation and growth of innovative start-ups	Employment in rapidly growing companies in innovation-intensive sectors	Rapidly growing start-ups
Financing		
Total	Composed indicator	Financing
National level	R&D rate	R&D rate
	Privately financed R&D	Privately financed R&D
	Public financing of RTI in the international comparison, in % of GDP	Public sector funding of R&D
	Returns from EU research vs domestic budget share	EU returns
University and basic research funding	Composed indicator	University and basic research funding
	Public financing of HERD in the international comparison, in % of GDP	Public HERD financing, in % of GDP
	Public financing of HERD in the international comparison, in % of HERD	Percentage of public HERD financing
	Competitive funding of basic research (FWF indicator, sister organisations comparison)	Competitive funding in basic research*
Corporate financing	Composed indicator	Corporate financing
	Corporate funding in % of GDP	Corporate funding
	Direct corporate funding	Direct corporate funding
	Indirect corporate funding	Indirect corporate funding
	Financing of BERD from abroad	Foreign financing of corporate R&D

Input/ Output	Source	Explanation
		Average of all individual indicators in the start-ups area
Input	World Bank	The indicator compares the regulation of starting up a limited company in the different countries based on the following four criteria: Number of required administrative steps, time taken, costs (% of per capita GDP) and minimum capital (% of per capita GDP).
Input	Invest Europe	This indicator measures the venture capital intensity based on the total amounts also invested in Austria by foreign funds (market statistics).
Input	Invest Europe	Percentage of private equity funds that are not invested by banks or government bodies.
Input	European Innovation Scoreboard	This index is calculated as the ratio of the percentage of people in improvement-driven entrepreneurship to the percentage of people in necessity-related entrepreneurship. (EIS indicator 1.3.2)
Output	European Innovation Scoreboard	The indicator shows the dynamic of rapidly growing companies in knowledge-intensive sectors. It is not known, however, whether or not the companies in question truly achieve their growth on the basis of innovation activities. (EIS indicator 4.1.2)
		Average of all individual indicators in the financing area
Input	OECD MSTI	R&D expenditure (GERD) in % of GDP
Input	OECD MSTI	GERD financed by the corporate sector in %
Input	OECD MSTI	GERD financed by public institutions
Input	EU Budget, WIFO calculation	Ratio of Austria's share of H2020 funds to Austria's share of the EU budget
		Average of all individual indicators in the universities and basic research financing sub-area
Input	Eurostat	Public financing of R&D expenditure in the higher education sector in the international comparison (in % of GDP)
Input	Eurostat	Public financing of R&D expenditure in the higher education sector in the international comparison, in % of the entire R&D expenditure of the higher education sector.
Input	Funds' Annual Reports WIFO calculation	Annual allocations of funds for financing basic research, per capita
		Average of all individual indicators in the corporate financing sub-area
Input	OECD	Average of all individual indicators in the corporate financing sub-area
Input	OECD	Direct corporate funding in % of GDP, e.g. R&D-relevant allocations by FFG or AWS.
Input	OECD	Tax incentives for research funding in % of GDP, research premium allocations in Austria.
Input	OECD MSTI	Percentage of BERD financed from abroad

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	Indicator (long name)	Short name
Digitisation		
Total	Composed indicator	Digitisation
	Composed indicator – Investments & infrastructure	Investments & infrastructure
	Percentage of investments in ICT with gross fixed capital investments	ICT investments
	Broadband penetration	Broadband
	Percentage of fibre glass connections from total broadband subscriptions	Fibre optics
Investments and infrastructure	Composed indicator	ICT specialists
	ICT basic skills	ICT basic skills
	Full-time ICT specialists	ICT specialists
	Female ICT specialists	Female ICT specialists
	ICT graduates per 1,000 of the population aged 20 to 29	ICT graduates
	Female ICT graduates per 1,000 of the population aged 20 to 29	Female ICT graduates
ICT specialists	Composed indicator	ICT invention performance
	ICT patents, strict ICT technologies, strict definition	ICT patents, strictly defined
	ICT patents, extensive ICT technologies, extensive definition	ICT patents, broadly defined
ICT invention capacity	Composed indicator	Use of ICT in companies
	Companies with ERP system	ERP usage
	Companies that use social media	Social media use

Input/ Output	Source	Explanation
		Average of all individual indicators in the digitisation area
Input		Average of all individual indicators in the investment and infrastructure sub-area
Input	EU KLEMS	Percentage of investments in ICT with gross fixed capital investments
Input	European Innovation Scoreboard	The contractually agreed download speed of the fastest Internet connection for a company is 100 Mb/s (EIS indicator 1.3.1), in % of all companies
Input	OECD	Percentage of fibre glass connections from total broadband subscriptions
		Average of all individual indicators in the ICT specialists sub-area
Input	Eurostat	People with “basic” or “above-basic” digital skills in each of the following four dimensions: Information, communication, problem solving and software for content creation (measured on the number of activities performed in the last three months).
Input	Eurostat	Full-time ICT specialists Broad definition on the basis of ISCO-08 classification while incorporating professions such as ICT service managers, ICT specialists, ICT technicians, ICT installation engineers and service providers.
Input	Eurostat	Percentage of women among ICT specialists. Broad definition on the basis of ISCO-08 classification while incorporating professions such as ICT service managers, ICT specialists, ICT technicians, ICT installation engineers and service providers.
Input	Eurostat	Graduates (ISCED 6-8) of information and communication technology study courses per 1,000 of the population aged 20 to 29
Input	Eurostat	Percentage of female graduates (ISCED 6-8) of information and communication technology study courses per 1,000 of the population aged 20 to 29
		Average of two subsequent indicators
Output	PATSTAT, autumn 2020; Inaba, Squicciarini 2017 (OECD), WIFO calculation	The indicator shows the relative invention specialisation on the basis of an RTA indicator (similar to RCA in foreign trade – Relative Technological Advantage vs Relative Comparative Advantage)
Output	PATSTAT, autumn 2020; Inaba, Squicciarini 2017 (OECD), WIFO calculation	The indicator shows the relative invention specialisation on the basis of an RTA indicators (similar to RCA in foreign trade – Relative Technological Advantage vs. Relative Comparative Advantage)
Input		Average of all individual indicators in the ICT use in companies sub-area
Input	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_ERP1)	Companies that use an ERP software package (e.g. Enterprise Resource Planning) to exchange information between various functional areas (accounting, planning, production, marketing).
Input	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_SM1_GE2)	Companies that use two or more of the following social media: Social networks, corporate blogs or micro blogs, websites for exchanging multimedia content, Wiki-based tools for knowledge exchanges. The use of social media means that the company has a user profile, an account or a user license, depending requirements and the type of social media.

	Indicator (long name)	Short name
Digitisation		
Use of ICT in companies	Companies that use Big Data	Big Data analyses
	Use of Cloud services	Cloud computing
	SMEs with online trade (at least 1% of revenue)	SME online trade
	SMEs with cross-border online trade	SME international online trade
Economic impact of ICT	Composed indicator	ICT impact
	Value creation share of sectors with high ICT intensity	ICT value creation
	Employment share of sectors with high ICT intensity	ICT employment
	Value creation share of ICT production sectors	Value creation share of ICT production sectors
	SMEs revenue in online trade	SME online trade revenue
Environment and climate		
Total	Composed indicator	Climate and environment
R&D, energy and climate	Composed indicator	R&D energy/climate
	R&D expenditure in the environment area	R&D expenditure in the environment area (in % of GDP) R&D expenditure in the environment area (in % of GBAORD)
	R&D expenditure in the energy area	R&D expenditure in the energy area (in % of GDP) R&D expenditure in the energy area (in % of GBAORD)
Inventions, environment and energy	Patents in energy and climate	Climate inventions
Use of environmental innovations/mechanisms	Composed indicator	Use of environmental innovations/mechanisms
	Usage rate of reusable materials	Usage rate of reusable materials
	Solar capacity	Solar capacity
	Companies with ISO Environment Certificate	Companies with ISO Environment Certificate
Effect of environmental innovations/mechanisms	Composed indicator	Effect of environmental innovations/mechanisms
	Greenhouse gas emissions	Greenhouse gases
	Exports of environmental products	Environmental product exports
	Resource productivity	Resource productivity

Input/ Output	Source	Explanation
Input	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_BD)	Big Data analysis (% of companies)
Input	Eurostat – Community survey on ICT usage and eCommerce in Enterprises	Cloud computing services (data storage, financing software, etc.) (% of companies)
Input	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_ESELL)	E-commerce sales (% of companies)
Input	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_AESEU)	Companies that have transacted electronic sales in other EU countries and the rest of the world
Output		Average of all individual indicators in the ICT economic impact sub-area
Output	Eurostat	Value creation shares in ICT-intensive sectors (users, excluding ICT material goods and service providers, in %)
Output	Eurostat	Employment shares in ICT-intensive sectors (users, excluding ICT material goods and service providers, in %)
Output	Eurostat	Value creation share of ICT material goods generation and ICT service providers (producers, in %)
Output	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_ETURN)	Total SME revenue from e-commerce, in % of total revenue
		Average of all individual indicators in the environment and climate area
Input		Average of all individual indicators in the R&D, energy and climate sub-area
Input	Eurostat	Expenditure for research and development in % of GDP, attributable in content terms to the environmental area
Input	Eurostat	Expenditure for research and development in % of the federal budget (GBAORD), attributable in content terms to the environmental area
Input	Eurostat	Expenditure for research and development in % of GDP, attributable in content terms to the environmental area
Input	Eurostat	Expenditure for research and development in % of the federal budget (GBAORD), attributable in content terms to the environmental area
Output	PATSTAT, autmn 2020; OECD 2015, WIFO calculations	The indicator shows the relative invention specialisation on the basis of an RTA indicator (similar to RCA in foreign trade – Relative Technological Advantage vs Relative Comparative Advantage)
		Average of all individual indicators in the use of environmental innovations/mechanisms sub-area
Output	Eurostat	The indicator measures the percentage of materials recovered and fed back into the economy again in all material use.
Output	Eurostat	Percentage of solar capacity in the share of all power generation
Input	ISO, OECD	Percentage of companies that have an ISO-14001:2015 Environmental Management Systems Certificate
		Average of all individual indicators in the impact of environmental innovations/mechanisms sub-area
Output	Eurostat	This indicator maps one of the Austrian Europe 2020 goals and the circumstance that an effective containment of climate change can only be achieved with an absolute reduction of greenhouse gases. The goal here is a reduction, and not an increase.
Output	Eurostat	Exports of environmental products in % of GDP (in line with EU definition)
Output	Eurostat	This indicator is a gauge for the physical resources consumption associated with the Austrian economy's annual production performance.

