

Report on Austria's Scientific
and Technological Capability
2020



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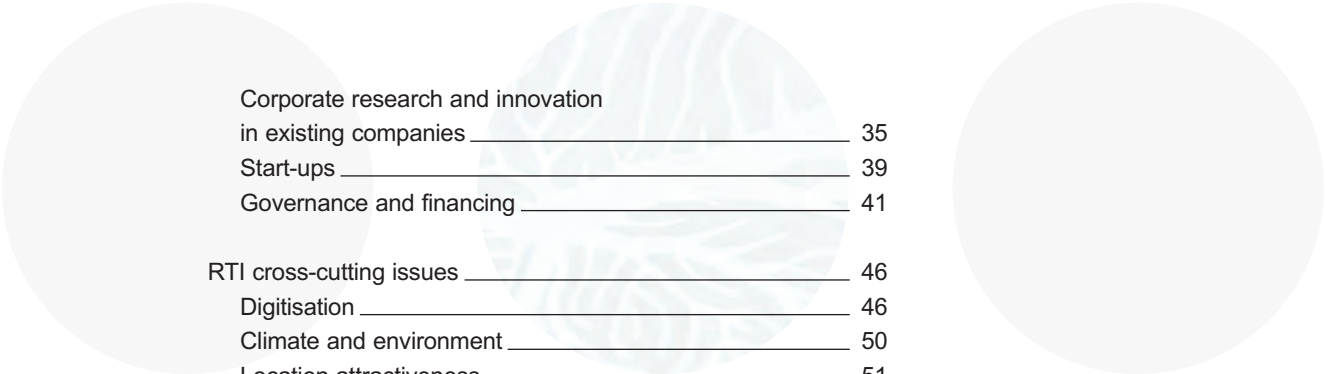
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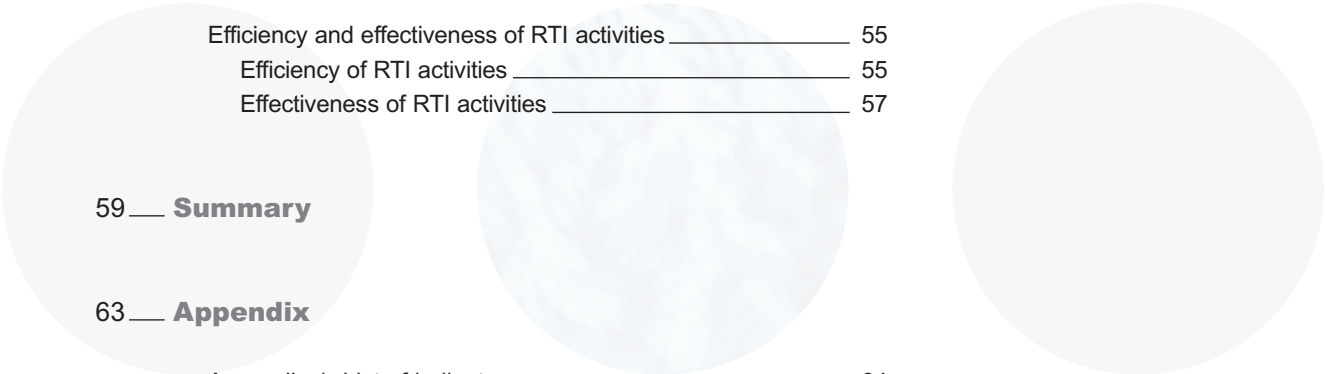
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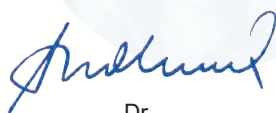
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preamble

In 2010 the Cabinet commissioned the Austrian Council with the compilation of an annual report on Austria's scientific and technological capability. In addition to an evaluation of the innovation performance of the domestic RTI system, this should also include the results of monitoring the implementation of the RTI Strategy 2020. The Austrian Council has performed this assignment since the strategy was adopted in 2011. When work began on a new strategy for research, technology and innovation, in early 2019 the Austrian Council submitted its last report in this respect, focusing on the RTI Strategy's rate of goal achievement. With the current report the Austrian Council is therefore taking the changed framework conditions into account. With the inauguration of the new Austrian Government, positive signals can be seen throughout the research, technology and innovation areas. The government programme includes ambitious objectives for the RTI policy and a series of important pointers to also continue pursuing the goal of making Austria a top location for research, technology and innovation. Special importance is afforded here to the issue of shaping the future RTI policy to meet the grand global challenges. The substructure for this is also an ambitious RTI Strategy 2030, which is to be developed on the basis of a status quo analysis.

The Austrian Council basically welcomes the overriding strategic objectives presented in the government programme. The Austrian Council has seized the Austrian Government's objectives (forging the new RTI Strategy in particular) as an opportunity to perform a systematic strengths-weaknesses analysis of the domestic RTI system in a large-scale project together with the Austrian Institute of Economic Research (German abbreviation – WIFO). With this report and the results herein the Austrian Council presents an additional basis for developing the new RTI Strategy. The Austrian Council offers the Austrian Government, as it has in the past, its expertise and active support for the forthcoming preparation of the strategic guidelines and their subsequent implementation. At this point it must be mentioned that the report was also completed during the Coronavirus crisis in early 2020. It was already clear that the protection measures against the Coronavirus (COVID-19) taken by the Austrian Government and countless other governments all over the world will have massive effects on both the global economy and national RTI systems. The actual effects of the pandemic could not, however, be reliably assessed at that time. Appropriate analyses will therefore be required after the crisis has been successfully dealt with. As part of its statutory mandate at the given time, the Austrian Council will also reply to the multifaceted questions raised by the crisis.



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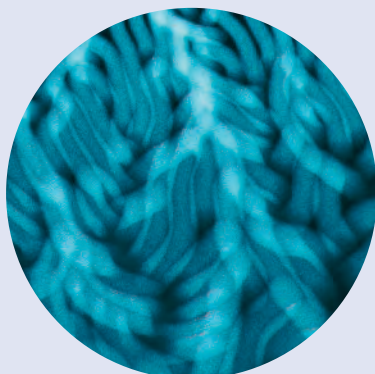
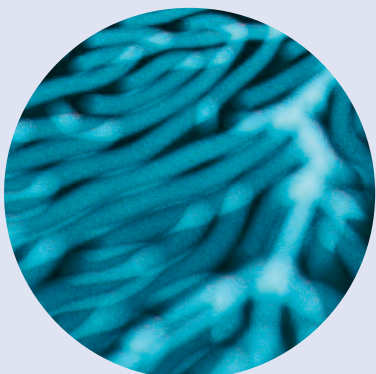
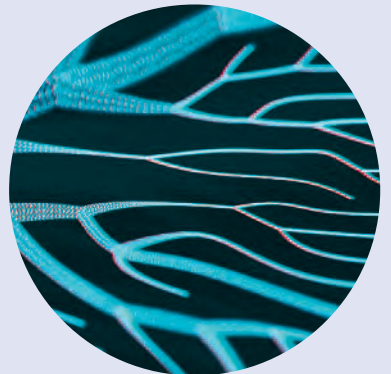
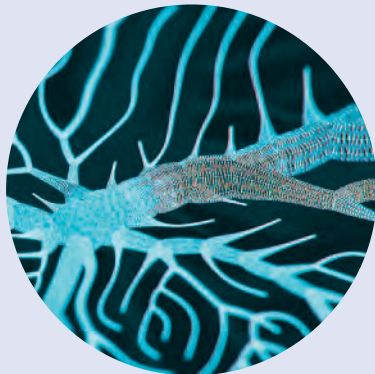
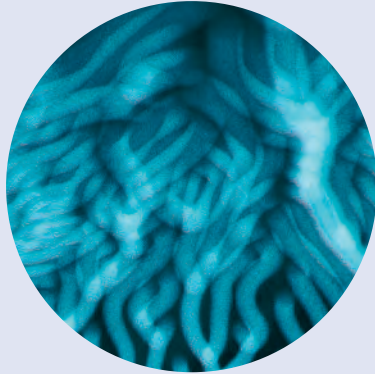
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introduction

The Austrian Government presents the development of an ambitious RTI Strategy 2030 as a key RTI policy objective in its 2020-2024 government programme.¹ Beginning with an analysis of the status quo and current challenges, strategic detailed goals for the RTI policy of the next ten years will be defined here and specific areas of action for their implementation will be specified (consonant with the location strategy and climate goals). This report on Austria's scientific and technological capability focuses on an evaluation of the strengths and weaknesses of the Austrian RTI system's performance in international comparisons. It should be seen as a descriptive basis for the "analysis of the status quo and current challenges" named in the government programme,

Analytical structure

In contrast to the Austrian Council's previous performance reports, the selection of indicators for this report is no longer bound to explicit objectives of the RTI Strategy 2011, but rather can be made more broadly, in order to systematically map strengths and weaknesses in the RTI system. The systematisation here is based on the following guidelines:

- The RTI system is mapped in detail, including important framework conditions such as the secondary education system, labour, capital and product market regulation, taxation, access to financing, etc. (see figure 1). Important here is that the skills and competences of various players, which are influenced by both their own competences and by the connectivity between the players and numerous framework conditions, back up the innovation per-

formance – the capability of the Austrian RTI system is illustrated on the basis of existing databases. The focus here is on a balanced strengths-weaknesses analysis.

The report's objectives

The report pursues two overriding objectives:

- (1) To analyse the current situation with Austria's innovation performance relative to the leading innovation nations and founded on an indicator-based strengths-weaknesses analysis, as well as a qualitative evaluation of relevant developments.
- (2) To draw conclusions, on the basis of which specific policy recommendations for the Austrian Government's strategy development to increase the capability of the Austrian RTI system can be made.

formance – the indicators used for this report will map this.

- The underlying principle here is the tracing of a chain of effects or logic chain². Strengths and weaknesses are illustrated on both the input side and the output side of innovation efforts, whereby efficiency considerations are also possible. Briefly, outputs here are both direct results of efforts ("outputs" – for example, patents as direct result of innovation efforts in companies) and further-reaching effects ("outcomes" – for example, the revenue that is achieved with innovations, which is based on the patents in questions; and "impacts" – for example, macroeconomic productivity effects). On the input side essentially monetary and human resources are presented; on the output side, where possible

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

2 McLaughlin, J. A. / Jordan, G. B. (1999): *Logic models: a tool for telling your programs performance story*. In: *Eval. Program Plann.*, 22(1), 1999, pp. 65–72.

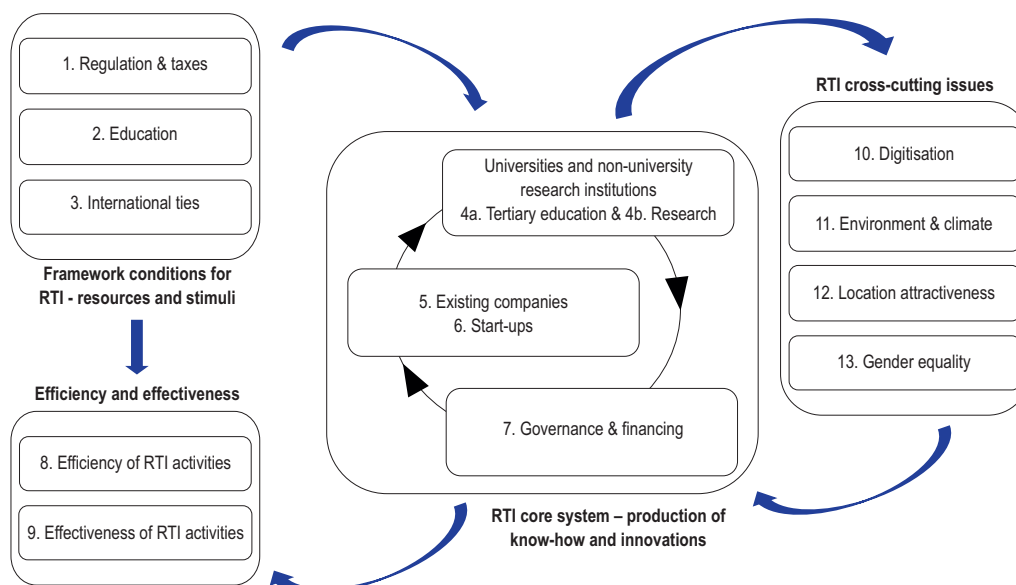
always both quantity and quality (e.g. the number and quality of patents).

- Chains of effects are not only illustrated for the corporate area, but rather also for important other areas of the RTI system, such as tertiary education or research at universities, for example, whose outputs are in turn inputs for corporate activities, but are not quoted again doubled as inputs with corporate activities.
- Correlated here, on the output side the difference is basically made according to frontiers in the areas of science, technology, innovation and economy, or according to RTI system areas with different production logics (e.g. secrecy or protection of knowledge in companies vs publication of knowledge at universities). This is important with efficiency issues (for which the assumption of the production function behind the transformation of inputs into outputs is key).

Figure 1 provides an overview of the underlying schema of the RTI system, on which this report is oriented. It consists of four sub-systems, which are interconnected with one another and influence each other reciprocally:

- (1) Specific framework conditions for research, technology and innovation, such as resources (human), incentives and regulations.
- (2) The core RTI system, within which university and non-university research institutions and R&D active companies can generate knowledge and innovations.
- (3) Cross-cutting issues such as climate and environmental protection or digitisation, which have effects on all sub-areas of the RTI system and are influenced by the rest of the RTI system. In the Austrian context, in addition to the major challenges of climate and digitisation, location attractiveness must also be emphasised,

Figure 1: Schematic illustration of the innovation system



Source: Janger, J. / Strauss-Kollin, A. (2020): Analysis of the performance of the Austrian RTI system. Study commissioned by the Austrian Council. Wifo, Vienna.



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as due to the high foreign financing of Austrian R&D expenditure it represents an important component for the RTI system's performance.