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	Indicator (long name)	Short name
Location attractiveness		
Total	Composed indicator	Location attractiveness
	Corporate funding in % of GDP	Corporate funding
	Effective tax burden on companies	Company taxation
	Strictness of the regulation of intellectual property rights	IPR regulation
	Number of publications among the most cited 10% worldwide	Quality of publications
	STEM graduates (male/female)	STEM graduates
	Female STEM graduates	Female STEM graduates
	Political stability	Political stability
	Quality of public service provision, infrastructure	Quality of public services
	Intensity of regulatory interventions, price controls, investment controls, etc.	Regulatory quality
	Rule of law, independent courts	Rule of law
Gender equality		
Total	Composed indicator	Gender equality
Schools & universities	Composed indicator	Gender equality in primary Gender equality
	Maths competence among 15-year-olds (PISA) – performance difference according to gender	PISA gender difference in mathematics
	Female STEM graduates	STEM graduates
	Graduates in technical-engineering studies	Female graduates in technology
Occupational differences	Composed indicator	Women in RTI professions
	Female ICT specialists	Female ICT specialists
	Share of female researchers	Female researchers
	Glass ceiling index (percentage of female professors in relation to the percentage of women in scientific and artistic HR)	EU Glass Ceiling Index Glasdeckenindex EU

Input/ Output	Source	Explanation
		Average of all individual indicators in the location attractiveness area
Input	OECD	Direct and indirect corporate funding in % of GDP
Input	Eurostat/OECD	Effective average tax rates, non-financial sector, %
Input	World Economic Forum	WEF indicator 1.15, Intellectual property protection. Answer to the survey question, "How much is intellectual property protected in your country?" [1 = Not at all; 7 = Extensively]
Output	European Innovation Scoreboard	The indicator is a gauge for the efficiency of the research system, highly cited publications are received as being of a higher order of quality. (EIS indicator 1.2.2.)
Output	Eurostat	Tertiary graduates in technological fields and the sciences (ISCED 5-8) per 1,000 of the population aged 20 to 29.
Output	Eurostat	
Input	Worldwide Governance Indicators	Political Stability and Absence of Violence
Input	Worldwide Governance Indicators	According to the World Bank, the quality of public services is a central factor to ensure government effectiveness. This includes smooth provisioning of public services such as schools or hospitals, quality of public administration as well as its independence under political pressure.
Input	Worldwide Governance Indicators	Regulatory quality and intensity of regulatory interventions.
Input	Worldwide Governance Indicators	Rule of law, quality of administrative bodies and constitutional principles.
		Average of all individual indicators in the gender equality area
		Average of all individual indicators in the schools & universities sub-area
Output	PISA	Difference between the averages of the test results of pupils with the international PISA test in the maths area.
Output	Eurostat	Tertiary graduates in technological fields and the sciences (ISCED 5-8) per 1,000 of the population aged 20 to 29.
Output	Eurostat	Percentage of graduates (ISCED 6-8) in engineering, manufacturing industries and construction industry subjects.
Input		Average of all individual indicators in the occupational differences sub-area
Input	Eurostat	Percentage of women among ICT specialists. Broad definition on the basis of ISCO-08 classification while incorporating professions such as ICT service managers, ICT specialists, ICT technicians, ICT installation engineers and service providers.
Input	OECD MSTI	This indicator measures the percentage of women in scientific research staff.
Input	She Figures	The indicator shows how probable it is that a woman will be promoted from a university's scientific staff to a lead position.

	Indicator
Efficiency of RTI activities	
DEA efficiency	Result of the DEA efficiency analysis – Science
	Result of the DEA efficiency analysis – Technology
	Result of the DEA efficiency analysis – Innovation
Input indicators	
	Researchers (FTE's) in all industries (per 1,000 of the population)
	R&D expenditure in the state and universities sector, in US dollars and purchasing power parities
	R&D expenditure in the corporate sector, in US dollars and purchasing power parities, in % of GDP
	Researchers in FTE in the corporate sector, per 1,000 of the population
	R&D expenditure in all sectors, in US dollars and purchasing power parities
	Researchers (FTE's) in universities and state institutions (per 1,000 of the population)
	Percentage of 25 to 30-year-old university graduates in % of the 25-34 age cohorts of the population
Output indicators	
	Aggregation of Leiden university ranking, relative to population
	Number of citable publications per 1,000 of the population
	Number of publications among the most cited 10% worldwide
	Patent applications at the EPO according to the inventor's place of residence, per 1,000 of the population
	Patent applications to the EPO, JPO and USPTO according to the inventor's place of residence, per 1,000 of the population
	Innovation revenue
	Contribution of innovation-intensive industries to value creation
	Employment in rapidly growing companies in innovation-intensive sectors
	Percentage of exports in the high price segment from all exports
	Complexity score of exported products
	Percentage of medium-high to high technology intensity exports from total exports

Short name	Input/ Output	Source
Science efficiency		For details and explanations of the indicators used in this area, please consult the respective study under https://www.wifo.ac.at/wwa/pubid/61111
Technology efficiency		For details and explanations of the indicators used in this area, please consult the respective study under https://www.wifo.ac.at/wwa/pubid/61111
Innovation efficiency		For details and explanations of the indicators used in this area, please consult the respective study under https://www.wifo.ac.at/wwa/pubid/61111
Input indicators		
Number of researchers	Input	OECD, Eurostat, WIFO calculation
R&D expenditure (state and universities sector) per researcher	Input	OECD, Eurostat, WIFO calculation
R&D expenditure (corporate sector)	Input	OECD, Eurostat, WIFO calculation
Number of corporate researchers	Input	OECD, Eurostat, WIFO calculation
R&D expenditure (GERD)	Input	OECD, Eurostat, WIFO calculation
Number of researchers (HEI&GOV)	Input	OECD, Eurostat, WIFO calculation
University graduates ISCED 5-8	Input	OECD
Output indicators		
University ranking, research performance	Output	CWTS Leiden Ranking, WIFO calculation
Number of publications per 1,000 of the population	Output	Scimago, World Bank, WIFO calculation
Quality of publications	Output	European Innovation Scoreboard
Patent applications	Output	PATSTAT, Herbst 2020; World Bank; WIFO calculation
Triadic patent applications	Output	PATSTAT, Herbst 2020; World Bank; WIFO calculation
Innovation revenue	Output	European Innovation Scoreboard
Innovation-intensive industries	Output	OECD, Eurostat, WIFO calculation
Rapidly growing start-ups	Output	European Innovation Scoreboard
Knowledge intensity exports	Output	Eurostat, UN COMTRADE
Export complexity	Output	BACI, WIFO calculation
Export quality	Output	Eurostat

appendix

	Indicator (long name)	Short name
Efficiency of RTI activities		
Total	Composed indicator	Effectiveness of RTI activities
Innovation	EIS Index	EIS Index
Economic and social	Composed indicator	Economic and social
	Per capita GDP	GDP/per capita
	Employment rate	Employment rate
	Unemployment rate	Unemployment rate
Quality of life	Better Life	Quality of life
Health	Composed indicator	Health
		Healthy life years (F)
		Healthy life years (M)
Environment	Composed indicator	Environment
	Greenhouse gas emissions	Greenhouse gases
	Energy intensity	Energy intensity
	Resource productivity and domestic material consumption (DMC)	Resource productivity

Input/ Output	Source	Explanation
		Average of all individual indicators for effectiveness of RTI activities
	European Innovation Scoreboard	The innovation index of the EIS allows the innovation performance of the EU member states to be compared. It is composed of 27 unweighted individual indicators, which affect several innovation-relevant areas (human resources, research spending, patents, structural change, for example).
		Average of all individual indicators in the economic and social sub-area
Output	Eurostat	The per capita gross domestic product (GDP) is a gauge for an economy's performance. It is defined as the value of all goods and services recently created, minus the value of all goods and services consumed here as preliminaries. The underlying figures are expressed in PPS, a single currency, which balances the price level differences between countries and therefore allows meaningful GDP volume comparisons.
Output	Eurostat	The employment rate complements the per capita GDP as a gauge for a country's economic development. The working population includes all people that worked during the report week for at least one hour for payment or to generate revenue, or did not work, but had a workplace that they were temporarily absent from.
Output	Eurostat	The unemployment rate complements the per capita GDP as a gauge for a country's economic development. The unemployment rate is defined as the percentage share of unemployed people in the labour force. The labour force includes employed and unemployed people. Data is seasonally adjusted.
Output	OECD	The indicator measures wealth and quality of life in a broad definition. It is composed of several areas, whereby income, education and health are not mapped with other areas due to overlappings. The other areas are working world balance – privacy, integration into social networks, participation in social/political activity, personal security, environmental quality, housing quality and life satisfaction.
Output		Average of all individual indicators in the health sub-area
Output	Eurostat	This indicator reflects challenges related to population ageing.
Output	Eurostat	Healthy life years can be influenced by both medical-technological advances and social innovations, such as new occupational prevention models, for example.
		Average of all individual indicators in the environment sub-area
Output	Eurostat	This indicator maps one of the Austrian Europe 2020 goals and the circumstance that an effective containment of climate change can only be achieved with an absolute reduction of greenhouse gases. The goal here is a reduction, and not an increase.
Output	Eurostat	This indicator shows the development of energy efficiency, so energy consumption that is, which is related to the Austrian economy's annual production performance.
Output	Eurostat	This indicator is a gauge for the physical resources consumption associated with the Austrian economy's annual production performance.

Annex 2: Results of the strengths-weaknesses analysis

Table 1: Strengths and weaknesses of the Austrian RTI system compared to the EU average, the innovation leaders and the top 3 at a glance

	AT compared to ...			Top Countries	Countries for composite calculation
	EU	IL	Top 3		
Framework conditions for RTI					
Regulation and taxes	92	85	46	(1) UK (2) SE (3) IE	18
Education	109	91	63	(1) FI (2) SE (3) UK	18
International ties	109	99	51	(1) LU (2) BE (3) IE	24
Core RTI system					
Tertiary education	106	94	60	(1) UK (2) SE (3) PL	23
Research at universities and non-university institutions	134	84	63	(1) CH (2) DK (3) NO	17
Corporate RTI	156	112	71	(1) AT (2) FI (3) DE	17
Start-ups and their growth	70	56	46	(1) SE (2) UK (3) NL	22
Financing	154	173	73	(1) AT (2) FR (3) BE	24
RTI efficiency and effectiveness (impact)					
Innovation efficiency	119	88	37	(1) CH (2) US (3) MT	32
Effectiveness & impact	112	92	69	(1) SE (2) IE (3) DE	23
RTI cross-cutting issues					
Digitisation	86	73	51	(1) SE (2) IE (3) DK	20
RTI climate	105	86	37	(1) DE (2) NL (3) EL	28
Location attractiveness	137	119	75	(1) IE (2) UK (3) FI	30
Gender equality	91	95	58	(1) RO (2) LT (3) PL	28

Table 2: Strengths and weaknesses of the Austrian RTI system compared to the EU average, the innovation leaders and the top 3 in detail

	AT compared to ...			Top Countries
	EU	IL	Top 3	
Framework conditions for RTI				
Regulation and taxes	92	85	46	(1) UK (2) SE (3) IE
Regulation	104	96	41	(1) NZ (2) UK (3) FI
Finance system	81	66	53	(1) UK (2) SE (3) DK
Tax system	87	90	43	(1) IE (2) TR (3) CH
Education	109	91	63	(1) FI (2) SE (3) UK
Early childhood care	97	87	69	(1) IS (2) DK (3) SE
Primary education	121	93	65	(1) FI (2) UK (3) IE
Secondary school level	105	91	58	(1) EE (2) FI (3) NL
Further training	126	58	46	(1) SE (2) CH (3) FI
International ties	109	99	51	(1) LU (2) BE (3) IE
Labour market interconnections	90	79	60	(1) LU (2) IE (3) UK
University interconnections	126	69	47	(1) LU (2) BE (3) NL
Innovation interconnections	102	119	47	(1) AU (2) RO (3) AT
Economy interconnections	102	102	57	(1) BE (2) IE (3) SI

	AT compared to ...			Top Countries
	EU	IL	Top 3	
Core RTI system				
Tertiary education	106	94	60	(1) UK (2) SE (3) PL
University teaching expenditure and support	104	78	50	(1) LU (2) SE (3) UK
University graduates as a whole	106	98	63	(1) UK (2) IE (3) PL
Research at universities and non-university institutions	134	84	63	(1) CH (2) DK (3) NO
Inputs	142	101	79	(1) CH (2) NO (3) DK
Research performance	128	70	49	(1) CH (2) DK (3) NL
Corporate RTI	156	112	71	(1) AT (2) FI (3) DE
RTI in SMEs	147	138	75	(1) UK (2) EL (3) BE
Corporate RTI expenditure and HR	153	112	76	(1) AT (2) BE (3) FI
Cooperation between science and economy	180	129	71	(1) DK (2) FI (3) AT
Corporate invention performance	224	83	56	(1) SE (2) DE (3) NL
Innovation impact – upgrading	135	105	83	(1) DE (2) SE (3) FI
Innovation impact – structural change	109	102	65	(1) LU (2) UK (3) DE
Start-ups and their growth	70	56	46	(1) SE (2) UK (3) NL
Governance & financing	154	173	73	(1) AT (2) FR (3) BE
R&D rate	100	127	75	(1) IL (2) KR (3) SE
University and basic research funding	120	84	72	(1) CH (2) FI (3) LU
Corporate financing	208	276	63	(1) FR (2) UK (3) IS
RTI efficiency and effectiveness (impact)				
Efficiency of RTI activities	119	88	37	(1) CH (2) US (3) MT
Innovation efficiency	107	108	52	(1) CY (2) US (3) LU
Science efficiency	87	74	29	(1) JP (2) CH (3) DE
Technology efficiency	162	81	30	(1) MT (2) IE (3) DE
Effectiveness & impact	112	92	69	(1) SE (2) IE (3) DE
EIS Index	127	88	79	(1) CH (2) SE (3) FI
Economic & social	117	98	75	(1) IS (2) CH (3) NO
Health	90	92	79	(1) SE (2) MT (3) BG
Environment result indicators	115	87	51	(1) UK (2) NL (3) LU
RTI cross-cutting issues				
Digitisation	86	73	51	(1) SE (2) IE (3) DK
Investments & infrastructure	65	49	36	(1) SE (2) LT (3) ES
ICT specialists	92	83	54	(1) IE (2) FI (3) IS
ICT invention performance	67	58	31	(1) RO (2) KR (3) SE
Use of ICT in companies	101	82	60	(1) IE (2) BE (3) DK
ICT impact	84	74	53	(1) CZ (2) LU (3) SK
RTI climate	105	86	37	(1) DE (2) NL (3) EL
R&D, energy, climate	91	78	24	(1) JP (2) KR (3) EL
Climate inventions	95	86	36	(1) NL (2) BE (3) IT
Greenhouse gases	142	96	57	(1) DK (2) NL (3) FI
Location attractiveness	137	119	75	(1) IE (2) UK (3) FI
Gender equality	91	95	58	(1) RO (2) LT (3) PL
Schools & universities – gender equality	81	89	46	(1) PL (2) EL (3) SI
Women in RTI professions	101	100	70	(1) LT (2) RO (3) EE

	Indicator	Current AT value	AT pos.	AT compared to...			
				EU	IL	Top 3	
Table 3: Regulation and taxes							
Total	Regulation and taxes	–	–	92	85	46	
Regulation	Regulation	–	–	104	96	41	
	Labour market regulation – individual	2.3	20	102	103	28	
	Labour market regulation – multiple**	3.3	28	96	90	3	
	Labour market regulation – temporary	2.2	22	108	99	18	
	Product market regulation	1.5	24	92	89	66	
	IPR regulation	81.4	7	120	99	93	
Finance system	Finance system	–	–	81	66	53	
	Size of the capital market	170.2	15	82	45	38	
	Investor protection	35.0	19	105	110	83	
	VC funds financing structure	82.6	12	111	99	83	
	Venture capital intensity	0.1	16	25	12	9	
Tax system	Tax system	–	–	87	90	43	
	Company taxation	23.1	24	85	89	49	
	Wage and salary charges	47.9	33	87	82	32	
	Tax and levies ratio	42.4	31	88	99	47	

Table 4: Education

Overall system	Education	–	–	109	91	63	
	Education spending in % of GDP	3.1	24	96	87	66	
	Education spending per student	15,096.6	3	147	111	83	
	School performances – high competence	8.4	23	104	82	46	
	School performances – low competence	14.5	18	125	102	62	
Early childhood care	Early childhood care	–	–	97	87	69	
	Early childhood care	96.0	11	103	100	96	
	Early childhood teacher-child ratio	13.6	20	90	74	42	
Primary education	Primary education	–	–	121	93	65	
	Spending per pupil (primary education)	8,777.2	6	150	101	77	
	Spending relative to GDP – primary education	0.9	23	78	62	45	
	Supervisory relationship in primary education	12.0	11	107	119	80	
	Primary education – top	8.0	23	89	74	30	
	Primary education – low	3.0	6	177	102	44	
	Primary education reading – top	8.0	20	74	63	40	
	Primary education reading – average	84.0	12	103	95	93	
	Primary education reading – low	2.0	3	230	100	86	
	Primary education reading – average	541.0	17	101	98	96	
	Maths & Science VS – top	8.0	17	106	91	30	
	Maths & Science VS – average	79.5	10	106	101	87	
	Maths & Science VS – low	4.0	9	150	103	41	
	Maths & Science VS – average	530.5	11	102	100	92	

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	–	–	–	(1) UK (2) SE (3) IE	18	–	–	–
	–	–	–	(1) NZ (2) UK (3) FI	32	–	*	–
	-0.82	-0.81	2.7	(1) US (2) CA (3) IE	39	2000–2019	OECD Employment Protection Database	
	0.36	0.00	3.3	(1) NZ CL (3) IN	39	2000–2019	OECD Employment Protection Database	yes
	-1.07	0.00	2.2	(1) CA (2) US (3) UK	39	2008–2019	OECD Employment Protection Database	yes
	–	–	1.5	(1) UK (2) ES (3) DK	34	2018–2018	OECD Indicator for Product Market Regulation	yes
	1.22	0.22	80.7	(1) FI (2) CH (3) LU	41	2016–2020	World Economic Forum	yes
	–	–	–	(1) UK (2) SE (3) DK	20	–	*	no
	-51.78	22.59	147.6	(1) CZ (2) LU (3) NL	28	2000–2019	World bank, World Development Indicators	–
	-0.26	0.00	35.0	(1) NZ (2) CA UK	43	2013–2019	World bank, Doing Business	no
	2.55	12.55	70.0	(1) NO BG (3) SE	22	2007–2019	Invest Europe	no
	0.39	-0.29	0.4	(1) CH (2) UK (3) NO	22	2007–2019	Invest Europe	no
	–	–	–	(1) IE (2) TR (3) CH	28	–	*	no
	1.62	-6.60	29.7	(1) BG (2) HU (3) LT TR	33	2000–2019	Eurostat/OECD	–
	4.45	0.60	47.3	(1) CL (2) NZ (3) MX	36	2000–2019	Eurostat/OECD	yes
	1.20	0.16	42.3	(1) MX (2) CL (3) IE	36	2000–2019	Eurostat/OECD	yes
								yes
	–	–	–	(1) FI (2) SE (3) UK	18	–	–	–
	-0.04	-0.06	3.1	(1) IL (2) NO (3) NZ	37	2012–2017	OECD	no
	0.41	3.88	12,481.4	(1) LU (2) CH (3) AT	37	2012–2017	OECD	no
	-0.17	-1.33	9.8	(1) KR (2) CN (3) JP	42	2007–2019	PISA, TIMSS, PIRLS	no
	-1.83	1.14	13.4	(1) CN (2) FI (3) EE	42	2007–2019	PISA, TIMSS, PIRLS	yes
	–	–	–	(1) IS (2) DK (3) SE	27	–	*	–
	1.52	11.40	84.6	(1) FR DK IE UK	32	2000–2018	Eurostat	no
	-0.42	-1.80	18.2	(1) AU (2) IS (3) SE	35	2002–2018	OECD	yes
	–	–	–	(1) FI (2) UK (3) IE	20	–	*	–
	2.80	3.21	7,494.6	(1) LU (2) CH (3) NO	31	2012–2017	Eurostat	no
	0.19	0.03	0.9	(1) IS (2) DK (3) SE	31	2012–2017	Eurostat	no
	-0.10	0.14	11.9	(1) LU (2) EL (3) PL	31	2013–2019	Eurostat	yes
	0.25	1.00	7.0	(1) KR (2) JP (3) CN	34	2007–2019	PIRLS, TIMSS	no
	-1.69	-1.50	4.5	(1) KR (2) JP LV	34	2007–2019	PIRLS, TIMSS	yes
	0.75	0.00	8.0	(1) IE (2) UK (3) BG	27	2006–2019	PIRLS	no
	1.50	0.00	84.0	(1) FI (2) LV (3) IE	27	2006–2019	PIRLS	no
	-0.25	0.00	2.0	(1) LV NL (3) IE SE AT FI IT	27	2006–2019	PIRLS	yes
	0.09	0.04	538.0	(1) IE (2) FI (3) UK	27	2006–2019	PIRLS	no
	1.38	2.00	6.0	(1) KR (2) JP (3) CN	31	2007–2019	TIMSS	no
	8.38	7.00	72.5	(1) KR (2) JP (3) CN	31	2007–2019	TIMSS	no
	-3.50	-3.00	7.0	(1) KR (2) JP (3) LV CN	31	2007–2019	TIMSS	no
	0.24	0.24	515.5	(1) KR (2) JP (3) CN	31	2007–2019	TIMSS	no