The functioning of the interaction of all sub-areas and players of the RTI system in turn decides on (4) the efficiency and effectiveness of the RTI activities. The latter must be considered potential effectiveness and incorporates overriding economic and social impact indicators, such as economic performance, health or environmental measures. The level of the measures must not be associated causally with innovation performance, but can demonstrate need for action for the RTI policy – if, for example, important environmental KPIs such as the level of greenhouse gas emissions are significantly above that of any

Methodical procedure

The report generally uses the innovation leaders according to the European Innovation Scoreboard 2019 as a benchmark.³ For some years now these have been the top-ranking countries, Sweden, Finland, Denmark and the Netherlands. For additional illustration the average of the EU member states or the respective global top three are also used regularly as comparative values. Details on the results are provided in Annex 2, “Results of the strengths-weaknesses analysis”, in which individual results on all RTI system sub-areas outlined in the report are presented. Annex 1 provides an overview of the indicators used and their data sources, as well as the available countries and

other country, this can serve as motivation for the RTI policy, whose mechanisms must be oriented more on combating climate change, by using technological or social innovations, for instance.

Nonetheless, a broader approach cannot map all relevant indicators or measured values either. An even more detailed illustration of regional innovation systems in particular would by far exceed this approach's framework. The performance of players is essentially measured using diverse company types, universities and non-university research institutions. The research and innovation contribution of civil society institutions, for example, is not recorded. Essentially the approach here does not make any claim to completeness either.

the data's time series dimension. Further details are also provided in the “Analysis of the Austrian RTI system's performance” commissioned by the Austrian Council and performed by WIFO⁴, in which the databases used for this report are listed.

Methodically the respective indicator values are based on a ratio of Austria's values relative to the EU average, to the innovation leaders and to the respective top three countries. With the country selection, essentially all available countries were considered, so globally leading innovation countries such as the USA, South Korea, Japan and Israel as well. Data availability, however, is generally better for countries of the European

³ EU Commission (2019): European Innovation Scoreboard 2019. Luxembourg.

⁴ Janger, J. / Strauss-Kollin, A. (2020): Analyse der Leistungsfähigkeit des österreichischen FTI-Systems. Study commissioned by the Austrian Council. WIFO, Vienna.

Union. In addition to the ratio values, Austria's growth and the growth difference to the leading innovation countries are also shown.

Colours in tables or graphics visualise the ratio values with regard to Austrian performance as follows (values rounded off):

- Green: Value over 110
- Bright green: Value between 100 and 109
- Yellow: Value between 90 and 99
- Orange: Value between 75 and 89
- Red: Value under 75

Austria's values above 100 show a higher level compared to the comparison countries, while values under 100 indicate a lower Austrian level. Colours in tables also visualise Austrian growth values as follows:

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

Important here is that a below-average Austrian value must not be equated in every case with a negative effect on the RTI system. Correlated with the level of taxes it also depends, for example, on how taxes flow back into the quality of public services and funding. The colours therefore firstly illustrate the direction of Austria's difference relative to the leading innova-

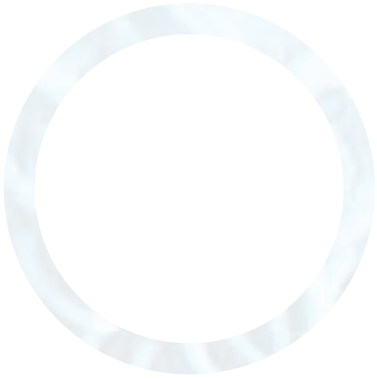
tion countries; more precise and target-oriented interpretations are made qualitatively in the description of the indicators.

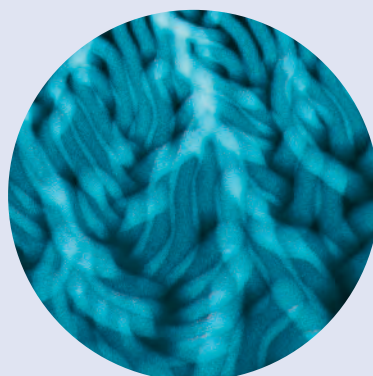
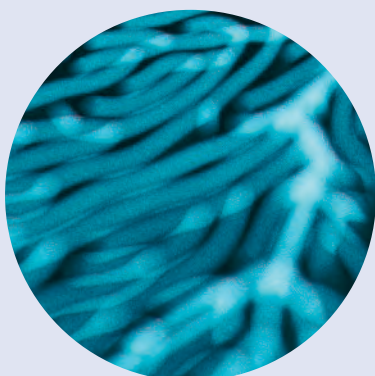
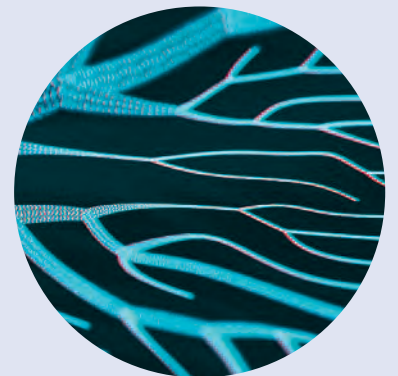
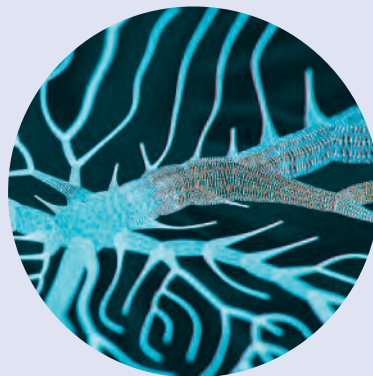
In each area of the RTI system there are sub-areas in which a composed indicator shows the arithmetic average of the individual indicators. In a brief summary only these fourteen composed indicators are shown (see figure 3 and Annex 2, table 1); in a long summary the overall indicators and the composed indicators of the sub-areas are shown (see Annex 2, table 2). Composed indicators enable a simplified illustration in order to communicate important findings. The view of the causes of the findings is lost here however, so it is important to use both the brief summary for an analysis of the performance and these composed indicators to complement a multi-dimensional analysis of the findings' causes⁵, which is performed as the detailed individual indicators of the sub-areas.

An arithmetic average also implies an equal weighting of all indicators. In real life some indicators show greater importance for innovation performance than others. These differences are, however, recorded qualitatively in the explanations for the indicators; the composed indicators serve purely as communication aids.

introduction

5 Grupp, H. / Schubert, T. (2010): Review and new evidence on composite innovation indicators for evaluating national performance. In: Res. Policy, 39(1), 2010, pp. 67–78.





Strengths and weaknesses of the Austrian RTI system in the international comparison at a glance

overview

In its 2019 report on Austria's Scientific and Technological Capability the Austrian Council drew attention to the fact that the Austrian RTI system scores quite well in the international comparison, however due to the weak development dynamic it also shows a clear and consistent distance to the group of leaders over the period.⁶ This is also expressed in Aus-

tria's respective positions in relevant rankings on innovation performance and competitiveness (see table 1).

Table 1 illustrates an example of how Austria has not succeeded in achieving a place among the top ten in key international rankings. Comparable countries score significantly better here, especially Switzerland, Sweden, Denmark, Finland and the Netherlands. The indices listed

Table 1: Overview of positionings in the five most important rankings for innovation performance, competitiveness and quality of life

	Number of top 10 positions	Number of top 20 positions
Switzerland	5	
Sweden	5	
USA	4	1
Denmark	4	1
Finland	4	1
Singapore *	4	
Germany	3	2
Netherlands	3	2
United Kingdom	3	2
Norway	3	2
Canada	3	2
Luxembourg	3	2
New Zealand	1	3
Japan	1	3
Ireland	1	3
Australia	1	2
Iceland	1	2
Belgium	0	3
Austria	0	3
Taiwan	0	2
Malaysia	0	2
South Korea	0	1
France	0	1

Sources: Global Innovation Index, Global Competitiveness Index, World Competitiveness Index, OECD Better Life Index, World Bank (Doing Business) (each figure reflects the last year for which it was available).

⁶ Austrian Council (2019): Report on Austria's Scientific and Technological Capability 2019. Vienna, p. 7 and pp. 56 ff.

here are only some prominent examples among many. Considered across all rankings we can see an Austrian performance trend that on the whole has been stagnating or even declining since 2005. At best Austria is mostly in the mid-field, which does not correspond with its top place in the area of per capita GDP or R&D expenditure. This finding is confirmed by the WKO Monitoring Report, which summarizes Austria's performance in more than 150 international rankings and in recent years shows a clearly visible downward trend (see figure 2).⁷

The performance results of the Austrian RTI system are presented below. This complete overview is based on the aggregated results of the WIFO strengths-weaknesses analysis already mentioned.⁸ Based on the schematic illustration of the RTI system in figure 1 the strengths and weaknesses of the Austrian RTI system compared with the innovation leaders (figure 3) are illustrated below. Figure 3 shows how the Austrian RTI system has both strengths and some key weaknesses

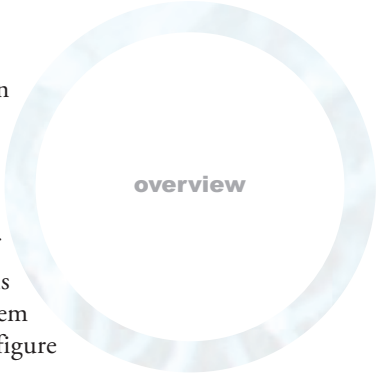
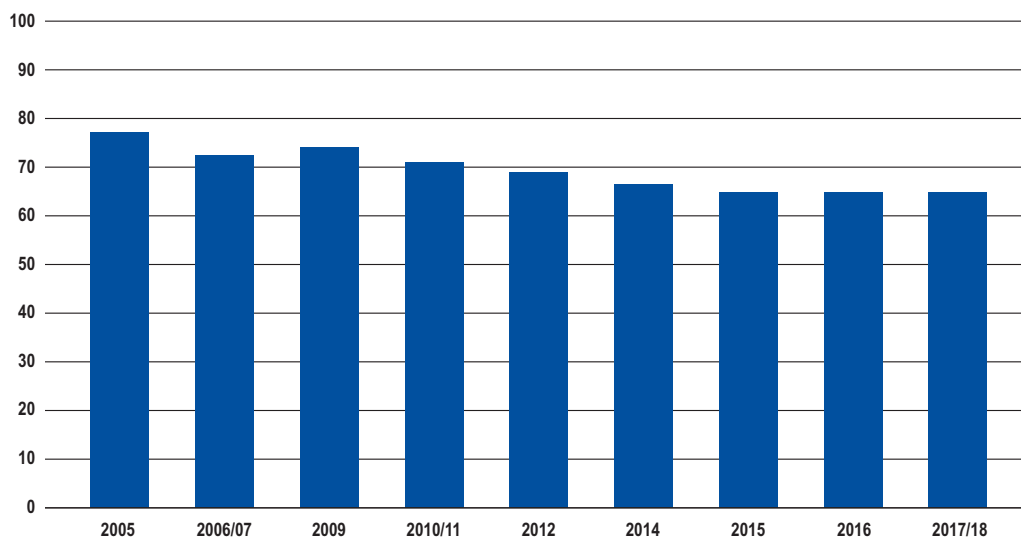


Figure 2: Downward development of the WKO Monitoring Index based on 150 international rankings⁹



Source: WKO (2019): WKO Monitoring Report 2018: Wo steht Österreich? Vienna, p. 1.

⁷ WKO (2019): WKO Monitoring Report 2018: Wo steht Österreich? Vienna.

⁸ Janger, J. / Strauss-Kollin, A. (2020): Analyse der Leistungsfähigkeit des österreichischen FTI-Systems. Study commissioned by the Austrian Council. Vienna.

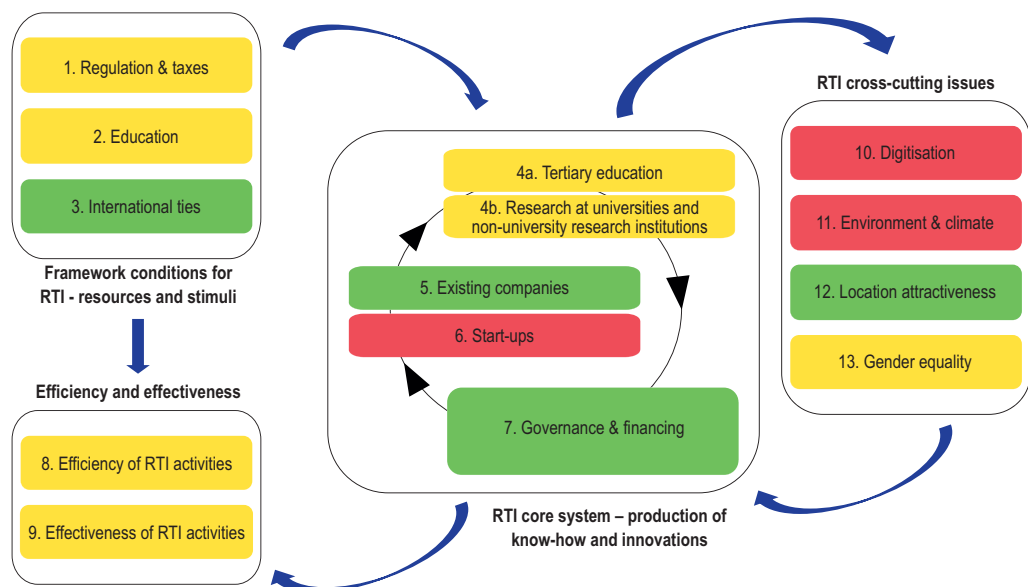
⁹ The Monitoring Index shows how in 2017/2018, on average Austria was just outside of the top one third of business locations, among the best 35.2 percent to be precise. Overall, this means Austria is rated better than 64.8 percent of the locations worldwide, but 35.2 percent are still ahead of Austria. Compared with 2015 and 2016 it has therefore fallen slightly. In 2005 some 77.1 percent of such locations were behind Austria, and only 22.9 percent ahead of it.

overview

compared with the leading innovation nations. The RTI system's strengths include the well-established international network, the high level of RTI support for existing companies and their notable performance, the generally above-average level of R&D financing and the above-average location attractiveness in relation to the comparison countries. The greatest weakness in the core RTI system is clearly the area of innovative start-ups; in the cross-cutting issues area, digitisation and climate and environmental protection in particular are the most problematic. In all sub-areas there are also specific challenges that impede an innovation performance improvement. The problem areas that the Austrian Council has already addressed several times in its previous

reports on Austria's scientific and technological capability must be mentioned here, beginning with parts of the education system, on to the framework conditions at the universities and research funding, and through to gender issues. The overview clearly shows how the Austrian RTI system by and large demonstrates solid performance. Nevertheless there is still catch-up potential in many sub-areas compared with the leading countries. The picture is somewhat different if we compare Austrian innovation performance with that of the European Union's member states or the respective best performers around the world. Table 2 shows the aggregated results of the strengths-weaknesses analysis for all sub-areas of the Austrian RTI system relative to the average EU performance (first column), to that of the

Figure 3: Strengths and weaknesses of the Austrian RTI system compared with the innovation leaders



Source: Janger, J. / Strauss-Kollin, A. (2020): Analysis of the performance of the Austrian RTI system. Study commissioned by the Austrian Council. Wifo, Vienna, p..

The colours reflect that of a traffic light and is defined as follows:
 ● green = Austria (AT) performs better than Innovation Leaders (IL);
 ● yellow = AT performs as well as IL;
 ● red = AT performs worse than IL.

innovation leaders (second column and figure 3) and to that of the respective top three (third column). Compared with the average EU level, Austria scores significantly better, and almost continuously so. Only one area stands out as below-average: Start-ups and growth. This area even shows acute weaknesses 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 (details in the “Start-ups” section). The Austrian level is indeed below the EU average, but with a smaller distance, in four sub-areas – regulation and taxes, digitisation, environment and climate, and gender equality. All other sub-areas mostly rank clearly above the levels of the comparison countries. If we compare Austria with the respective top

three in the world, unsurprisingly the picture looks significantly worse. From this perspective we can see that Austria only manages to join the group of best performers (globally speaking) in two sub-areas, namely the area of corporate research and innovation and the area of R&D expenditure (details are discussed in the “Corporate research and innovation in existing companies” section and in the “Governance and financing” section). It is also easy to see that Sweden appears disproportionately often in the global top three group. In the fifteen sub-areas examined the Scandinavian country ranks nine times at a global top position, and even ranks number one five times. Denmark is also in the top three six times and takes first place three times. Finland and Ireland follow

overview

Table 2: Strengths and weaknesses of the Austrian RTI system compared to the EU average, 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	81	69	(1) DK (2) IE (3) SE	17
Education	107	92	70	(1) FI (2) UK (3) SE	17
International ties	111	106	66	(1) LU (2) BE (3) EE	24
Core RTI system					
Tertiary education	105	91	61	(1) DK (2) PL (3) SE	21
Research at universities and non-university institutions	145	80	67	(1) CH (2) DK (3) NL	15
Corporate RTI	154	103	76	(1) SE (2) FI (3) AT	21
Start-ups and their growth	72	55	47	(1) DK (2) SE (3) NL	21
Governance & financing	165	143	105	(1) BE (2) AT (3) FR	24
RTI efficiency and effectiveness (impact)					
Innovation efficiency	122	95	68	(1) SE (2) DK (3) NL	13
Effectiveness & impact	112	94	68	(1) SE (2) DE (3) UK	22
RTI cross-cutting issues					
Digitisation	84	68	50	(1) SE (2) IE (3) DK	19
RTI climate	86	73	32	(1) DE (2) SI (3) RO	31
Location attractiveness	134	108	74	(1) IE (2) FI (3) CH	27
Gender equality	91	86	57	(1) RO (2) PL (3) LT	26

Source: WIFO.



overview

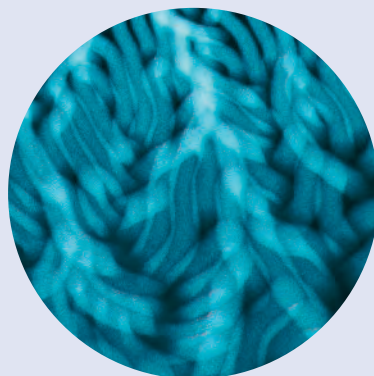
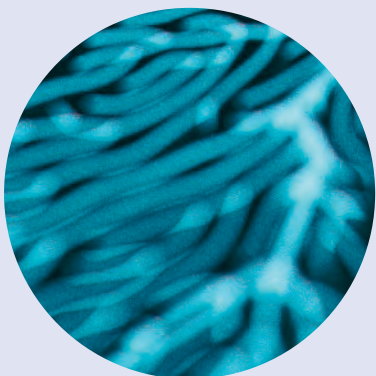
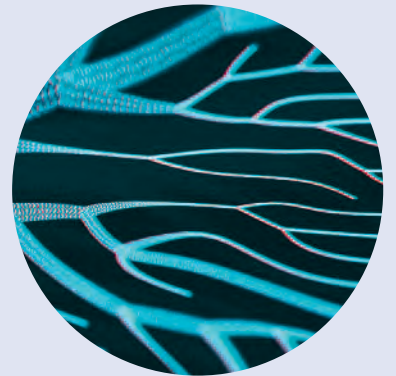
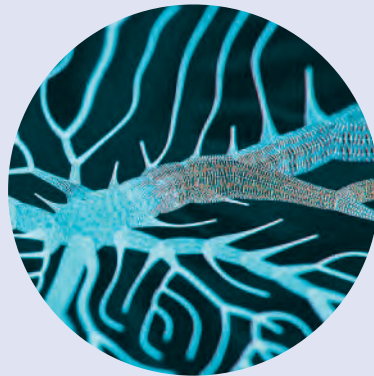
with four mentions each among the top three and first place once each.

Austria never makes it to number one, although the Austrian Council believes it certainly has the potential in some areas to join the absolute top worldwide.

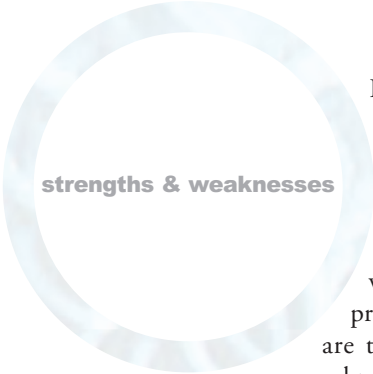
The Austrian Government's programme, for example, explicitly names the areas of climate and environmental protection and

digitisation as policy priorities in which Austria should play a forerunner role in Europe and the world.¹⁰ Specific investments and the creation of conducive framework conditions to achieve these ambitious objectives are therefore required accordingly. The RTI system acts in this respect as a key enabler, which is why it also requires the appropriate basic conditions to be able to provide the necessary stimuli.

¹⁰ Austrian Government (2020): *Aus Verantwortung für Österreich. Regierungsprogramm 2020–2024*. Vienna, pp. 102 ff. and pp. 316 ff.



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



If we consider the overall picture in figure 3 and the more detailed overview in table 2, it becomes evident that the results of the strengths-weaknesses analysis of the Austrian RTI system summarised herein by and large correspond with the results of the Austrian Council's previous reports. The known strength areas are therefore also opposed by the known weaknesses of those areas in which the Austri-

an Council has already found an acute need for action for some years now. The individual strengths, weaknesses and challenges compared with the leading innovation nations, Sweden, Finland, Denmark 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.



Framework conditions for RTI – Resources and stimuli

Regulation and taxes

Regulation and taxes are among the basic framework conditions and political steering instruments. Regulations, legislation, specifications and taxes regulate the daily life of citizens and companies and are important political instruments to promote individual, social and ecological well-being, as well as economic growth.¹¹ The European Commission and the Austrian Government have therefore also added regulatory and taxation policy highlights to their political agenda.¹² Taxes are of course among the most important instruments for a government to stimulate entrepreneurial initiatives, research and innovation.¹³ They can also contribute to entrepreneurial risk and reduce the costs of entrepreneurial activity, and taxation regulations can also remedy market failure (e.g. insufficient investments in R&D, risk financing and external effects such as environmental pollution). On the other hand well organised R&D tax incentives promote investments in the RTI system and the innovation produced in it.¹⁴

Some aspects from this area can generally also be categorized as location factors. All other things being equal, higher regulatory density and higher taxes therefore have a negative effect on a location's attractiveness. Naturally the details also depend on the specific shaping of the taxation and regulation system – the benefits that a burden might entail that is. A look at the indicators used for this report shows a rather below-average Austrian performance compared with the innovation leaders (see figure 4). The figure shows clearly how there is also only one

indicator at the leading countries level both in the regulation area and in the finance system and taxes areas; to some extent all other indicators are even significantly below the level of the innovation leaders – and in many cases even below the European average (details in table 3 in Annex 2).

With regard to regulation figure 4 shows both strengths and weaknesses. While with labour market regulation, for example, Austria sometimes scores better and sometimes worse compared with the comparison countries, in the product market regulation¹⁵ context the weaknesses clearly predominate. With regard to the regulations for the protection of intellectual property rights Austria is in a very good position, and not only in relation to the innovation leaders, but rather also to the best performers, Finland, Switzerland and the Netherlands (see table 3 in Annex 2 for this). However due to the respective geopolitical upheavals, the trade conflicts they entail and the resulting rise in problems with the protection of intellectual property rights, there is also still a need for greater attention to this issue and the adjustments underway in Austria.

The distance to the innovation leaders with the indicators for the finance system (especially risk capital intensity and capital market parameters) shown in figure 4 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

strengths & weaknesses

11 OECD (2018): OECD Regulatory Policy Outlook 2018. OECD Publishing, Paris, pp. 19 ff.

12 For this see the EU Commission's Better Regulation website: https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how_en

13 Keuschnigg, C. / Ecker, B. / Sardadvar, S. / Rainer, C. (2017): Innovationsland Österreich F&E: Unternehmensentwicklung und Standortattraktivität. Study commissioned by the Austrian Council. Vienna, pp. 60 ff.

14 See European Commission (2014): A Study on R&D Tax Incentives. European Commission Working Paper 52/2014.

15 The OECD has developed a series of indicators for regulating the product markets, both on economy level and sector level. These indicators measure the extent to which political framework conditions promote or impede competition in product market areas in which competition is possible.

strengths & weaknesses

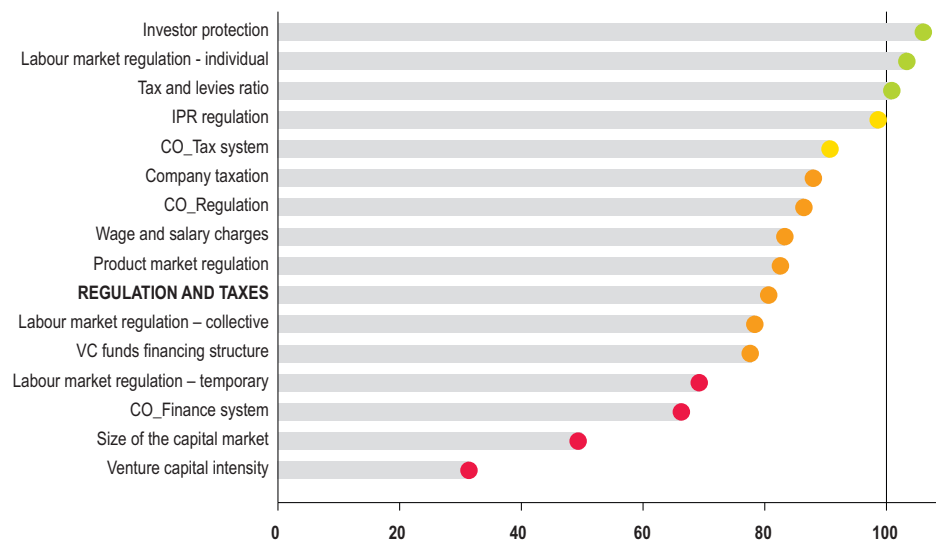
with venture investments are required (see the “Start-ups” and “Location attractiveness” sections).¹⁶

With regard to the tax and levies ratio it should be noted that international organisations such as the OECD or the IMF have repeatedly said that the total tax and levies burden in Austria is too high and therefore must be reduced.¹⁷ The results of international rankings (location) such as those of the IMD also indicate this.¹⁸ So in other words, the good scoring of the “Tax and levies ratio” indicator in no way implies a sat-

isfactory dynamic of this variable, but rather it must only be seen relative to the value of the leading innovation nations (Scandinavian), which almost continuously have a higher tax level than Austria (details in table 3 in Annex 2). This structure in particular emerges in connection with Austria as a social state, where in the international comparison Austria has a relatively generous social system with corresponding expenditure, which must be counter-financed with taxes. Pensions are one of the biggest systemic cost drivers here.

In conjunction with the too high tax and levies

Figure 4: Strengths and weaknesses in the regulation and taxes area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

16 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. / Ecker, B. / Sardadvar, S. / Rainer, C. (2017): Innovationsland Österreich F&E: Unternehmensentwicklung und Standortattraktivität. Study commissioned by the Austrian Council. Vienna.

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

18 IMD (2019): World Competitiveness Ranking 2019. Lausanne.

ratio, growth-unfriendly taxes such as those on income merit special mention, as they have a negative effect per se on a country's consumption structure (and therefore on growth).¹⁹ The high income tax could also entail negative effects on Austria's attractiveness for highly qualified researchers from abroad. Previous governments have not managed to achieve an appropriate compromise here. Ultimately the problem is also due to the fact that income and wage tax revenue is responsible for about one third of the total volume and a reduction would therefore result in massive payment failures.

There are several options on offer to relieve the high levies burden. In line with the OECD recommendations a shift to "growth-friendly" taxes is in particular advisable, and would include taxes on assets, for example.²⁰ A further possibility (rather obvious in the current situation), would be a higher taxation burden on harmful to the environment factors – the current government therefore also brought an aptly-named eco-social tax reform into play.²¹ Such a reform relieves the labour factor and burdens harmful to the environment activities. A double dividend could then be drawn down – more funds for private consumption (via higher net in-

come) with corresponding growth effects and lower environmental impact.²² Important here is that a systemic remodelling of the tax system is essential with a reform of this kind. Individual adjustments here and there must be avoided, as a holistic remodelling of the tax system is also required. Determining the macroeconomic effects of individual taxation measures is important here. Due to the comparatively easy implementation, the fuel oil tax (key word, "fuel tourism") or a CO₂ tax are obvious starting points for such a reform. But further-reaching mechanisms such as an "emission trading scheme" are also possible approaches in this respect.