* Average of all individual indicators in the sub-area

** The top 3 relative values equals zero; since this value cannot be divided, the difference is shown here.

appendix

	Indicator	Current AT value	AT pos.	AT compared to...			
				EU	IL	Top 3	
➡➡ Education							
Secondary school level	Secondary school level	–	–	105	91	58	
	Spending per pupil (secondary education)	23,164.1	3	161	114	90	
	Spending relative to GDP – secondary education	2.1	9	122	103	86	
	Secondary education school performances – top	8.7	21	112	84	57	
	Secondary education school performances – low	22.2	26	107	87	50	
	PISA reading – top	7.2	25	100	74	52	
	PISA reading – low	23.6	25	101	86	51	
	PISA reading – average	484.4	24	101	98	93	
	PISA reading gender difference	28.1	16	116	123	61	
	PISA performance difference – origin	62.5	30	70	111	3	
	PISA mathematics – top	12.6	15	123	97	55	
	PISA mathematics – low	21.1	20	113	87	49	
	PISA mathematics – average	498.9	19	102	99	93	
	PISA mathematics gender difference	13.3	40	47	30	5	
	PISA Science – top	6.3	21	108	75	50	
	PISA Science, low	21.9	26	107	89	48	
	PISA Science, average	489.8	24	101	98	93	
	Inheritance of education 1	40.1	31	93	96	63	
	Inheritance of education 2	13.0	27	96	89	50	
	Early school leavers	7.8	13	115	98	47	
	Percentage of work-related graduates*	79.1	1	174	151	108	
Further training and life-long learning	Further training	14.7	12	126	58	46	

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	–	–	–	(1) EE (2) FI (3) NL	29	–	*	–
	1.44	1.53	21,474.0	(1) LU (2) CH (3) AT	31	2012–2017	Eurostat	no
	-2.67	-2.13	2.3	(1) BE (2) CY (3) FR	32	2012–2017	Eurostat	no
	-1.24	-2.18	11.6	(1) CN (2) KR (3) JP	42	2006–2019	PISA	no
	-1.74	1.08	19.3	(1) EE (2) CN (3) JP	42	2006–2019	PISA	yes
	0.31	-0.22	7.5	(1) CA (2) FI (3) NZ	42	2000–2019	PISA	no
	-1.62	4.31	19.3	(1) EE (2) IE (3) FI	41	2000–2019	PISA	yes
	0.07	-0.08	492.1	(1) CN (2) EE (3) CA	42	2000–2019	PISA	no
	9.46	8.56	20.2	(1) MX (2) CL (3) UK	42	2015–2019	PISA	yes
	-1.29	0.00	62.5	(1) MT (2) NZ (3) CA	38	2018–2019	PISA	yes
	3.64	-1.72	14.3	(1) CN (2) KR (3) NL	42	2003–2019	PISA	no
	-1.54	2.31	18.8	(1) CN (2) EE (3) JP	42	2003–2019	PISA	yes
	0.10	-0.08	505.6	(1) CN (2) JP (3) KR	42	2003–2019	PISA	no
	0.73	-7.09	22.2	(1) EL (2) SI (3) SE	41	2012–2019	PISA	yes
	-1.19	-3.68	10.0	(1) JP (2) FI (3) EE	42	2006–2019	PISA	no
	0.83	5.51	16.3	(1) EE (2) JP (3) CN	42	2006–2019	PISA	yes
	-0.09	-0.32	510.8	(1) EE (2) JP (3) FI	42	2006–2019	PISA	no
	-6.15	-4.19	44.3	(1) MX (2) TR (3) ES	41	2000–2019	PISA	yes
	-1.41	-3.65	16.6	(1) EE (2) IS (3) CA	41	2000–2019	PISA	yes
	1.96	-2.40	10.2	(1) HR (2) LT (3) EL	32	2000–2019	Eurostat	yes
	1.81	-1.52	80.6	(1) AT (2) CZ (3) HR	32	2013–2018	Eurostat	no
	-3.28	6.40	8.3	(1) SE (2) CH (3) FI	32	2000–2019	Eurostat	no

* Average of all individual indicators in the sub-area

** Not included in composite secondary level

	Indicator	Current AT value	AT pos.	AT compared to...			
				EU	IL	Top 3	
Table 5: International ties							
Overall system	International ties	–	–	109	99	51	
Labour market interconnections	Highly-qualified immigrants	30.50	24	90	79	60	
University interconnections	University interconnections	–	–	126	69	47	
	International co-publications	1,924.53	11	138	73	53	
	International doctoral students	33.30	10	152	74	54	
	EU returns	103.41	13	88	61	35	
Innovation interconnections	Innovation interconnections	–	–	102	119	47	
	Foreign-owned patents	26.37	24	80	97	27	
	Austria-owned foreign patents	88.24	25	104	127	88	
	Patent applications with domestic and foreign inventors	25.37	15	126	138	31	
	Foreign R&D financing	15.90	7	100	114	43	
Economy interconnections	Economy interconnections	–	–	102	102	57	
	Openness	75.25	13	91	107	48	
	GVC integration 1	34.54	17	92	91	55	
	GVC integration 2	22.16	14	105	119	65	
	GVC integration 3	27.58	11	120	91	60	

Table 6: Tertiary education

University teaching	Tertiary education	–	–	106	94	60	
Inputs	University teaching expenditure and support	–	–	104	78	50	
	University expenditure	19,205.50	12	116	69	51	
	Supervisor-student ratio at universities	15.3	19	93	86	49	
University graduates	University graduates as a whole	–	–	106	98	63	
	University graduates	41.6	27	96	86	64	
	University graduates, ISCED 6-8	27.1	32	67	58	49	
	STEM graduates	22.8	6	129	145	79	
	Female STEM graduates	12.4	16	102	125	60	
	Female graduates in technology	47.3	27	83	95	67	
	Female graduates in technology	27.6	22	93	112	72	
	Doctorate holders, STEM	0.9	10	129	88	57	
	International doctoral students	33.3	10	152	74	54	

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	–	–	–	(1) LU (2) BE (3) IE	24	–	–	–
	-0.26	12.30	18.2	(1) LU (2) IE (3) UK	32	2004–2019	Eurostat	no
	–	–	–	(1) LU (2) BE (3) NL	28	–	*	–
	-1.17	4.81	1,385.5	(1) IS (2) CH (3) DK	33	2012–2019	European Innovation Scoreboard	no
	-3.91	7.33	25.9	(1) LU (2) CH (3) NL	32	2008–2018	Eurostat	no
	-2.72	-1.59	123.3	(1) BE (2) CY (3) NL	28	2008–2019	EU-Budget, WIFO calculations	no
	–	–	–	(1) AU (2) RO (3) AT	37	–	*	–
	-1.83	-1.71	36.5	(1) CL MX (3) RO	41	2000–2019	PATSTAT, autumn 2020; WIFO calculations	no
	7.94	6.26	81.9	(1) IS BG LV EE EL AU RO NZ HR LT SI	41	2000–2019	PATSTAT, autumn 2020; WIFO calculations	no
	1.52	-0.05	25.6	(1) CL (2) AU (3) MT	41	2000–2019	PATSTAT, autumn 2020; WIFO calculations	no
	-9.41	-3.96	19.8	(1) IL (2) LV (3) CZ	38	2000–2019	OECD MSTI	no
	–	–	–	(1) BE (2) IE (3) SI	28	–	*	–
	14.42	6.61	68.6	(1) BE (2) SK (3) HU	28	2000–2020	AMECO	no
	1.95	2.45	32.0	(1) LU (2) IE (3) MT	43	2005–2016	OECD	no
	2.23	3.28	18.8	(1) CH (2) IN (3) BE	43	2000–2018	World Bank	no
	-1.50	0.68	26.9	(1) IS (2) IE (3) CH	43	2000–2018	World Bank	no
	–	–	–	(1) UK (2) SE (3) PL	23	–	–	–
	–	–	–	(1) LU (2) SE (3) UK	23	–	*	–
	-0.30	3.42	10,850.5	(1) LU (2) UK (3) CA	37	2000–2017	OECD Education at a Glance	no
	1.47	-1.64	16.9	(1) LU (2) MT (3) NO	28	2013–2019	Eurostat	yes
	–	–	–	(1) UK (2) IE (3) PL	27	–	*	–
	-6.93	11.14	30.5	(1) KR (2) CA (3) JP	38	2004–2019	OECD	no
	-3.54	6.23	20.9	(1) LT (2) CH (3) IS	36	2004–2019	OECD/Eurostat	no
	9.22	15.60	7.2	(1) IE (2) FR (3) UK	34	2000–2018	Eurostat	no
	0.06	0.80	11.6	(1) IE (2) UK (3) PL	32	2013–2018	Eurostat	no
	-1.71	-3.40	50.7	(1) CY (2) PL (3) BG	32	2005–2018	Eurostat	no
	6.23	5.36	22.2	(1) PL (2) RO (3) IS	32	2005–2018	Eurostat	no
	-0.06	0.30	0.6	(1) CH (2) UK (3) ES	34	2000–2018	Eurostat	no
	-3.91	7.33	26.0	(1) LU (2) CH (3) NL	32	2008–2018	Eurostat	no

* Average of all individual indicators in the sub-area

	Indicator	Current AT value	AT pos.	AT compared to...			
				EU	IL	Top 3	
Table 7: Research at universities and non-university institutions							
Research	Research at universities and non-university institutions	–	–	134	84	63	
Inputs	Expenditure and HR in research at universities & non-university institutions	–	–	142	101	79	
	Number of researchers (HEI&GOV) per 1,000 of the population	2.1	18	100	83	62	
	R&D expenditure (state and universities sector) per 1,000 of the population	0.6	5	212	106	79	
	R&D expenditure (state and universities sector) in % of GDP	0.9	6	100	112	93	
	Basic research (expend. as a percent. of GDP)	0.5	4	154	104	83	
	Competitive funding in basic research*	26.7	8	44	35	27	
Research performance	Research perform., univ. & non-univ. instit.	–	–	128	70	49	
	University ranking, research performance	58,752	12	77	46	22	
	Number of publications per 1,000 of the population	2.9	13	124	73	58	
	Quality of publications	11.2	16	129	85	76	
	ERC grants	2.5	10	172	71	37	
	International co-publications	1,924.53	11	138	73	53	