Recommendations for the regulation and taxes area

In line with an increase in tax system efficiency and consonant with the recommendations of the most important international institutions, the Austrian Council recommends an inspection of the relevant reform steps with the goal of reducing Austria's overall tax and levies burden in the coming years and focusing on a future-oriented system. Ecological aspects must in

strengths & weaknesses

19 For this see OECD (2010): Taxes and Growth: Tax Policy Reform and Economic Growth, OECD Tax Policy Studies, No. 20, OECD Publishing, Paris.

20 Since there is a series of wealth taxes, which would basically apply for counterfinancing (general wealth tax, financial transaction tax, property tax, inheritance tax, among others), the question now is, which would be best? There is general consensus that wealth taxes on financial assets are inherently problematic because financial assets can be very easily moved into other countries (a revenue effect would therefore fizzle out). A general wealth tax by definition entails a levy problem. Many observers believe the most logical wealth tax is property tax, not least of all because in this context the problem of assessed values has not yet been resolved and an alignment with market values would definitely have potential for considerable added volume. Inheritance tax could also be considered in this context.

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

22 WIFO has examined the possible effects of an eco-social tax reform in Austria on greenhouse gas emissions, distribution and the economy based on a macroeconomic environment-energy model (see Kirchner, M. / Sommer, M. / Kratena, K. / Kletzan-Slamanig, D. / Kettner-Marx, C. (2018): CO₂ taxes, equity and the double dividend – Macroeconomic model simulations for Austria. In: Energy Policy, Volume 126, March 2019, pp. 295–314). The aptly-named "rebound effect" merits critical mention in this context, as it can result in the savings potential of efficiency improvements not being or only partially being realised. Efficiency improvement ensures the consumer has fewer expenses and therefore can procure further products, which in turn leads to increased consumption.




strengths & weaknesses

particular also be pushed more intensively to the fore here. In this respect the Austrian Council welcomes the objectives for eco-social tax reform anchored in the government programme, with which, in addition to the “greening” of the tax system required to achieve climate goals, a reduction of the tax and levies burden will also be implemented, which in turn has a beneficial effect on location attractiveness.

The Austrian Council also recommends to the Austrian Government that it actively support the EU Commission’s objectives and plans to protect and accelerate the enforcement of intellectual property rights. Furthermore the Austrian Council believes that with the integration of the relevant stakeholders and players of the domestic innovation system an Austrian position must be established, which would be introduced within the scope of the planned communication channels in political debates and the EU’s opinion formation processes. The Austrian Council also recommends measures be implemented at national and European level to reduce the drain

Education



Education and training are the foundation on which each and every person can shape their future. At the same time in their entirety they also form the basis for an economy and a society’s medium and long-term innovative capability and therefore the groundwork for a business location’s performance. The value of education in today’s world with its countless challenges therefore grows continuously in importance.²⁴ The results of this strengths-weaknesses analysis should therefore be a wake-up call for the Austrian education policy. This being because on

of patents from Austria and the EU and their economic exploitation in other countries, with the goal of improving strategic IPR utilisation, and in Austria in particular.²³

To strengthen the Austrian capital market the Austrian Council recommends the removal of taxation obstacles, the establishment of a robust capital market law for more legal certainty to build investor confidence and improve financial literacy via good investment principles. The capital market law must be reformed with the goal of creating internationally competitive framework conditions for affiliated companies. The Austrian Council also suggests further efforts to create a liquid stock exchange, on one hand to then make an IPO easier for successful start-ups and therefore facilitate a profitable exit for venture capitalists, and on the other hand to prevent favouring foreign stock exchanges (e.g. Frankfurt) and consequently to strengthen companies’ location commitment.

A detailed recommendation on the issue of risk capital intensity is provided in the “Start-ups” section.

the whole the capability of the domestic education system cannot keep up with that of the innovation leaders, as shown by figure 5, in spite of so many strengths, such as the amount of education investments, the above-average student-teacher ratio in primary education or the low number of early school leavers.²⁵ Across the board there is not one single sub-area of the education system with its performance above the level of the leading innovation nations. A serious structural problem of the Austrian education system also results in above-average high educa-

²³ See Austrian Council (2019): Recommendation for increasing the protection and exploitation of intellectual property rights of 16 Oct. 2019 Vienna.

²⁴ Klingholz, R. / Lutz, W. (2016): *Wer überlebt? Bildung entscheidet über die Zukunft der Menschheit*. Campus Verlag, Frankfurt am Main, New York.

²⁵ Compared with the respective top three in the world, Austria is only among the world’s leading countries concerning two of the indicators used: with the amount of education spending Austria is at third place globally; and with the percentage of career-oriented graduates it even takes first place (see Annex 2 for details).

tion inheritance and social selection²⁶ and in gender-related segregation into school types.²⁷ The Austrian schooling system has actually been familiar with this “separating element” of education for some time now and it is still additionally exacerbated by early selection in different education pathways.²⁸ The early segregation of children to grammar schools and secondary schools in particular damages the socially disadvantaged and weaker performance pupils and prevents these children’s individual talents from being discovered and developed, which has a detrimental effect on the economy.²⁹ The indicators³⁰ used for this report show clearly that the Austrian education system cannot manage to reduce or remove the negative effects of this early selection.³¹ This is true both in the comparison with the global top three and for the innovation leaders, as well as the EU aver-

age (see also table 4 in Annex 2). While in primary education with the values for “Low reading literacy” and for “Low maths & science competence” there are still no differences in relation to those of the innovation leaders, very significant distances are already visible in secondary education. We can then conclude that by the end of primary education the percentage of pupils with weak performances with reading and in maths is maintained at a level that corresponds with that of the leading innovation nations. The separation into grammar schools and secondary schools that happens with the transition from primary education to secondary education then, however, very quickly generates effects that in Austria result in a significant relegation of pupils with weak performances. At the same time of course, the effect often pos-

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26 The instance of high education inheritance is found across the entire education system. The vocational higher level schools, with which a significant correlation between the education level of parents and children cannot be established, are an exception here. See Austrian Council (2016): Report on Austria’s Scientific and Technological Capability 2016. Vienna, pp. 16 f. See also: Lassnigg, L. / Laimer, A. (2013): Berufsbildung in Österreich. Hintergrundbericht zum Nationalen Bildungsbericht 2012. Projektbericht des IHS, Wien, pp. 39–44.

27 Structural school system conditions also reinforce gender-related segregation into types of schools. Girls and boys must decide when still very young (mid-puberty) for more or less STEM-intensive school types. The research assumes that in this sensitive phase girls and boys in particular orient themselves on gender stereotypes and consequently deselect “gender-atypical” school types (such as purely technical schooling, e.g. higher technical institutes). It also shows that girls are frequently more broadly talented and oriented. See, e.g. Salchegger, S. / Glaeser, A. / Widauer, K. / Bitesnich, H. (2017): Warum besuchen Mädchen mit Spitzenleistungen in Mathematik so selten eine höhere technische Lehranstalt? Ursachen und Folgen von Geschlechterunterschieden bei der Schulwahl. In: Schlögl, P., et al. (ed.): Berufsbildung, eine Renaissance? WBV, Bielefeld, pp. 172–183.

28 This was even verified by the Austrian Government’s RTI Strategy 2011: “The education system segregates very early along training and education lines and selects access to education heavily oriented on social strata. In the absence of permeability of the education routes, this early selection determines the educational horizon of children and young people, and can scarcely be corrected later” (Austrian Government [2011]: Der Weg zum Innovation Leader. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 14).

29 For this see Keeley, B. (2010): Humankapital. Wie Wissen unser Leben bestimmt. Bonn: Licensed edition of the Bundeszentrale für Politische Bildung. P. 15 f. It should be added here that there is often a clear difference in level between secondary schools in the country and those in the big cities. However the indicators only apply to statements on the overall situation.

30 For senior classes and vocational training in particular there are no suitable indicators for the international comparison. Although the upper secondary level is important for qualifying to study and most of the recent graduates for RTI and IT are provided by the vocational schools, these issues cannot be adequately considered in this report.

31 Cf. footnote 26.

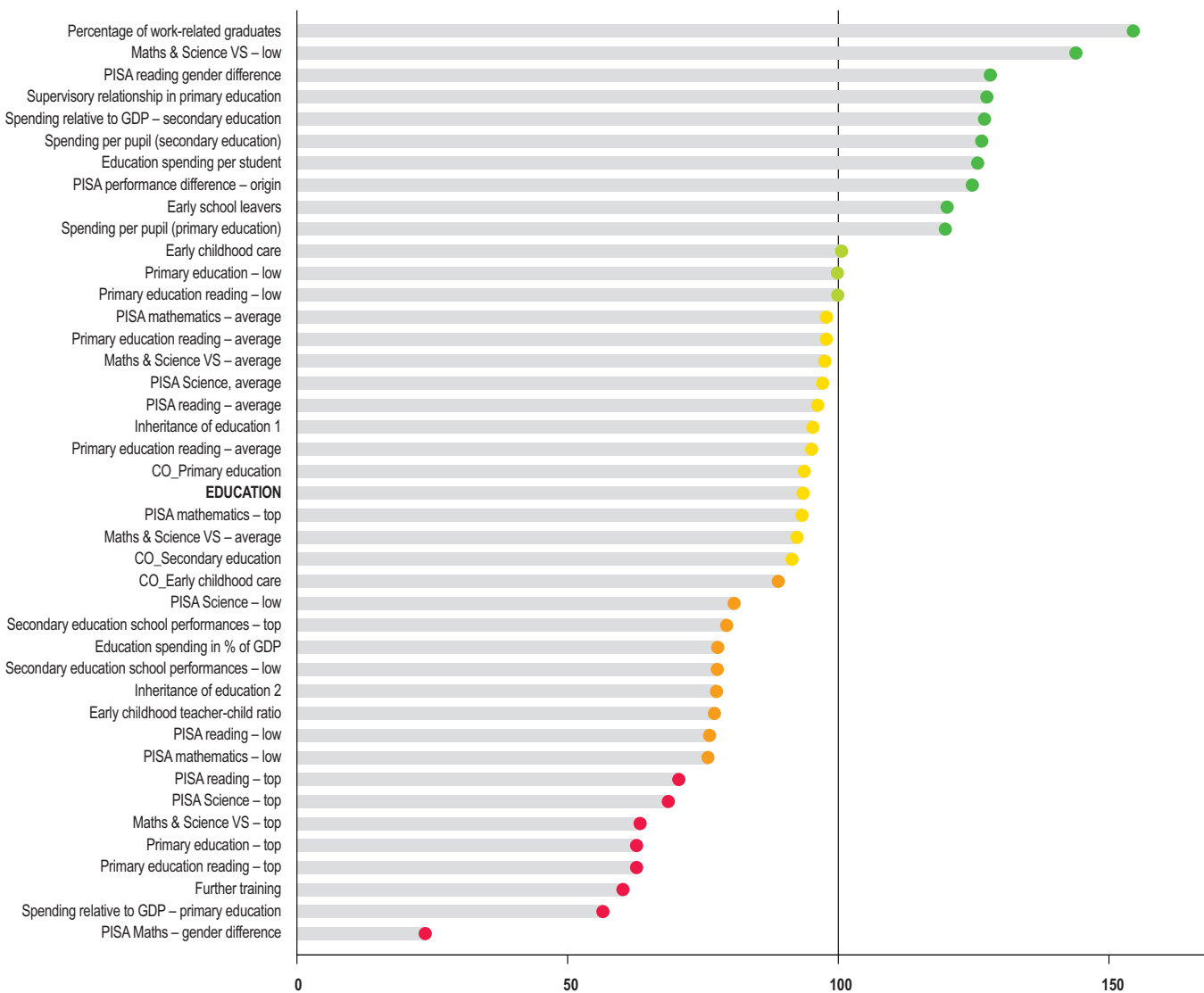


tulated as a reason for early selection, namely the performance increase of talented pupils, does not occur. The increase in pupils with top performances in reading, maths or the sciences to be expected for Austria in the international comparison does not happen either –

on the contrary: Austrian pupils are also comparably far behind with the “Reading – top” and “Science – top” indicators. The distance is only still on a reasonable level with “Maths – top”.

These results are especially critical because, as mentioned above, the international comparison

Figure 5: Strengths and weaknesses in the education area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

shows that with regard to spending per pupil, Austria has one of the most expensive schooling systems (details in table 4 in Annex 2). And yet in spite of the high education investments, evidently the corresponding results cannot be achieved with the resources used. Quite the contrary, as compared with the innovation leaders the school performances delivered are only below-average (see both the “School performances – high competence” and the “Competence – low” indicators). The results with regard to equal opportunity and social permeability³² are also far below the level of the leading countries and even below the European average (see the indicators for “Education inheritance” in Annex 2, table 4). The Austrian Council also believes this is due to an insufficient structure with the distribution of competences between federal and state level.³³ The Austrian Council believes measures such as the reintroduction of having to repeat a year from second class upwards included in 2018’s “Pädagogik-Paket” (“Education Package”)³⁴, performance groups or numerical marks are unsuitable to reform the education system sufficiently to enable a catch-up process aligned with the innovation leaders. The “reinforcement of social separating walls” (Stefan Hopmann³⁵) is far more of a threat, as neither the individual opportunities of disadvantaged children nor the framework conditions within the schools or even the school performances are improved. The special German classes introduced in 2018 and hastily implemented also appear to be an ineffective means to remedy language deficits in German with children who have another first language. Contrary to international experiences,

according to which multilingualism can also be used in the class as a resource and children with different first languages benefit from joint lessons, in Austria children and young people are socially isolated by the German class model. The “Curriculum Mehrsprachigkeit” (“Multilingualism Curriculum”)³⁶ framework model developed in Austria between 2011 and 2014, which should sensitise the (future) teacher vis-à-vis the multilingualism phenomenon and generate skills for them, which support them in their class work in heterogeneous classes that are often characterised by their social, cultural and linguistic diversity, is now in use in South Tyrol and Switzerland. Austria, however, took a route using separate special classes for German with mostly insufficient framework conditions (groups were too numerous, staff was under-qualified, lack of space). This is in total contrast to successful international models and the idea of an inclusive school.

In summary we can say that in the last two decades since the introduction of the PISA tests, a reduction of the distance to the leading countries in the education area has not been achieved. For some years now the Scandinavian countries in particular have shown solid education performance, which is also reflected in the results of international rankings.³⁷ The results of the strengths-weaknesses analysis summarised in table 2 also show that Sweden and Finland in particular are among the global best performers in the education area. Austria on the other hand, cannot increase the performance of its education system with its education spending which is by

strengths & weaknesses

32 In addition to the colleges, the possibility of vocational baccalaureate was also created to improve permeability, and was well received. Statements on its actual effects, however, cannot be made.

33 Although an initial attempt to streamline competences was actually made when the education boards were set up (see Boards of Education Establishment Act – BGBl. I no. 138/2017), this still appears to be insufficient. And it will only be possible to evaluate the actual effects in a few years.

34 Pädagogik-Paket (Education Package) 2018, https://www.bmbwf.gv.at/Themen/schule/schulrecht/erk/paedagogik_paket_2018.html

35 “Schulpaket stärkt ‘soziale Trennwände’”, <https://orf.at/stories/3042601/>

36 Krumm, H.-J. / Reich, H. (2011): Curriculum Mehrsprachigkeit. Vienna-Koblenz; Österreichisches Sprachen-Kompetenz-Zentrum / BMBF (2014): Basiskompetenzen Sprachliche Bildung für alle Lehrenden. Graz.

37 See, for example, OECD (2019): Education at a Glance, 2019: OECD Indicators. OECD Publishing, Paris.



strengths & weaknesses

far above-average in the global comparison, and cannot use the available resources efficiently and equal opportunities-oriented.

Recommendations for the education area

To increase the efficiency of the education system and to improve the individual future life-shaping opportunities of all pupils, the Austrian Council recommends the problem of education inheritance and across the board excessive social selectivity be prioritised on the basis of scientific findings. In this respect the Austrian Council recommends commitment to comprehensive schools for 10- to 14-year-olds with the appropriate implementation of the same and with simultaneous specific measures to raise the overall performance level. As the percentage of pupils that achieve top competences is already low in primary education, the Austrian Council recommends specific countermeasures here. In addition to a longer comprehensive school phase, this also requires the massive expansion

of interwoven all-day schools, the distribution of resources to schools according to a social and opportunities index, more funding for integration and an aggressive use of international experiences in dealing with pupils' multilingualism (with simultaneously improved framework conditions for support in learning German) and for improving gender equality.³⁸

To remedy the underlying problem of complex governance in the education system and the insufficient structure of the distribution of competences, the Austrian Council recommends a structural simplification and competencies streamlining³⁹ between federal and state level in favour of the federal.

In addition to these measures the Austrian Council also suggests evaluations for detailed issues and previous measures in the education area be performed, on the issue, for example, as to whether and how the introduction of vocational baccalaureate has improved social permeability or how the pivotal school leaving examinations have had an effect on the study level.

International ties

International ties are key for a small, open and very export-oriented economy such as Austria's. And yet an RTI system must have strong international interconnections to benefit from international knowledge flows – these can also happen on several levels, with research collaborations, mobility of students and employees, corporate collaborations, and even as part of economic trade relations (“disembodied and embodied knowledge”). According to Statistik Austria's foreign trade statistics, Austria earns more than 50 percent of its economic output

abroad.⁴⁰ This is also reflected in the performance of the indicators used for this report for the interconnections in the economy and innovation areas (see figure 6). In both areas Austria is predominantly above the level of the leading innovation nations (see also table 5 in Annex 2). The successful international ties of the Austrian economy, which are mapped for this report based on World Bank data (World Integrated Trade Solution), are especially noticeable. Only Ireland, Finland, Luxembourg, Belgium and Singapore are integrated more intensively into

³⁸ As international comparisons show again and again that there are countries where girls achieve better performances in maths than boys, the gender gaps especially conspicuous in Austria with basic competences and choice of education cannot be attributed to biological factors. The use of international experiences is therefore also recommended here. Gender and diversity competences on all levels of the school and education area, especially with teaching and teacher training, are generally required to more broadly activate children's and young people's potential. The recommendations of the Austrian University Conference on “the expansion of gender competence in university processes” (2018) also tend in this direction. See also the chapter on “Gender equality”.

³⁹ Cf. footnote 33.

⁴⁰ Statistik Austria (2020): Der Außenhandel Österreichs. Vorläufige Ergebnisse 2019. Vienna.

the global market. Austria is also behind Switzerland, the Netherlands, Belgium and Ireland in ETH Zürich's globalisation index ranking, where it ranks fifth.⁴¹

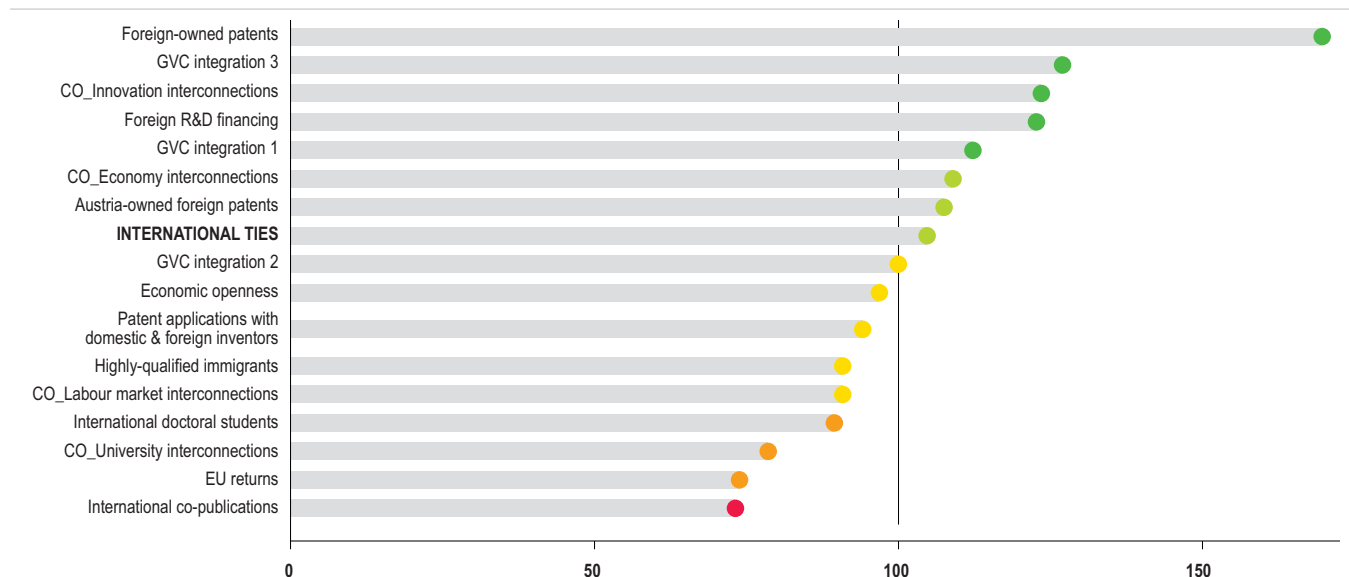
In the EU integration index, which measures the level of the member countries' integration into the European Single Market, since 2004 Austria has moved from seventh to third place.⁴² This is reflected in the relevant figures: According to Statistik Austria, in 2018 approximately 70 percent of Austrian foreign trade (imports/exports) was transacted with EU member states. This is basically very welcome news, however from a global point of view, numerous regions outside of Europe are in a serious catch-up process, which is why these developments (especially in the Asian region), must be examined more closely than has previously been the case.

Indeed the global networking of Austrian research institutions is also highly relevant in the

academic area as well. The results of the strengths-weaknesses analysis here show how the interconnection of domestic universities is significantly below the level of the innovation leaders (see figure 6). The global best performers in this respect include Switzerland, Luxembourg, Denmark and the Netherlands (see also table 5 in Annex 2). As an EU member, however, Austria is also robustly integrated into the European research area. The EU and its research policy are therefore relevant for Austria and have a significant influence on the Austrian RTI landscape. The "EU return" indicator, which traces the participation in the research framework programmes, is correspondingly above the EU member states' average level – and has been quite stable for some years now. A significantly higher level of allocations can be observed for the 2014 to 2018 period in particular.

strengths & weaknesses

Figure 6: Strengths and weaknesses in the international ties area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with "CO_" prefix (= "Composite").

41 See <https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html>

42 <http://www.eu-index.uni-goettingen.de/?p=80>



strengths & weaknesses

Due to opposing developments with allocations and Austria's national budget shares, however, a slightly regressive value was registered here recently. But compared with the innovation leaders the Austrian return quota is constantly lower over the period. The Netherlands are largely responsible for this, as they participate disproportionately high and very successfully in the framework programmes (details in table 5 in Annex 2).

Recommendations for the international networking area

To specifically counteract the weakening development trend with the return quota from the European research framework programmes, the Austrian Council recommends the existing and well established support and consulting services for the domestic research community be goal-oriented further expanded in all aspects relevant to the European programme, while also further

developing existing services. With regard to networking and co-shaping, participation of domestic experts on European committees and work platforms must be made more attractive with suitable measures.

The Austrian Council also recommends setting up specific initiatives and creating better framework conditions to support the universities with their internationalisation activities, to offer researchers the temporal and financial freedom required for a successful international cooperation and consequently to strengthen the Austria research location in both the international and the European network.⁴³

The Austrian Council reiterates its recommendation for the specific expansion of scientific representations in countries with strategic importance for the domestic innovation system.⁴⁴ Greater use of synergies and better coordination of science representations with external representations of other RTI players, and those of the WKO, must be pushed ahead here.



⁴³ See inter alia, Austrian Council (2017): Recommendation on the way to the forefront of innovation of 30 Nov. 2017.

⁴⁴ See Austrian Council (2015): Report on Austria's Scientific and Technological Capability 2015. Vienna, p. 70.

Core RTI system – Knowledge and innovation production

Tertiary education

The demand for highly-qualified labour is high and will continue to grow intensively around the globe in the coming years, especially in the technology and IT areas.⁴⁵ A socially just and equal opportunity access to the tertiary education sector and an attractive studies offering are essential basic requirements to be able to cover this demand in line with social and economic exigencies. Top-quality technical education (training) and the strengthening of transversal competences (e.g. strategic and innovative thinking, emotional intelligence, cross-cultural skills and global awareness) also have a positive effect on individual employability; their importance also increases continually in guaranteeing a country's innovation and competitiveness, as well as its social well-being.⁴⁶

A good indication for this is provided by employment rate data, for example, which for university graduates is 84.5 percent and therefore currently 11.5 percentage points above the Austrian average⁴⁷, as does a comparison of the median income according to educational attainment, which for university graduates is approximately 40 percent above the average gross annual income.⁴⁸

In this respect the results of this analysis are

therefore cause for concern, given that in the international comparison there are without doubt areas in which Austria's tertiary education system surpasses the level of the leading innovation nations – namely the relatively high number of STEM and technology graduates.⁴⁹ On the whole, however, the areas in which the performance of domestic third level education is indeed clearly below that of the comparison countries predominate, as shown clearly in figure 7.

As positive as the picture for the technology and STEM graduate areas may be, it is just as regrettable that on the whole Austria is clearly below the level of the leading countries with regard to the percentage of university graduates. This in particular applies with the “University graduates (ISCED 6-8)” indicator, which by far has the worst value for this area. This is all the more critical, as the percentage of university graduates (ISCED 6-8) in the cohort of the 30 to 34-year-old is only 25.7 percent and therefore even in the EU comparison ranks in the lower third.⁵⁰ In the broader “University graduates” indicator⁵¹, which also incorporates graduates of vocational higher level schools, the distance to the innovation leaders is lower, but there is also catch-up requirement.

strengths & weaknesses

45 See OECD (2019): OECD Employment Outlook 2019: The Future of Work. OECD Publishing, Paris.

46 Hanushek, E. A. / Woessmann, L. (2020): Education, Knowledge capital, and economic growth. In: Bradley, S. / Green, C. (eds.): The Economics of Education. A Comprehensive Overview. Academic Press, London, pp. 171–182.

47 The average total employment rate in Austria in 2018 was 73 percent in the 15-64 age group. For the population group with tertiary education (ISCED 5–8) the employment rate is 84.5 percent and therefore almost 40 percentage points above that of the population group with compulsory schooling (48.2 percent) (secondary level I, ISCED 0–2). Eurostat: Employment rates by sex, age and educational attainment level (%).

48 Cf. Austrian Court of Auditors (2018): Allgemeiner Einkommensbericht 2018. Series “EINKOMMEN 2018/1”. Vienna, table 60: Average gross annual income of full-year full-time employees according to educational achievement and gender, 2017.

49 The low percentage of women with ICT graduates must, however, be highlighted in this respect (see the “Digitisation” section).

50 It should be noted that structural differences of the comparison countries with regard to the delimitation of the higher education sector from the secondary education sector allow for some scope for interpretation. “Short cycle” programmes at universities, for example, are also lacking.