Table 8: Corporate research and innovation in existing companies

Overall system	Corporate RTI	–	–	156	112	71	
	Corporate RTI (reduced indicators set)	–	–	167	110	65	
	Inputs in corporate RTI (including cooperations)	–	–	165	121	75	
	Corporate RTI outputs	–	–	144	104	66	
SMEs	RTI in SMEs	–	–	147	138	75	
	Innovative SMEs	45.0	9	136	105	76	
	Innovation revenue	12.6	11	114	155	64	
	SMEs & cooperation	22.1	6	191	154	85	
Inputs for RTI in companies	Corporate RTI expenditure and HR	–	–	153	112	76	
	BERD	1.3	4	269	140	80	
	Innovative companies	62.6	9	128	111	89	
	Foreign-funded R&D	15.9	7	100	114	43	
	Number of corporate researchers	3.7	7	160	95	78	
	Female researchers	30.1	24	83	89	60	
	Industry structure-adjusted R&D intensity	1.0	1	176	124	104	

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	–	–	–	(1) CH (2) DK (3) NO	17	–	–	–
	–	–	–	(1) CH (2) NO (3) DK	33	–	*	–
	2.07	4.72	1.0	(1) NZ (2) IS (3) NO	38	2002–2018	OECD MSTI	no
	0.29	5.88	0.2	(1) NO (2) LU (3) DK	38	2002–2019	OECD MSTI	no
	0.10	0.27	0.7 0.4	(1) DK (2) NO (3) DE	38	2002–2019	OECD MSTI	no
	2.44	2.66		(1) CH (2) KR (3) DK	33	2002–2017	OECD MSTI	no
	-2.10	2.58	19.7	(1) CH (2) LU (3) FI	8	2007–2019	Funds' annual reports, WIFO calculations	no
	–	–	–	(1) CH (2) DK (3) NL	22	–	*	–
	1.34	1.41	51,813.0	(1) CH (2) NL (3) UK	29	2009–2018	CWTS Leiden Ranking, WIFO calculations	no
	-1.82	4.19	1.6	(1) CH (2) DK (3) IS	43	2005–2019	Scimago, World bank, WIFO calculations	no
	0.74	0.06	11.1	(1) NL (2) UK (3) CH	40	2010–2017	European Innovation Scoreboard	no
	-2.63	3.98	1.7	(1) CH (2) IL (3) NL	32	2009–2019	European Research Council	no
	-1.17	4.81	1,385.5	(1) IS (2) CH (3) DK	33	2012–2019	European Innovation Scoreboard	no
	–	–	–	(1) AT (2) FI (3) DE	17	–	–	–
	–	–	–	(1) AT (2) DE (3) FI	19	–	–	–
	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
	–	–	–	(1) UK (2) EL (3) BE	33	–	*	–
	4.47	4.35	40.7	(1) CA (2) PT (3) NO	38	2010–2017	European Innovation Scoreboard	no
	4.00	0.67	11.9	(1) SK (2) CH (3) ES	33	2010–2017	European Innovation Scoreboard	no
	3.03	1.57	20.5	(1) UK (2) EE (3) IS	33	2010–2017	European Innovation Scoreboard	no
	–	–	–	(1) AT (2) BE (3) FI	21	–	*	–
	4.21	6.79	0.4	(1) IL (2) CH (3) KR	38	2002–2019	OECD MSTI	no
	3.36	6.37	56.2	(1) EE (2) CH (3) CY	32	2008–2018	Eurostat CIS	no
	-9.41	-3.96	19.9	(1) IL (2) LV (3) CZ	38	2000–2019	OECD MSTI	no
	1.44	3.80	2.0	(1) KR (2) SE (3) FI	37	2002–2019	OECD MSTI	no
	3.61	9.35	20.7	(1) LV (2) LT (3) IS	32	2002–2017	OECD MSTI	no
	1.98	0.97	0.9	(1) AT (2) BE (3) US	31	2008–2017	Eurostat, OECD	no

* Average of all individual indicators in the sub-area

** Not included in overall score

	Indicator	Current AT value	AT pos.	AT compared to...			
				EU	IL	Top 3	
»» Research and innovation in existing companies							
Cooperation between science and economy	Cooperation between science and economy	–	–	180	129	71	
	Companies with innovation cooperations	23.2	2	181	154	126	
	Leiden Ranking – cooperation with companies	42,649	6	266	99	58	
	University financing by companies	5.1	18	92	134	28	
Invention quality and quantity	Corporate invention performance	–	–	224	83	56	
	Patent applications	0.2	7	251	94	69	
	Triadic patent applications	0.027	11	186	62	28	
	Super patents	1.6	5	236	94	72	
Innovation impact – upgrading	Innovation impact – upgrading	–	–	135	105	83	
	Export quality	81.2	7	124	97	93	
	Export complexity	1.6	9	147	114	74	
Innovation impact – structural change	Innovation impact – structural change	–	–	109	102	65	
	Knowledge intensity exports	58.3	11	114	115	81	
	Innovation-intensive industries	0.4	10	115	114	50	
	Employment in knowledge-intensive sectors	15.0	15	105	81	56	
	Innovation-intensive service exports	78.0	18	103	99	72	

Table 9: Start-ups							
Overall system	Start-ups and their growth	–	–	70	56	46	
Start-up regulation, financing and funding	Start-up regulation	83.2	40	93	90	85	
	Venture capital intensity	0.08	16	25	12	9	
	VC funds financing structure	82.6	12	111	99	83	
	Motivation for entrepreneurial activity	2.7	18	75	34	26	
Starting and growth of innovative start-ups	Rapidly growing start-ups	2.5	28	47	47	27	

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	–	–	–	(1) DK (2) FI (3) AT	27	–	*	–
	19.58	13.19	10.0	(1) UK (2) AT (3) DK	32	2004–2016	Eurostat CIS	no
	2.14	10.84	16,888.9	(1) IS (2) SE (3) FI	39	2009–2018	CWTS Leiden Ranking	no
	1.24	1.07	4.1	1) CN (2) KR (3) DE	38	2002–2017	OECD MSTI	no
	–	–	–	(1) SE (2) DE (3) NL	26	–	*	–
	2.11	2.56	0.1	(1) CH (2) SE (3) DE	41	2000–2017	PATSTAT, autumn 2020; World bank, WIFO calculations	no
	0.37	-2.05	0.038	(1) JP (2) CH (3) NL	40	2000–2017	PATSTAT, autumn 2020; World bank, WIFO calculations	no
	3.21	2.25	1.1	(1) DE (2) SE (3) FI	27	2000–2018	PATSTAT, autumn 2020; World bank, WIFO calculations	no
	–	–	–	(1) DE (2) SE (3) FI	27	–	*	–
	3.18	1.16	80.0	(1) FI (2) DE (3) SE	28	2010–2019	Eurostat	no
	0.84	-0.18	1.7	(1) JP (2) CH (3) DE	42	2000–2018	BACI, WIFO calculations	no
	–	–	–	(1) LU (2) UK (3) DE	30	–	*	–
	3.87	2.93	55.3	(1) JP (2) KR (3) HU	41	2005–2019	Eurostat, UN COMTRADE	no
	0.01	0.02	0.3	(1) CL (2) JP (3) KR	38	2008–2018	OECD, Eurostat, WIFO calculations	no
	0.34	1.00	14.0	(1) IL (2) LU (3) CH	33	2011–2018	European Innovation Scoreboard	no
	5.55	4.45	73.6	(1) TR (2) NO (3) LU	38	2010–2019	Eurostat	no
	–	–	–	(1) SE (2) UK (3) NL	22	–	–	–
	-0.07	0.35	78.7	(1) NZ (2) CA (3) AU	43	2004–2020	World bank	no
	0.39	-0.29	0.37	(1) CH (2) UK (3) NO	22	2007–2019	Invest Europe	no
	2.55	12.55	70.0	(1) NO BG (3) SE	22	2007–2019	Invest Europe	no
	-5.56	-3.78	3.5	(1) DK (2) IS (3) FI	32	2012–2019	European Innovation Scoreboard	no
	-0.82	-0.35	2.9	(1) IE (2) HU (3) SK	30	2010–2017	European Innovation Scoreboard	no

* Average of all individual indicators in the sub-area

	Indicator	Current AT value	AT pos.	AT compared to...			
				EU	IL	Top 3	
Table 10: Financing							
Total	Financing	–	–	154	173	73	
National level	R&D rate	3.2	6	100	127	75	
	Private sector funding in R&D expenditure	69.8	14	100	97	82	
	Public sector funding of R&D	1.0	2	100	123	100	
	EU returns	103.4	13	88	61	35	
University and basic research funding	University and basic research funding	–	–	120	84	72	
	Public HERD financing, in % of GDP	0.6	5	200	113	92	
	Percentage of public HERD financing	85.4	4	116	104	95	
	Competitive funding in basic research*	26.7	8	44	35	27	
Corporate financing	Corporate financing	–	–	208	276	63	
	Corporate funding	26.3	4	228	293	77	
	Direct corporate funding	7.8	14	152	143	47	
	Indirect corporate funding	18.5	4	296	525	77	
	Foreign financing of corporate R&D	20.7	6	158	144	49	

Table 11: Digitisation

Total	Digitisation	–	–	86	73	51	
Investments and infrastructure	Investments & infrastructure	–	–	65	49	36	
	ICT investments	14.4	8	121	103	71	
	Broadband	17.0	20	66	37	31	
	Fibre optics	3.0	33	9	7	4	
ICT specialists	ICT specialists	–	–	92	83	54	
	ICT basic skills	66.0	10	118	91	80	
	ICT specialists	4.3	13	104	70	65	
	Female ICT specialists	20.4	12	109	107	80	
	ICT graduates	2.3	20	77	77	31	
	Female ICT graduates	0.8	21	53	68	15	
ICT invention capacity	ICT invention performance	–	–	67	58	31	
	ICT patents, strictly defined	0.5	27	67	59	31	
	ICT patents, broadly defined	0.5	28	68	58	31	
Use of ICT in companies	Use of ICT in companies	–	–	101	82	60	
	ERP usage	43.0	6	120	98	87	
	Social media use	58.0	12	111	87	79	
	Big Data analyses	6.0	27	49	37	28	