51 ISCED 5–8.

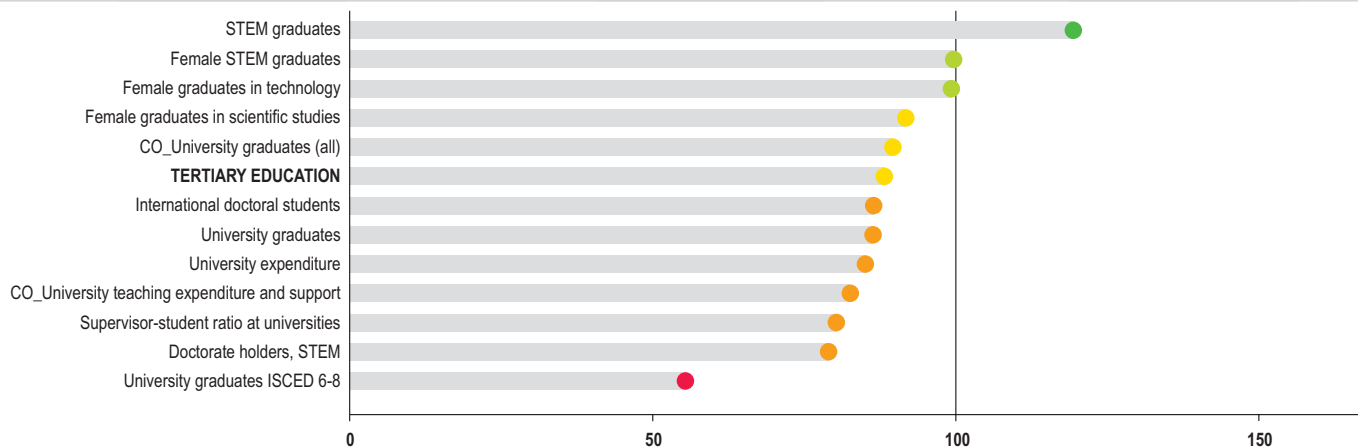
strengths & weaknesses

The increasing participation in the tertiary education sector and rising student numbers over the past 10 to 15 years are therefore a very positive development, attributable to higher transfer rates after secondary school graduation and a high number of foreign students.⁵² The positive trend with the increase in graduate numbers is also important for the employment rate mentioned at the beginning.

The Austrian Council believes the strategic further development of the higher education area⁵³ anchored in the government programme should therefore continue to pursue two key goals with increased emphasis: Firstly the universities must be equipped with sufficient resources to align the framework conditions with the leading inno-

vation nations with regard to financing levels, supervision ratios and infrastructure, etc. Secondly the student flows must be managed more effectively, which would in particular require a swifter expansion of the universities of applied sciences sector, in order to ensure the additional requirement for study places in demand for the medium-to long-term (see also the “Efficiency of RTI activities” section).⁵⁴ Therefore it is crucial that the range of subjects at the universities of applied sciences be further developed and broadened. At the same time a HR development strategy must also be drafted, which focuses on a greater pool of full-time teaching staff, with which this expansion can be ensured in the appropriate quality and quantity. A long-term secured and stable financing development should support the goal defined

Figure 7: Strengths and weaknesses in the tertiary education area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

⁵² In the past three years, for demographic reasons (falling secondary school graduate numbers) a slight decline in student and beginner numbers at universities was actually registered. However, a further increase is expected for the long-term.

See Statistik Austria (2017): Statistik Austria 2017 university forecasts commissioned by the Federal Ministry of Science, Research and Economic Affairs, November 2017. Uni:data, evaluations, beginners.

⁵³ Austrian Government (2020): Aus Verantwortung für Österreich. Regierungsprogramm 2020–2024. Vienna, pp. 304 ff.

⁵⁴ See Austrian Council (2017): Recommendation for the further development of the universities of applied sciences sector in the Austrian education and science system of 30 May 2017.

in the framework concept for the higher education plan of increasing the percentage of technical college students towards 40 percent.⁵⁵

An increase in higher education expenditure therefore continues to be urgently required if the quality of teaching and research is to be guaranteed. The expenditure for the higher education sector could actually be significantly increased in the comparison period and has average annual growth of 3.36 percent. Due to the also increasing access rates over the last decade and in places even higher investments in the comparison countries, Austria is nevertheless still clearly behind the group of innovation leaders (see figure 7).

The supervisor-student ratios are directly connected with the budget for the universities. In this respect Austria is clearly behind the innovation leaders and up to 2017 even had a negative dynamic. The university budget increase in the current performance agreement period (PA 2019-2021) by an average 13 percent could enable a trend reversal, as greater focus was made on the improvement of the supervisor-student ratios and the expansion of scientific staff. However, to enable strong Austrian universities to compete on an equal footing with the leading universities in Europe, further appropriate adjustments to the budget in the following periods are also urgently required.

The effects of the changing framework conditions (capacity-oriented study place financing, increase in the number of scientific employees, regulation of the new university places) can only be gauged and evaluated in a few years. Further improvements are nevertheless 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).

Reference was mostly recently made to the, in relation to the innovation leaders, only very slightly increasing percentage of international doctoral students at Austrian universities. The Netherlands (with 43 percent), Sweden and Denmark (with 35 percent each) are clearly more successful than Austria in this research-relevant indicator. And Finland, whose percentage of international doctoral students at approximately 22 percent is actually still about eight percentage points behind Austria, also succeeded over the last ten years in almost tripling this share. The lower value for Austria is therefore also remarkable because the rate of international participants in bachelor and master studies at domestic universities is among the highest in Europe and significantly above that of the innovation leaders.⁵⁶ This development has negative effects on the science location in several ways. On one hand this is an indicator that the research conditions in Austria appear to be less attractive for young scientists than with the innovation leaders or the top three countries, Luxembourg, Switzerland and the Netherlands (see also table 6 in Annex 2). Worth mentioning here are, among others, the offering of structured doctoral programmes, attractive career posts or sufficiently interesting research funding offers. On the other hand, due to the empirically high research and publication activity of this researcher group, this also continues to have a negative effect on the output indicators, such as the number of publications or securing third party funds (see the “Research at universities and non-university institutions” section). These highly qualified researchers are also lacking on the domestic labour market, and especially in the corporate research area.

strengths & weaknesses

55 See the expert report on the university plan by Loprieno, A. / Menzel, E. / Schenker-Wicki, A. (2011): Zur Entwicklung und Dynamisierung der österreichischen Hochschullandschaft – eine Außensicht. Rahmenkonzept für einen Hochschulplan. Basel – Mülheim an der Ruhr – Zurich, p. 55.

56 OECD (2019): Education at a Glance 2019. OECD Publishing, Paris, p. 242, table B6.1: “Mobility of international and foreign participants in education in the tertiary area.”



strengths & weaknesses

Recommendations for the tertiary education area

The Austrian Council believes it is urgently necessary to accelerate measures for the structural further development of the Austrian higher education area. To this end the tasks and functions of universities and universities of applied sciences must be strategically coordinated with one another more intensively than before. It is also important that the profiling of the universities be driven forward and international visibility be increased.

As a basis here and for the urgently required investments in the higher education sector the Austrian Council recommends the goal of a university expenditure rate of two percent of GDP continue to be pursued with increased emphasis. The poor supervision ratio in many study programmes is one of the main reasons for longer study times and high drop-out numbers. The Austrian Council therefore recommends, in addition to the introduction and consistent implementation of a capacity and quality-oriented study place management, the number of scientific staff required in the study programmes affected also be increased to an internationally comparable level and that appropriate positions be set up at the higher education institutes.

To further improve the study conditions at the universities, and especially in study fields with lower supervision capacities and insufficient in-

frastructure, and to increase the number of graduates, the Austrian Council recommends further reinforcing and improving suitable measures, such as study guidance and information, acceptance and access regulations and building up teaching and research staff. A clear and transparent differentiation of education and training goals in the higher education sectors should contribute to better student orientation to steer them to the study places suitable for them and to enable efficient courses of study.

Necessary capacities and infrastructures at universities and universities of applied sciences should, where allowed by prospective studies, be built up in line with the future interests, requirements and demands of students, society and the economy. To leverage students' existing potential, the studies support system must be further developed with regard to its social accuracy and socially just study access.

The Austrian Council recommends an increase in the number of technical college study places in the study fields in demand, appropriate HR and infrastructure equipping and a sufficient number of career posts in order to achieve the required teaching and research capacity and to promptly meet the existing requirement for specialists. The goal of a forty percent share of technical college students should be more ambitiously pursued than has previously been the case.⁵⁷

Research at universities and non-university Institutions

Public research institutions (universities, universities of applied sciences and non-university research institutes) are an essential pillar of the innovation system. Their key tasks include the generation of knowledge, its dissemination and application in the economy and society, and the training of highly qualified graduates.⁵⁸ The shaping

of effective and efficient framework conditions for research at universities and non-university research institutions is therefore an essential basic requirement for a successful RTI policy.⁵⁹

The results of the strengths-weaknesses analysis are correspondingly problematic for the Austrian RTI system. This shows that Austria is

⁵⁷ See Austrian Council (2017): Recommendation for the further development of the universities of applied sciences sector in the Austrian education and science system of 30 May 2017 Vienna.

⁵⁸ See Austrian Council (2015, ed.): Designing the Future. Economic, Societal and Political Dimensions of Innovation. Echomedia Verlag, Vienna.

⁵⁹ See Austrian Council (2017, ed.): Zukunft und Aufgaben der Hochschulen: Digitalisierung – Internationalisierung – Differenzierung. LIT Verlag, Münster-Vienna.

actually just about at the level of the leading countries in individual sub-areas, but it does not actually reach or surpass it in one single sub-area (see figure 8).

The input indicators score best: Generally speaking the Austrian R&D quota of 3.19 percent is one of the highest worldwide; Europe-wide only Sweden is ahead of Austria (see the “Governance and financing” section). If we consider the R&D expenditure in the higher education sector we see how in this respect Austria is at a relatively high level compared with the innovation leaders. The growth rate of the past ten years is at an average of 0.12 percentage points above that of the leading countries: Between 2007 and 2017 higher education expenditure in Austria rose by more than 50 per-

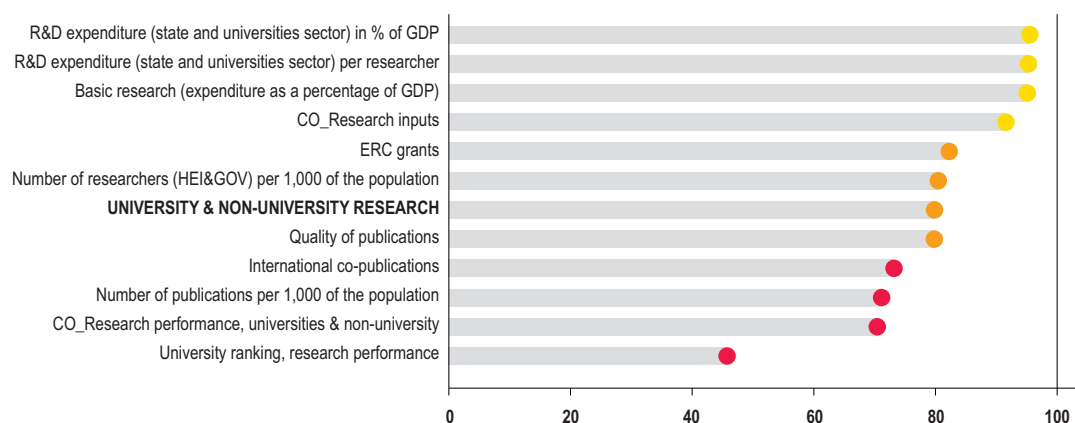
cent to approximately EUR 2.5 billion.⁶⁰

In the state sector, which from 2017 also included non-university research⁶¹, the expenditure for research in 2017 was approximately EUR 800 million. With a financing share of 0.93 percent of GDP for the two sectors, Austria is thankfully in the innovation leaders group (details in table 7, Annex 2).

Also positive here is the fact that more and more people are interested in becoming researchers. Currently two out of every 1,000 inhabitants work in research at universities and non-university research institutions. Austria is therefore still clearly behind the top countries, Iceland, Norway and Denmark⁶², which each have more than three researchers per 1,000 in-

strengths & weaknesses

Figure 8: Strengths and weaknesses in the universities and non-university institutions area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

60 Expenditure for research and experimental development (R&D) 2017 according to implementing sectors/survey areas and types of expenditure. Statistik Austria, last change on 18 Dec. 2019.

61 State sector: Federal institutions (with the exclusion of those grouped in the university sector), state, local authority and professional association institutions, R&D facilities of social insurance agencies, financed by the public sector and/or controlled private non-profit institutions as well as R&D facilities of the Ludwig Boltzmann Institute; from 2017 including Austrian Academy of Sciences and AIT Austrian Institute of Technology GmbH; including regional hospitals.

62 In each of the top countries, Iceland, Norway and Denmark, there are significantly more than 3 researchers per 1,000 inhabitants.



strengths & weaknesses

habitants; due to the high increase rates in recent years the distance to the group of innovation leaders was, however, successively reduced (see Annex 2, table 7). With an annual increase rate of approximately five percent, the expenditure per researcher is also now in the area of the comparison group.

With 0.54 percent of GDP, the data on public expenditure for basic research also shows that Austria is in the area of the innovation leaders. With this value, however, the basic research expenditure is behind the goal of 0.94 percent of GDP formulated in the RTI Strategy 2020. With 1.47 percent Switzerland is the undisputed leader here. This sustainably strong financing of basic research is a weighted factor for Switzerland's excellent research performance – parallel with the investments in research infrastructures, a high percentage of foreign doctoral students and a high level of more competitive project funding. This outstanding performance by the Swiss Confederation is also expressed in the results of the strengths-weaknesses analysis: Switzerland enjoys first place worldwide in all sub-categories for this sub-area of the RTI system (see table 7 in Annex 2). Switzerland is also the undisputed world leader with the allocation of competitive basic research funding. By contrast the comparatively low volume of this area in Austria is a persistent shortcoming. Austria is far below the average here in relation to the global top three – Switzerland, Finland and Sweden –, and the distance is also considerable compared with the average level of the innovation leaders. Austria therefore spends less than EUR 30 per inhabitant for these budget items, while the innovation leaders' average is more than EUR 70. Despite the fact that the Austrian Council has topicalized this undesirable development for some years now, the percentage of competitive basic research funding from overall financing has not increased. Compared with the leading countries a negative de-

velopment was even observed over the past fifteen years (details in table 7 in Annex 2).

The adverse development of the public sector's funding priorities in the RTI system and insufficient funds for competitive research funding, combined with obstructive framework conditions (high number of students in relation to professors/science staff and partially insufficient infrastructure) in higher education, and at the universities in particular, have a negative effect on research performance. Compared with the leading innovation nations, the indicators used in this respect consequently show significantly weaker research performance in some places. In individual discipline rankings, some universities actually occupy leading positions, but to a marginal degree. Measured on the scientific output (number and quality of publications), in the international comparison Austria's universities at best achieve mid-field positions on the whole. These findings are confirmed by an analysis of the scientific impact in 35 disciplines at Austria's universities.⁶³

The number of ERC grants acquired is a further gauge for the research performance and international success of researchers. Researchers at Austrian research institutions are above-average successful here compared with the EU member states, and the number of projects granted has increased annually by more than nine percent since 2009 (for details see Annex 2, table 7). As shown by figure 8, in relation to the innovation leaders Austrian performance is, however, significantly worse. Austria's distance to the leading innovation nations is also continually greater, as it has increased even more intensively over the respective period. There has also been considerable catch-up potential to the global top performers, Switzerland, Israel and the Netherlands, for some years now.

Beyond the scope of already on-going measures to improve the framework conditions, such as the study funding introduced at the begin-

⁶³ Austrian Council (2019): Report on Austria's Scientific and Technological Capability 2019, pp. 35 ff.

ning of the current 2019-2021 performance agreement period⁶⁴, the further increase in research funding and financing to the level of the leading countries, specific measures for controlling student flows and an effective increase in the number of professors and scientific staff should be more vigorously made the top priorities on the RTI policy agenda. These measures could start a positive dynamic, which would have an enhancing effect on research performance and the scientific output. This would however require both an accelerated commitment to strengthening the research conditions in the entire higher education sector and the long-term securing of the investments this entails.

Recommendations for the research at universities and non-university institutions area

A strong research environment is an essential location factor for the internationally attractive Austria research location. The public sector must in particular focus here on basic research funding, which is found at the beginning of every value creation chain, entails a high success risk, and therefore is only performed marginally by corporate research. The Austrian Council therefore recommends the commitment to strengthening the science location specified once again in the government programme be bolstered by a significant increase in the funds awarded in competition to finance basic re-

Corporate research and innovation in existing companies

The overriding objectives of RTI policy strategies include the promotion of technological progress to consequently increase international competitiveness and guarantee increased prosperity for a society.⁶⁶ The European Union, for example, defines the goal of the RTI policy

search to the level of the leading nations. The Austrian Council's recommendation for the implementation of the excellence initiatives is once again directed at the Austrian Government and should be financed as part of an ambitious RTI Strategy 2030 in the proposed scope.⁶⁵

The framework conditions for researchers must be improved to increase the scientific output. In addition to the current beefing up of posts for professors, the Austrian Council recommends that a massive expansion of jobs for PhD students also be enabled by extending the structured doctoral programme. An additional career development option is created here with the funding of cooperative doctoral studies recently introduced in the Austrian Science Fund's portfolio, which will be run jointly by universities and universities of applied sciences. The modernisation of the research infrastructure must continue to be driven forward, strategically coordinated with long-term plannability and funding certainty. In addition to the research-relevant conditions at national level, an attractive environment for international researchers also includes the ability to participate in international top research. Existing obstacles should be removed with regulatory legislation (Foreign Labour Act, the AusIBG) to promote a productive exchange of knowledge ("brain circulation").

herein as strengthening the scientific and technological bases of European industry and promoting the development of its international competitiveness.⁶⁷ And in its RTI Strategy 2011 the Austrian Government also specified that it intended to, "further develop the potential of

strengths & weaknesses

64 University funding from federal funds, UG § 12f.

65 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.

66 See the articles in the third part of this book: Austrian Council (2015, ed.): Designing the Future. Economic, Societal and Political Dimensions of Innovation. Echomedia Verlag, Vienna.

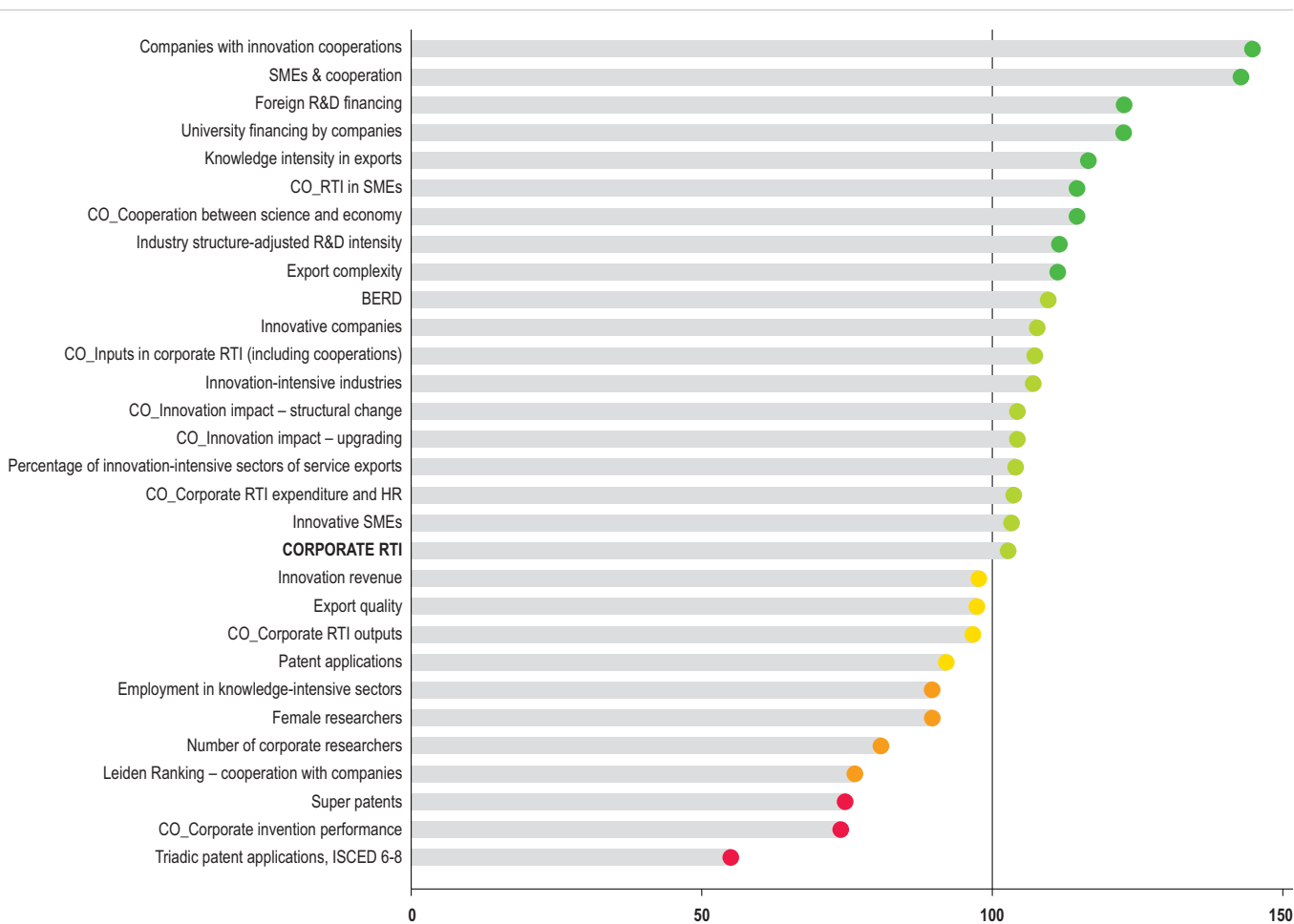
67 European Parliament (2019): Brief illustrations for the European Union – Research and technology policies. <https://www.europarl.europa.eu/factsheets/de/sheet/66/forschungs-und-technologiepolitik>



science, research, technology and innovation in Austria and employ it in its entirety to meet the social and economic challenges of the future [...] and to consequently strengthen the competitiveness of our economy and increase the prosperity of our society”.⁶⁸

Measured by these standards, the performance of the Austrian RTI system is above-average high. On the whole and compared with the innovation leaders, the “Corporate research and innovation in existing companies” area is the most successful sub-area of the domestic RTI system. As shown clearly in figure 9, the major-

Figure 9: Strengths and weaknesses in the corporate research and innovation in existing companies area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

⁶⁸ Austrian Government (2011): Der Weg zum Innovation Leader. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, p. 9.

ity of the twenty indicators used for this sub-area are to some degree even significantly above the level of the leading innovation nations. Particular emphasis must be afforded here to the pronounced culture of cooperation between science and economy, the high R&D intensity of the domestic economy and the above-average export strength in the area of knowledge-intensive and medium and high-tech products. Another eight indicators are almost at the same level as that of the comparison countries or just below. This category, for example, includes the number of patent applications or the revenue that Austrian companies generate with innovations. One especially important area for the evaluation of corporate innovation performance, however, exhibits a massive distance to the innovation leaders: that of the two indicators to map the quality of inventions – triadic patent applications and the aptly-named “super patents”.

Austria is relatively well positioned with the indicators defined as inputs for RTI in companies. The R&D expenditure for corporate research is clearly above the level of the comparison countries. The high level of corporate funding must also be referred to in this respect, as it is significantly above the level of the innovation leaders (see the “Location attractiveness” section). The percentage of foreign-funded R&D is also very high in Austria, whereby a regressive trend can be seen here in the comparison period. With regard to the employment figures in corporate research, Austria actually scores somewhat poorer than the leading countries – but on the whole, the performance is sufficient for Austria to enjoy success here compared with the global best performers.

The good scoring of the domestic SMEs must

also be emphasised. Comparatively speaking the Austrian medium-sized sector is clearly innovative, as shown by the positive course of the relevant indicators (see table 8 in Annex 2). Due to the small-scale structure of the Austrian economy, the sector therefore contributes significantly to increasing the national innovation performance.

The long-standing “lighthouse” in the corporate area (the cooperation between science and economy) is also still significantly above the average level of the innovation leaders. The indicators relevant here are at a top level, as shown in figure 9. Austria also makes it into the top three on the global level (see Annex 2, table 8). The development trends of the last ten years are thoroughly positive and above the comparison countries’ average. This illustrates how the culture of cooperation in Austria has also developed exceptionally well due to appropriate funding mechanisms.

On the output side this is opposed by a low number of patent applications for inventions with a greater technological scope, which can also introduce a corresponding structure change. These are recorded with the “Triadic patent applications” and “Super patents” indicators. The latter designate patents for revolutionary inventions.⁶⁹ The triadic patents are patent applications to all three of the most important patent offices in the world in Japan, the USA and Europe, which suggest high quality and advanced technological maturity of the patented inventions.⁷⁰ Austria is clearly below the level of the innovation leaders here and even more significantly below that of the global top three, Japan, Switzerland and the Netherlands (see also table 8, Annex 2).

strengths & weaknesses

69 Reinstaller, A. / Reschenhofer, P. (2019): Der Beitrag österreichischer Erfindungen zur Entwicklung von Schlüsseltechnologien. Ergebnisse auf der Grundlage eines neuen Patentanzeigers. Study commissioned by the Austrian Council. Vienna.

70 Unterlass, F. / Hranayai, K. / Reinstaller, A. (2013): Patentindikatoren zur Bewertung der erfinderischen Leistung in Österreich. Study commissioned by the Austrian Council. Vienna, pp. 40 f.

strengths & weaknesses

An increase in patent activity in the context of technologically important inventions should therefore be an important goal of the new RTI Strategy 2030, as these can both heavily influence the development of individual companies and also contribute to the improvement of a country's innovation performance.⁷¹ Empirical studies show that the joint effect of higher public and private research expenditure (in particular in basic research as well) significantly increases the number of inventions and patent applications. The resulting innovations in turn accelerate the structural change and are crucial for a technologically advanced country's success in international competition: "The results suggest that investments in basic research have an important effect on innovation performances at the technological frontier."⁷²

Recommendations for the corporate research and innovation in existing companies area

The Austrian Council recommends the existing and well established framework conditions for research and innovation in the corporate sector be improved even more with a further developed combination of innovation-friendly regulations and taxes (see also the "Regulation and taxes" section). To this end a holistic concept that also ensures the positive development of corporate research and innovation in Austria in the future must be worked out as part of the new RTI Strat-

egy 2030. In this context the Austrian Council also recommends an innovation model be designed, which also promotes "more radical" plans, such as alternative approaches to green innovation, a recycling economy, more frugal and social innovation, etc.⁷³

To support the technological structure change, the Austrian Council recommends the established approaches to research funding be checked for options of taking added risk with the funding of risky projects. Alternative awarding models that result in an adjustment of the criteria and mechanisms applied with the project evaluation should also be checked. On the whole the access to funding and subsidies for radical innovators must be made easier.⁷⁴ For this, relevant incentive structures at governance level must also be improved.⁷⁵

Based on the regressive development of the share of foreign-funded R&D the Austrian Council recommends checking the effects of existing initiatives to relocate research centres in Austria, and in particular the FFG's Headquarter Programme. An adjustment or the development of new approaches might be required here. However the key factors of location attractiveness must in particular be optimised (see the "Location attractiveness" section). Priorities here include the number and quality of graduates, the excellence of university research and the scientific outputs, or even the functioning of the IPR regulation.

71 For this see Keuschnigg, C. / Ecker, B. / Sardadvar, S. / Rainer, C. (2017): Innovationsland Österreich F&E: Unternehmensentwicklung und Standortattraktivität. Study commissioned by the Austrian Council. Vienna, pp. 62 ff.

72 Keuschnigg, C. / Kogler, M. (2014): Der Zusammenhang von Akademikerquote, Beschäftigung und Wachstum. IHS Policy Brief, no. 4, April 2014, p. 8.

73 See Austrian Council (2019): Report on Austria's Scientific and Technological Capability 2019, p. 22; idem (2015): Report on Austria's Scientific and Technological Capability 2015, pp. 57 f.

74 See Dachs, B. / Kalcik, R. / Wasserbacher, D. (2019): Radikale Innovation und Firmenalter. Study commissioned by the Austrian Council. Vienna, pp. 27 f.

75 See also Austrian Council (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation in Österreich. Vienna, p. 21.

A detailed recommendation to further increase graduate numbers is provided in the “Tertiary education” section.