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	–	–	–	(1) AT (2) FR (3) BE	24	–	*	–
	1.36	1.30	1.9	(1) IL (2) KR (3) SE	38	2000–2019	OECD MSTI	no
	13.50	7.80	62.0	(1) IL (2) JP (3) BE	37	2000–2019	OECD MSTI	no
	0.16	0.24	0.7	(1) NO (2) AT (3) KR	38	2000–2019	OECD MSTI	no
	-2.72	-1.59	123.3	(1) BE (2) CY (3) NL	28	2008–2019	EU-Budget, WIFO calculations	no
	–	–	–	(1) CH (2) FI (3) LU	8	–	*	–
	-0.04	0.08	0.5	(1) CH (2) DK (3) NO	35	2002–2017	Eurostat	no
	2.79	-5.96	91.4	(1) LU (2) NO (3) SK	35	2002–2017	Eurostat	no
	-2.10	2.58	19.7	(1) CH (2) LU (3) FI	8	2007–2019	Funds' annual reports, WIFO calculations	no
	–	–	–	(1) FR (2) UK (3) IS	37	–	*	–
	0.09	0.09	17.3	(1) FR (2) UK (3) KR	41	2002–2018	OECD	no
	0.03	0.01	7.2	(1) HU (2) KR (3) IS	42	2002–2018	OECD	no
	0.05	0.07	11.1	(1) FR (2) UK (3) IT	41	2000–2018	OECD	no
	-14.52	-9.23	29.9	(1) IL (2) CZ (3) IE	38	2002–2017	OECD MSTI	no
	–	–	–	(1) SE (2) IE (3) DK	20	–	–	–
	–	–	–	(1) SE (2) LT (3) ES	21	–	*	–
	0.40	0.61	13.0	(1) NL (2) US (3) SE	27	2000–2017	EU KLEMS	no
	-21.60	5.00	12.0	(1) DK (2) SE (3) PT	30	2012–2019	European Innovation Scoreboard	no
	-11.65	1.37	1.6	(1) KR (2) JP (3) LT	36	2016–2019	OECD	no
	–	–	–	(1) IE (2) FI (3) IS	32	–	*	–
	5.40	2.00	64.0	(1) IS (2) NO (3) NL	32	2015–2019	Eurostat	no
	-0.10	1.40	2.9	(1) SE (2) FI (3) LU	32	2004–2019	Eurostat	no
	-1.60	-1.70	22.1	(1) BG (2) LT (3) LV	32	2004–2019	Eurostat	no
	-1.37	-0.14	2.4	(1) IE (2) FI (3) NO	32	2010–2018	Eurostat	no
	-0.54	0.09	0.8	(1) IE (2) IS (3) BG	32	2010–2018	Eurostat	no
	–	–	–	(1) RO (2) KR (3) SE	41	–	*	–
	2.13	1.11	0.4	(1) RO (2) KR (3) SE	41	2000–2016	PATSTAT, autumn 2020; Inaba, Squicciarini 2017 (OECD), WIFO calculations	no
	2.00	1.12	0.4	(1) RO (2) KR (3) SE	41	2000–2016	PATSTAT, autumn 2020; Inaba, Squicciarini 2017 (OECD), WIFO calculations	no
	–	–	–	(1) IE (2) BE (3) DK	29	–	*	–
	1.20	18.00	25.0	(1) BE (2) DK (3) FR NL LT	31	2010–2019	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_ERP1)	no
	-10.80	20.00	38.0	(1) MT (2) CY (3) UK IE DK NL	31	2013–2019	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_SM1_GE2)	no
	-2.40	0.00	6.0	(1) MT (2) NL (3) IE BE	29	2018–2018	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_BD)	no

* Average of all individual indicators in the sub-area

** Not included in overall score

	Indicator	Current AT value	AT pos.	AT compared to...			
				EU	IL	Top 3	
»» Digitisation							
Use of ICT in companies	Cloud computing	11.0	24	55	29	24	
	SME online trade	20.0	14	106	84	59	
	SME international online trade	8.0	3	163	160	80	
Economic impact of ICT	ICT impact	–	–	84	74	53	
	ICT value creation	12.1	22	86	84	56	
	ICT employment	9.3	16	90	85	62	
	Value creation share of ICT production sectors	6.0	29	80	69	56	
	SME online trade revenue	9.0	18	78	56	38	

Table 12: Environment and climate

Total	Environment and climate	–	–	105	86	37	
R&D, energy, climate	R&D, energy, climate	–	–	91	78	24	
	R&D expenditure in the environment area (in % of GDP)	0.010	10	90	83	29	
	R&D expenditure in the environment area (in % of GBOARD)	0.6	28	29	42	10	
	R&D expenditure in the energy area (in % of GDP)	0.020	11	138	91	29	
	R&D expenditure in the energy area (in % of GBOARD)	2.7	18	106	98	29	
Patents in energy & climate	Climate inventions	1.0	20	84	85	32	
Use of environmental innovations/measures	Use of environmental innovations/measures	–	–	95	86	36	
	Utilization rate of recyclable materials	11.5	9	124	94	48	
	Solar capacity	6.6	19	76	86	32	
	Companies with ISO Environment Certification	0.3	21	86	77	28	
Impact of environmental innovations/measures	Impact of environmental innovations/measures	–	–	142	96	57	
	Greenhouse gases	102.7	25	80	80	44	
	Export of environmental products	2.9	3	234	134	81	
	Resource productivity	2.0	13	112	74	47	

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	-9.80	5.00	6.0	(1) FI (2) NO SE	31	2014–2018	Eurostat – Community survey on ICT usage and eCommerce in Enterprises	no
	2.40	6.00	14.0	(1) IE (2) DK (3) SE	31	2010–2019	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_ESELL)	no
	2.60	4.00	4.0	(1) IE (2) IS (3) AT	31	2011–2019	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_AESEU)	no
	–	–	–	(1) CZ (2) LU (3) SK	27	–	*	–
	-0.04	-0.01	12.8	(1) SK (2) LU (3) CZ		2005–2018	Eurostat	no
	-0.01	0.00	8.9	(1) SI (2) LU (3) SK	30	2005–2018	Eurostat	no
	0.01	-0.01	6.6	(1) BG (2) CH (3) LU	30	2005–2018	Eurostat	no
	-1.50	1.00	8.0	(1) IE (2) NO (3) CZ	29	2010–2019	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_ETURN)	no
	–	–	–	(1) DE (2) NL (3) EL	28	–	–	–
	–	–	–	(1) JP (2) KR (3) EL	35	–	*	–
	0.00	0.00	0.010	(1) EL (2) KR NO JP SI DE	35	2004–2019	Eurostat	no
	-0.11	-0.73	1.4	(1) SI (2) EL (3) RO	35	2004–2019	Eurostat	no
	0.02	0.02	0.000	(1) JP (2) KR (3) DE	35	2004–2019	Eurostat	no
	2.55	2.00	0.7	(1) JP (2) FR (3) KR	35	2004–2019	Eurostat	no
	-1.86	-1.62	1.4	(1) MT (2) DK (3) LV	41	2000–2018	PATSTAT, autumn 2020; OECD 2015, WIFO calculations	no
	–	–	–	(1) NL (2) BE (3) IT	28	–	*	–
	8.24	4.90	6.6	(1) NL (2) BE (3) FR	28	2010–2019	Eurostat	no
	-1.05	6.54	0.0	(1) DE (2) MT (3) BE	31	2000–2019	Eurostat	no
	3.69	5.19	0.2	(1) CH (2) JP (3) RO	37	2005–2018	ISO, OECD	no
	–	–	–	(1) DK (2) NL (3) FI	28	–	*	–
	0.83	-0.03	103.3	(1) LT (2) LV (3) RO	32	2000–2018	Eurostat	yes
	0.57	0.53	2.4	(1) FI (2) DK (3) AT	28	2014–2017	Eurostat	no
	-0.17	1.21	1.6	(1) CH (2) NL (3) UK	32	2000–2019	Eurostat	no

* Average of all individual indicators in the sub-area

	Indicator	Current AT value	AT pos.	AT compared to...			
				EU	IL	Top 3	
Table 13: Location attractiveness							
Total	Location attractiveness	–	–	137	119	75	
	Corporate funding	0.3	4	228	293	77	
	Company taxation	23.1	24	85	89	49	
	IPR regulation	81.4	7	120	99	93	
	Quality of publications	11.2	16	129	85	76	
	STEM graduates	22.8	6	129	145	79	
	Female STEM graduates	12.4	16	102	125	60	
	Political stability	1.0	13	133	94	65	
	Quality of public services	1.5	14	142	81	77	
	Regulatory quality	1.5	15	122	83	78	
	Rule of law	1.9	7	174	100	96	

Table 14: Gender equality

Total	Gender equality	–	–	91	95	58	
Schools & universities	Schools & universities – gender equality	–	–	81	89	46	
	PISA gender difference in mathematics	13.3	40	47	30	5	
	Female STEM graduates	12.4	16	102	125	60	
	Female graduates in technology	27.6	22	93	112	72	
Occupational differences	Women in RTI professions	–	–	101	100	70	
	Female ICT specialists	20.4	12	109	107	80	
	Female researchers	30.1	24	83	89	60	
	Glass Ceiling Index EU	1.5	13	112	104	71	

Table 15: Efficiency of RTI activities

Total	Efficiency of RTI activities	–	–	119	88	37	
DEA efficiency	Science efficiency	–	–	87	74	29	
	Technology efficiency	–	–	162	81	30	
	Innovation efficiency	–	–	107	108	52	
Input indicators	Number of researchers	5.9	6	132	90	80	
	R&D expenditure (state and universities sector) per 1,000 of the population	0.6	5	212	106	79	
	R&D expenditure (corporate sector)	1.3	4	269	140	80	
	Number of corporate researchers	3.7	7	160	95	78	
	R&D expenditure (GERD)	1.9	4	251	128	97	
	Number of researchers (HEI & GOV)	2.1	18	100	83	62	
	University graduates ISCED 5-8	41.6	27	96	86	64	



	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	–	–	–	(1) IE (2) UK (3) FI	30	–	*	–
	0.09	0.09	0.2	(1) FR (2) UK (3) KR	41	2002–2018	OECD	no
	1.62	-6.60	29.7	(1) BG (2) HU (3) LT TR	33	2000–2019	Eurostat/OECD	yes
	1.22	0.22	80.7	(1) FI (2) CH (3) LU	41	2016–2020	World Economic Forum	no
	0.74	0.06	11.1	(1) NL (2) UK (3) CH	40	2010–2017	European Innovation Scoreboard	no
	9.22	15.60	7.2	(1) IE (2) FR (3) UK	34	2000–2018	Eurostat	no
	0.06	0.80	11.6	(1) IE (2) UK (3) PL	32	2013–2018	Eurostat	no
	3.20	0.92	0.8	(1) IS (2) NZ (3) LU	43	2000–2019	Worldwide Governance Indicators	no
	-0.87	-1.35	1.9	(1) CH (2) DK (3) FI	43	2000–2019	Worldwide Governance Indicators	no
	-0.14	-0.27	1.5	(1) NZ (2) AU (3) NL	43	2000–2019	Worldwide Governance Indicators	no
	0.03	0.12	1.8	(1) FI (2) NO (3) CH	43	2000–2019	Worldwide Governance Indicators	no
	–	–	–	(1) RO (2) LT (3) PL	28	–	–	–
	–	–	–	(1) PL (2) EL (3) SI	32	–	*	–
	0.73	-7.09	22,2	(1) EL (2) SI (3) SE	41	2012–2019	PISA	yes
	0.06	0.80	11,6	(1) IE (2) UK (3) PL	32	2013–2018	Eurostat	no
	6.23	5.36	22,2	(1) PL (2) RO (3) IS	32	2005–2018	Eurostat	no
	–	–	–	(1) LT (2) RO (3) EE	28	–	*	–
	-1.60	-1.70	22,1	(1) BG (2) LT (3) LV	32	2004–2019	Eurostat	no
	3.61	9.35	20,7	(1) LV (2) LT (3) IS	32	2002–2017	OECD MSTI	no
	-1.07	-3.54	2,4	(1) RO (2) MT (3) BG	33	2004–2016	She Figures	yes
	–	–	–	(1) CH (2) US (3) MT	32	–	*	–
	–	–	–	(1) CY (2) US (3) LU	28	–	–	–
	–	–	–	(1) JP (2) CH (3) DE	31	–	–	–
	–	–	–	(1) MT (2) IE (3) DE	31	–	–	–
	1.74	4.11	3.0	(1) KR (2) SE (3) DK	37	2002–2019	OECD, Eurostat, WIFO calculations	no
	0.29	5.88	0.2	(1) NO (2) LU (3) DK	38	2002–2019	OECD, Eurostat, WIFO calculations	no
	4.21	6.79	0.4	(1) IL (2) CH (3) KR	38	2002–2019	OECD, Eurostat, WIFO calculations	no
	1.44	3.80	2.0	(1) KR (2) SE (3) FI	37	2002–2019	OECD, Eurostat, WIFO calculations	no
	3.42	6.64	0.6	(1) CH (2) IL (3) KR	38	2000–2019	OECD, Eurostat, WIFO calculations	no
	2.07	4.72	1.0	(1) NZ (2) IS (3) NO	38	2002–2018	OECD, Eurostat, WIFO calculations	no
	-6.93	11.14	30.5	(1) KR (2) CA (3) JP	38	2004–2019	OECD	no

* Average of all individual indicators in the sub-area



	Indicator	Current AT value	AT pos.	AT compared to...			
				EU	IL	Top 3	
Efficiency of RTI activities							
Output indicators	University ranking, research performance	58,751.9	12	77	46	22	
	Number of publications per 1,000 of the population	2.9	13	124	73	58	
	Quality of publications	11.2	16	129	85	76	
	Patent applications	0.2	7	251	94	69	
	Triadic patent applications	0.027	11	186	62	28	
	Innovation revenue	12.6	11	114	155	64	
	Innovation-intensive industries	0.4	10	115	114	50	
	Gazelles	2.5	28	47	47	27	
	Knowledge intensity exports	58.3	11	114	115	81	
	Export complexity	1.6	9	147	114	74	
	Export quality	81.2	7	124	97	93	

Table 16: Effectiveness of RTI activities

Total	Effectiveness & impact	–	–	112	92	69	
Innovation	EIS Index	126.1	11	127	88	79	
Economic & social	Economic & social	–	–	117	98	75	
	GDP/per capita	126.0	8	123	84	62	
	Employment rate	73.6	11	105	99	91	
	Unemployment rate	4.5	14	134	122	62	
	Quality of life	6.6	17	105	88	84	
Health	Health	–	–	90	92	79	
	Healthy life years (F)	67.7	27	91	94	79	
	Healthy life years (M)	71.6	30	90	90	80	
Environment	Environment result indicators	–	–	115	87	51	
	Greenhouse gases	102.7	25	80	80	44	
	Energy intensity	3.9	7	153	106	62	
	Resource productivity	2.0	13	112	74	47	

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	1.34	1.41	51,671.9	(1) CH (2) NL (3) UK	29	2009–2018	CWTS Leiden Ranking	no
	-1.82	4.19	1.6	(1) CH (2) DK (3) IS	43	2005–2019	Scimago, World bank, WIFO calculations	no
	0.74	0.06	10.7	(1) NL (2) UK (3) CH	40	2010–2017	European Innovation Scoreboard	no
	2.11	2.56	0.1	(1) CH (2) SE (3) DE	41	2000–2017	PATSTAT, Herbst 2020; W, WIFO calculations	no
	0.37	-2.05	0,038	(1) JP (2) CH (3) NL	40	2000–2017	PATSTAT, Herbst 2020; World bank, WIFO calculations	no
	4.00	0.67	11.9	(1) SK (2) CH (3) ES	33	2010–2017	European Innovation Scoreboard	no
	0.01	0.02	0.3	(1) CL (2) JP (3) KR	38	2008–2018	OECD, Eurostat, WIFO calculations	no
	-0.82	-0.35	2.9	(1) IE (2) HU (3) SK	30	2010–2017	European Innovation Scoreboard	no
	3.87	2.93	55.3	(1) JP (2) KR (3) HU	41	2005–2019	Eurostat, UN COMTRADE.	no
	0.84	-0.18	1.7	(1) JP (2) CH (3) DE	42	2000–2018	BACI, WIFO calculations	no
	3.18	1.16	80.0	(1) FI (2) DE (3) SE	28	2010–2019	Eurostat	no
	–	–	–	(1) SE (2) IE (3) DE	23	–	*	–
	0.19	1.03	117.4	(1) CH (2) SE (3) FI	33	2012–2019	European Innovation Scoreboard	no
	–	–	–	(1) IS (2) CH (3) NO	–	–	*	–
	0.29	-0.17	128.0	(1) LU (2) IE (3) CH	34	2010–2019	Eurostat	no
	0.92	5.10	68.5	(1) IS (2) CH (3) NL	32	2000–2019	Eurostat	no
	0.54	1.00	3.5	(1) CZ (2) DE (3) PL	32	2000–2019	Eurostat	yes
	.	.	6.6	(1) NO (2) NL (3) DK	36	2020–2020	OECD	no
	–	–	–	(1) SE (2) MT (3) BG	–	–	*	–
	-3.26	-5.80	73.5	(1) MT (2) BG (3) SE	31	2004–2018	Eurostat	no
	-3.50	-4.70	76.3	(1) SE (2) BG (3) MT	31	2004–2018	Eurostat	no
	–	–	–	(1) UK (2) NL (3) LU	–	–	*	–
	0.83	-0.03	103.3	(1) LT (2) LV (3) RO	32	2000–2018	Eurostat	yes
	0.92	-0.61	4.4	(1) IE (2) DK (3) UK	28	2000–2019	Eurostat	yes
	-0.17	1.21	1.6	(1) CH (2) NL (3) UK	32	2000–2019	Eurostat	no

* Average of all individual indicators in the sub-area

Appendix 3: Comparison of the RTI Strategy 2030 objectives with the Council recommendations 2015–2020 and the 2018 OECD Review

The following comparison allocates all Council recommendations for research and technology development from 2015 to 2020 to the objectives of the RTI Strategy 2030 and the corresponding strategic areas of action. The recom-

mendations of the “OECD Review of Innovation Policy: Austria 2018” are also allocated. The objective here is to provide an overview of which recommendations of the Austrian Council and the OECD were included in the RTI Strategy 2030.

Goal 1 of the RTI Strategy: Join the international leaders and strengthen Austria as an RTI location

- **Goal 1.1: Ranking improvement in international indices (European Innovation Scoreboard [EIS]: From top 8 to top 5; Digital Economy & Society Index [DESI]: From top 13 to top 5; Global Innovation Index [GII]: From top 19 to top 10)**

Austrian Council:

- Report on Austria’s Scientific and Technological Capability 2019, p. 59 ff.
 - Recommendations for the RTI policy in the 27th legislative period – Recommendation of 16 October 2019, pp. 11 ff.
- OECD:
- Reviews of Innovation Policy Austria 2018, pp. 65 ff.

- **Goal 1.2: Acquire 5-10 new RTI-intensive leading companies and expand existing ones**

Austrian Council:

- No such recommendation during the last period
- OECD:
- No such recommendations in the OECD Review

- **Goal 1.3: Increase number of permanently R&D-active companies by 20%**

Austrian Council:

- No such recommendation during the last period
- OECD:
- Reviews of Innovation Policy Austria 2018, p. 18

- **Goal 1.4: Austria’s stronger positioning in European value creation chains by participating in at least 3 more “Important Projects of Common European Interest” (IPCEIs – currently participation in two)**

Austrian Council:

- Recommendation for Austria’s efficient integration into the European industry policy of 22 March 2019
- OECD:
- No such recommendations in the OECD Review

- **Goal 1.5: Utilise opportunities of digitisation for society, economy, climate protection and management for Austria and drive forward digital transformation**

Austrian Council:

- Recommendation for the establishment of an holistic industry and technology policy strategy for platform economy in Austria of 6 June 2019
 - Wie geht es weiter? Vorschläge für die Gestaltung der Forschungsdekade 2020–2030, p. 14
- OECD:
- Reviews of Innovation Policy Austria 2018, p. 18, p. 20

Areas of action related to Goal 1

- **Area of action 1.1: Expand research and technology infrastructure and secure accessibility**

Austrian Council:

- Recommendation on funding the research infrastructure and shaping of sustainable funding certainty of 15 November 2018
 - Recommendation for setting up a nationwide database to illustrate research inputs and outputs of 22 March 2018
- OECD:
- Reviews of Innovation Policy Austria 2018, p. 33, p. 41

- **Area of action 1.2: Increase participation in EU missions, EU partnerships and IPCEIs**

Austrian Council:

- Recommendation for Austria's efficient integration into the European industry policy of 22 March 2019
- Report on Austria's Scientific and Technological Capability 2015, p. 70

OECD:

- Reviews of Innovation Policy Austria 2018, p. 14, p. 208

- **Area of action 1.3: Promote and strategically align internationalisation**

Austrian Council:

- Report on Austria's Scientific and Technological Capability 2015, p. 64 f., p. 70
- Recommendation on Austria's internationalization in research, technology and innovation of 8 April 2014

OECD:

- Reviews of Innovation Policy Austria 2018, p. 37 f., p. 208 f.

Goal 2 of the RTI Strategy: Focus on efficiency and excellence

- **Goal 2.1: Steady increase in R&D expenditure measured on GDP to join the global leaders (top 5; currently at 7 according to OECD ranking)**

Austrian Council:

- Recommendation on setting budgetary priorities in Austria of 19 December 2016.
- Recommendation for funding education, research and innovation in Austria of 5 September 2016
- Recommendation on the way to the forefront of innovation of 30 November 2017

OECD:

- Reviews of Innovation Policy Austria 2018, p. 13

- **Goal 2.2: Expansion of the venture capital pool (also by positioning and establishing 5 corporate venture funds in Austria), to raise venture capital expenditure from 0.02% to 0.1% compared to GDP**

Austrian Council:

- Recommendation for the mobilisation of risk capital to secure sustainable innovation and growth financing of 16 October 2019
- Recommendation for the improvement of the framework conditions for starting innovative companies in Austria of 22 March 2018

OECD:

- Reviews of Innovation Policy Austria 2018, p. 90

- **Goal 2.3: 100% more economically successful academic spin-offs**

Austrian Council:

- Recommendations on the way to the forefront of innovation of 30 November 2017, p. 25 f.
- Report on Austria's Scientific and Technological Capability 2015, p. 53 ff., p. 58 f.

OECD:

- Reviews of Innovation Policy Austria 2018, pp. 25 ff., pp. 87 ff.

- **Goal 2.4: Top 10 placing with European Research Council (ERC) grants (per inhabitant)**

Austrian Council:

- Recommendation on setting up the new EU research framework programme and the national framework conditions for participation in EU mechanisms of 29 June 2018, p. 5
- Report on Austria's Scientific and Technological Capability 2019, p. 41 f., p. 57

OECD:

- Reviews of Innovation Policy Austria 2018, p. 145 f.

- **Goal 2.5: Strengthen participation in Horizon Europe and secure top three place with success rate**

Austrian Council:

- Recommendation on setting up the new EU research framework programme and the national framework conditions for participation in EU mechanisms of 29 June 2018
- Recommendation on the negotiations of the European Multiannual Financial Framework (MFF) and the 9th EU research framework programme of 23 April 2018

OECD:

- Reviews of Innovation Policy Austria 2018, pp. 39 ff., pp. 206 ff.

● **Goal 2.6: Increase the corporate sector's success rate with Horizon Europe from 18.2% to at least 20%**

Austrian Council:

- Recommendation on the negotiations of the European Multiannual Financial Framework (MFF) and the 9th EU research framework programme of 23 April 2018

OECD:

- No such recommendations in the OECD Review

Areas of action related to Goal 2

● **Area of action 2.1: Fund excellent basic research**

Austrian Council:

- Recommendations for the RTI policy in the 27th legislative period of 16 October 2019, p. 6. f.
- Recommendation on increasing excellence in science and research of 16 August 2018
- Recommendation for the excellence programme to promote science as key for more cooperation and competition in basic and top-quality research of 22 March 2018
- Recommendation to set up a mechanism to accelerate Blue Sky Research of 2 December 2016

OECD:

- Reviews of Innovation Policy Austria 2018, p. 17 f., p. 20, p. 41 f.

● **Area of action 2.2: Support applied research and its impact on economy and society**

Austrian Council:

- Recommendation for more risk in research funding of 9 March 2017
- Recommendation for innovation-promoting public procurement in Austria of 1 September 2016
- Report on Austria's Scientific and Technological Capability 2015, p. 48 f.

OECD:

- Reviews of Innovation Policy Austria 2018, p. 195

● **Area of action 2.3: RTI to achieve climate goals**

Austrian Council

- Report on Austria's Scientific and Technological Capability 2020, p. 50 f.
- Wie geht es weiter? Vorschläge für die Gestaltung der Forschungsdekade 2020–2030, p. 14
- Report on Austria's Scientific and Technological Capability 2017, p. 27 ff.

OECD:

- Reviews of Innovation Policy Austria 2018, p. 39, pp. 40 ff., pp. 201 ff.

Goal 3 of the RTI Strategy: Promote knowledge, talents and skills

● **Goal 3.1: Increase the percentage of science, technology, engineering, and mathematics (STEM) graduates by 20%, increase the percentage of women with graduates in technical subjects by 5%**

Austrian Council:

- Report on Austria's Scientific and Technological Capability 2020, p. 26 f., p. 51, p. 54

OECD:

- Reviews of Innovation Policy Austria 2018, p. 28 f., p. 138, fig. 4.2

● **Goal 3.2: Secure a top three place in the Institute for Management Development (IMD) World Talent Ranking (currently rank 4)**

Austrian Council:

- No corresponding recommendations (only the rankings are mentioned, see recommendations on the way to the forefront of innovation of 30 November 2017, for example)

OECD:

- No such recommendations in the OECD Review

● **Goal 3.3: Create incentives for business careers for scientists**

Austrian Council:

- Recommendation for the establishment of entrepreneurship-promoting competences in the Austrian education system of 16 December 2019

OECD:

- Reviews of Innovation Policy Austria 2018, pp. 87 ff.

- **Goal 3.4: Place two Austrian universities among the top 100 (according to Times Higher Education World University Ranking currently one university among the top 200)**

Austrian Council:

- Austria 2030-2050, issues on the way to the forefront of innovation, Austrian Council input paper for an RTI strategy 2030, 2019, p. 22 ff.

OECD:

- No such recommendations in the OECD Review

- **Goal 3.5: Increase the percentage of the science and research staff applying from abroad, especially at universities, to 45%**

Austrian Council:

- No such recommendation during the last period

OECD:

- Reviews of Innovation Policy Austria 2018, p. 33, p. 143

- **Goal 3.6: 100% more Austrian STEM students, who complete studies or a study semester abroad via funding programmes**

Austrian Council:

- No such recommendation during the last period

OECD:

- No such recommendations in the OECD Review

Areas of action related to Goal 3

- **Area of action 3.1: Develop and support human resources**

Austrian Council:

- “create your UNIverse” – Recommendations for action for the future shaping of the universities of 15 February 2018
- Recommendation for policy prioritisation for the tertiary education sector, especially the universities of 14 September 2017
- Recommendation for the further development of the technical colleges sector in the Austrian education and science system of 30 May 2017

OECD:

- Reviews of Innovation Policy Austria 2018, p. 17 f., p. 27, p. 48, p. 55 f.

- **Area of action 3.2: Support international prospects for students and researchers**

Austrian Council:

- Report on Austria’s Scientific and Technological Capability 2015, p. 64 f., p. 70

OECD:

- No such recommendations in the OECD Review

Budgetary framework conditions

Budgetary framework conditions

- **The Austrian Research Funding Act**

Austrian Council:

- Recommendation on the Research Funding Act of 18 June 2020

- **“Future Fund Austria”**

Austrian Council:

- Recommendation on the implementation of a “Future Fund Austria for Research, Development and Innovation” of 26 August 2020
- Recommendation on the establishment of a future fund for science, research and innovation of 20 August 2019

Appendix 4: Indicators list for analysis of the RTI Strategy 2030 objectives

Goal 1: Join the international leaders and strengthen Austria as an RTI location

Ranking improvement in international indices

European Innovation Scoreboard Index (EIS)

Digital Economy and Society Index (DESI)

Global Innovation Index

Acquire 5-10 new RTI-intensive leading companies and expand existing ones

Increase number of permanently R&D-active companies by 20%

Austria's stronger positioning in European value creation chains by participating in at least 3 more "Important Projects of Common European Interest" (IPCEIs)

Utilise opportunities of digitisation for society, economy, climate protection and management for Austria and drive forward digital transformation

Goal 2: Focus on efficiency and excellence

Steady increase in R&D expenditure measured on GDP to join the global leaders (top 5; currently at 7 according to OECD ranking)

Expansion of the venture capital pool to raise venture capital expenditure from 0.02% to 0.1% compared to GDP

100% more economically successful academic spin-offs

Top 10 placing with European Research Council (ERC) grants (per inhabitant)

Strengthen participation in Horizon Europe

Secure top 3 place with Horizon Europe success rate (or Horizon 2020)

Increase the corporate sector's success rate with Horizon Europe from 18.2% to at least 20%

Goal 3: Promote knowledge, talents and skills

Increase the percentage of science, technology, engineering and mathematics (STEM) graduates by 20%

Increase the percentage of women with graduates in technical subjects by 5%

Secure a top three place in the Institute for Management Development (IMD) World Talent Ranking (currently rank 4)

Create incentives for business careers for scientists

Place two Austrian universities among the top 100 (according to Times Higher Education World University Ranking)

Increase the percentage of the science and research staff applying from the abroad, especially at universities, to 45%

100% more Austrian STEM students, who complete studies or a study semester abroad via funding programmes

	Source	Indicator
	European Innovation Scoreboard Index (EIS), current value: 2019	Austria's ranking in the overall index
	Digital Economy and Society Index, current value: 2020	Austria's ranking in the overall index
	Global Competitiveness Ranking, current value: 2019	Austria's ranking in the overall index
	–	–
	Statistik Austria R&D survey, current value: 2017	Number of R&D-active survey units
		Average of all indicators in the digitisation area, precise description of the indicators See Austrian Council annual report
	ECD MSTI, current value: 2018	R&D expenditure (GERD) in % of GDP
	Invest Europe, current value: 2019	
	Uni Data, knowledge balance	Number of spin-offs from universities, TCs and AAS
	European Research Council, current value: 2019	Total from Starting, Advanced and Consolidator Grants per million inhabitants
	EU PM (FFG), current value: 2020	Austria's share in all H2020 participations
	EU PM (FFG), current value: 2020	Success rate of Austrian H2020 participations
		Success rate of Austrian H2020 participations in the corporate sector
	Eurostat, current value: 2018	Tertiary graduates in technological disciplines and the sciences (ISCED 5-8) per 1,000 inhabitants aged 20 to 29
	Eurostat, current value: 2018	Percentage of women with university degrees (ISCED 6–8) in the F07 area – engineering, manufacturing industries and construction industry subjects
	MD Ranking, current value: 2020	Austria's ranking in the overall index
	–	–
	Times Higher Education Ranking, current value: 2021	
	UniData, current value: 2019	Percentage of science and research staff applying from abroad

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