A detailed recommendation on increasing the quality of the scientific output is provided in the

“Research at universities and non-university institutions” section.

A detailed recommendation on the IPR regulation issue is provided in the “Regulation and taxes” section.

strengths & weaknesses

Start-ups

The founding of young, innovative and knowledge-intensive companies is a key factor for an economy’s dynamic development.⁷⁶ Start-ups make a key contribution to accelerating structural change. It is not surprising then that the foundation of innovative start-ups area has been the focus of international RTI policy attention for some years now.⁷⁷ When adopting the RTI Strategy 2011 the Austrian Government also already defined the issue as a priority area of action on its RTI policy agenda.⁷⁸

Although a number of measures have been implemented in recent years with regard to start-up regulation, the Austrian RTI system continues to exhibit significant deficits in this area. Austria also continues to score quite poorly with the start-up activity indicators used for this report. As shown in figure 10, the level of the innovation leaders is not achieved in a single sub-area.

The results for start-up motivation and start-up funding are particularly bad, which ultimately has a negative effect on start-ups’ growth dynamic. Nor is the trend sufficient with any of the indicators used to be able to reduce the distance

to the leading countries or even just to the EU average (for details see table 9 in Annex 2). On the whole this results in the start-up area being one of the greatest weaknesses of the domestic RTI system. This scenario has long been known and is evidenced by the findings delivered by the Austrian Council in recent years.⁷⁹ A more in-depth review in this context is provided by the “Austrian Startup Monitor” (ASM)⁸⁰ and “Global Entrepreneurship Monitor Austria” studies commissioned with the cooperation of the Austrian Council.⁸¹ They examine the status, prospects and environment of Austrian start-ups in broadly applied analyses. Both studies show that financing the company structure was also considered a fundamental challenge in 2019. It was also shown that in entrepreneurial education there is catch-up requirement here in primary and secondary education in particular. The Austrian Council addressed these issues in two recommendations for the, “mobilisation of risk capital to secure sustainable innovation and growth financing”⁸² and the “establishment of entrepreneurship-promoting competences in the Austrian education system”.⁸³

76 AIT (2019): Austrian Startup Monitor 2019. Vienna, p. 116.

77 See, for example, Gadner, J. / Kim, G. E. / Leo, H. (2015): Startup Cultures. A Comparison of the Growing Importance of High-Tech Startups in Austria, Israel and Korea. In: Austrian Council (ed.): Designing the Future. Economic, Societal and Political Dimensions of Innovation. Echomedia Verlag, Vienna, pp. 226-251.

78 Austrian Government (2011): Der Weg zum Innovation Leader. Strategie der Bundesregierung für Forschung, Technologie und Innovation. Vienna, pp. 29 f.

79 See Austrian Council (2019): Report on Austria’s Scientific and Technological Capability 2019, pp. 42 ff.

80 AIT (2019): Austrian Startup Monitor 2019. Vienna.

81 Joanneum UAS (2019): Global Entrepreneurship Monitor 2018: Report on the entrepreneurship situation in Austria. Graz.

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

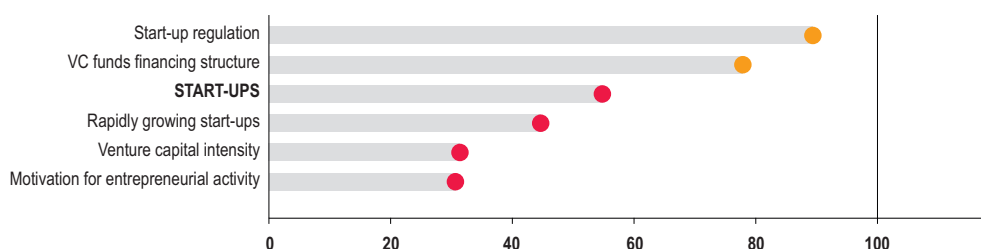
83 Austrian Council (2019): Recommendation for the establishment of entrepreneurship-promoting competences in the Austrian education system of 16 Dec. 2019. Vienna.

strengths & weaknesses

The most important objectives of the Austrian Council's recommendations to accelerate the start-up ecosystem in Austria are as follows: A broad and sustainable anchoring of "entrepreneurial education" is required to improve the motivation of start-ups – from primary to secondary education I + II and on into tertiary education. Developing creativity and innovation, planning and using resources on one's own initiative and motivated and implementing own ideas goal-oriented and independently are necessary skills and capabilities required for a successful company start-up and management. This also requires the funding of "financial education" and increased integration of financial competences in the education area. A holistic national strategy and own budget that is administered by a national agency set up especially for this are requirements to establish these competences in the Austrian education system, as is the case in Finland or Sweden for example. The Austrian Government must act

now and introduce the required initiatives to avoid that Austria loses touch within Europe. A strengthening of the capital market is urgently required for the secured financing of the expansion and growth phase of start-ups. Complete corporate financing through all development phases of a company is required to create optimum financing conditions. Financing by Business Angels in the expansion and growth phase is evaluated as good, however the venture capital offering is still severely underfunded. There is still no self-supporting venture capital sector in Austria. An appropriate bundle of measures would be a high priority here.⁸⁴ Among other elements this also includes the removal of the taxation discrimination of equity capital over loan capital, the introduction of an umbrella fund based on venture capital and flexible, internationally competitive framework conditions for affiliated companies. The legal framework conditions in the start-up process must also be modernised.

Figure 10: Strengths and weaknesses in the start-ups area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with "CO_" prefix (= "Composite").

⁸⁴ See Keuschnigg, C. / Sardadvar, p. (2019): Risk capital for financing innovation and growth. Study commissioned by the Austrian Council. St. Gallen-Vienna.

Recommendations for the start-up area

To increase the motivation of start-ups, the Austrian Council recommends the establishment of entrepreneurship-promoting competences in the Austrian education system.⁸⁵ A holistic national strategy, similar to Finland and Sweden, for “entrepreneurial education” must be established here and the budget required for this must be guaranteed. In this context the Austrian Council also welcomes the establishment of the “financial literacy” anchored in the government programme.

Furthermore the Austrian Council recommends the continuous improvement of bureaucratic and regulatory framework conditions for funding start-up activity be anchored in the new RTI strategy. In a first step for this, the usually mandatory presence of a notary as a formal requirement should be done away with, the inspection obligation of the register court should be limited and a liberalisation of the share classes with limited companies should be introduced. For more risk capital intensity, the Austrian Council recommends creating founder-friendly, legally-certain and competitive framework conditions to sustainably establish continuous

Governance and financing

In its “Review of Innovation Policy: Austria 2018” the OECD refers to the challenges in the governance structures of the Austrian RTI system, which hinder restructuring in the innovation leader direction.⁸⁷ The fragmentation of structures and the lack of effective coordination in shaping and implementing the research, technology and innovation policy are defined here as the greatest weaknesses. According to the OECD the Austrian RTI system could benefit

financing of the innovation chain in Austria. The development of an active, self-supporting risk capital sector must be given the highest possible priority for this.⁸⁶ This requires a suitable framework, such as appropriate legislative and taxation framework conditions for private equity (risk capital, Business Angel investments, crowdfunding, and similar), an improvement in the quality of the Austrian capital market and assessment stipulations of pension and insurance funds, for example, as also proposed by the OECD.

The Austrian Council also proposes an umbrella fund focused on venture capital be set up, into which pension funds and other institutional investors can be integrated as capital providers and drivers of innovation development, similar to that found in Scandinavian EU member states (e.g. Finland, Sweden). In addition to funding by banks, the Austrian Council also recommends developing funding options for innovative entrepreneurs and SMEs. The effectiveness of existing measures to improve the risk capital situation in Austria must be checked here.

greatly from an adaptation of the policy mix and governance adjusted to the changed requirements of the innovation structures and consequently support key further developments, such as those in the digitisation or Industry 4.0 area, and the surmounting of the most urgent societal challenges.

The strengths-weaknesses analysis does not provide any indicators for the governance area. It is, however, rather obvious that numerous ob-

strengths & weaknesses

85 Austrian Council (2019): Recommendation for the establishment of entrepreneurship-promoting competences in the Austrian education system of 16 Dec. 2019 Vienna.

86 For details, see Austrian Council (2019): Recommendation for the mobilisation of risk capital to secure sustainable innovation and growth financing of 16 Oct. 2019 Vienna.

87 OECD (2018): OECD Reviews of Innovation Policy: Austria 2018. OECD Publishing, Paris, pp. 19 ff. and p. 48.

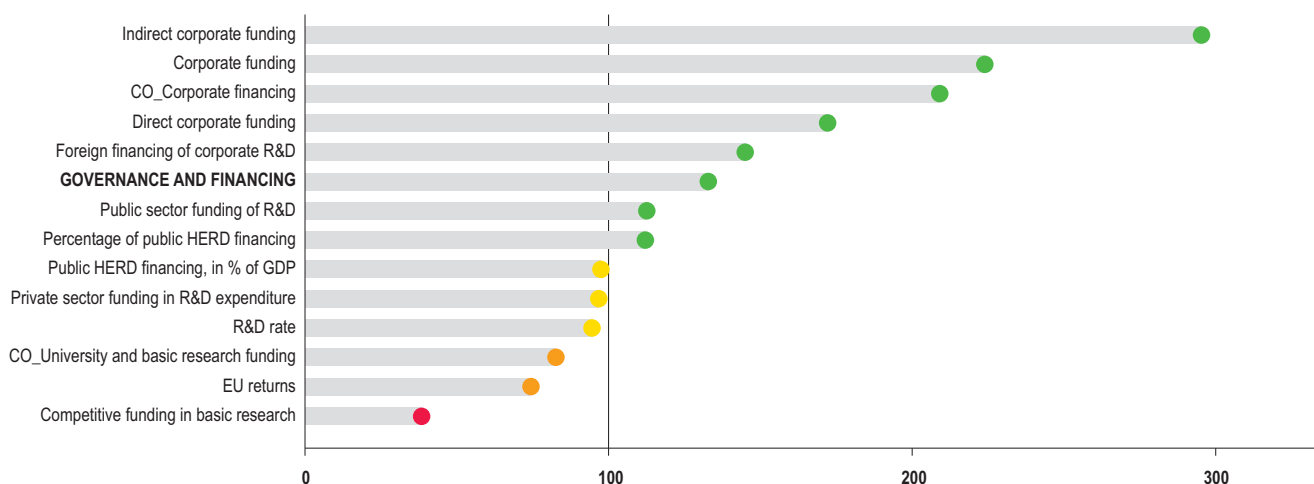
strengths & weaknesses

jectives for this area from previous years, and from the RTI Strategy 2011 in particular, which should both simplify, harmonise and produce a more transparent structure in the domestic RTI system, have not yet been achieved.⁸⁸ One positive development therefore is the fact that some key elements of a holistic and reform-oriented governance approach are anchored in the current government programme. In addition to working out a new strategic basis for the research, technology and innovation policy up to 2030, the RTI package for three-

year prioritisation, the establishing of an annual RTI summit and the planned adoption of the research funding act, in which specific improvements in the governance area are also defined, must be emphasized here.⁸⁹ The further developments of steering the research funding bodies planned by the Government, which the Austrian Council also referred to in its white paper⁹⁰ and more recently in its statement on the draft for the research funding act⁹¹, are also welcomed here.⁹²

It should also be noted that there is still optimisation potential in the “public understanding

Figure 11: Strengths and weaknesses in the governance and financing area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

88 For details, see also Austrian Council (2020): *Wie geht es weiter? Vorschläge für die Gestaltung der Forschungsdekade 2020–2030*. Vienna, pp. 12 ff.

89 Austrian Government (2020): *Aus Verantwortung für Österreich. Regierungsprogramm 2020–2024*. Vienna, pp. 309 f.

90 Austrian Council (2013): *White paper on controlling research, innovation and technology in Austria*. Vienna.

91 Austrian Council (2013): *Statement by the Austrian Council on the draft for a research framework act (2019)* of 16 Oct. 2019.

92 Austrian Government (2020): *Aus Verantwortung für Österreich. Regierungsprogramm 2020–2024*. Vienna, p. 310.

of science” area and the dialogue between science and society. The establishment of this dialogue has indeed shown in some successful formats that both researchers and the general public can be enthusiastic about it, however on closer examination one would have to recognise a rather strong social and regional differentiation of these activities.⁹³

The financing area is one of the Austrian RTI system’s dedicated strengths. As figure 11 illustrates, approximately half of the indicators available for this 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 high public share in R&D funding must also be emphasised. Austria ranks in this respect among the global top three (see Annex 2, table 10). Austria scores particularly poorly with competitive funding of basic research, which is topicalized in the “Research at universities and non-university institutions” section. The R&D expenditure in the energy and environment area also performs below-average, which in climate change terms is an obvious weakness (see also the “Environment and climate” section).

The Austrian Council already referred to the positive dynamic of the R&D quota in its past reports on Austria’s scientific and technological capability.⁹⁴ With a comparison of all OECD countries for 2018 (last year available), Austria was therefore in the absolute top of the field globally after South Korea, Israel and Sweden, ahead even of countries such as Germany, Fin-

land, the USA and China. Of the countries enjoying positions at the top, with a cumulative growth rate of 16 percent since 2010, after South Korea (+37 percent) and Israel (+26 percent), Austria exhibits one of the highest dynamics with the R&D quota. The goal of a quota of 3.76 percent by 2020 set in the RTI Strategy was perhaps not achieved. Nevertheless, we can say that in the international comparison Austria exhibits an impressive catch-up process and global top position.

The development in the private R&D quota area, which has improved by almost nine percent per year since 2010 and now is even above the goal level of 66 percent, is also positive – the innovation leaders usually show a 30:70 public vs private ratio here. The strong growth of the R&D quota in the last 20 years is driven by both the private and the public sector, whereby the public sector compensated for the failures of the private sector in the aftermath of the 2008 financial crisis.

Regardless of the currently strong growth of public R&D financing, in the near future more attention will have to be paid to the quality and efficiency of financing (see also the “Efficiency of RTI activities” section). The coming RTI Strategy should therefore allow for a reformulation of the quota target, which is oriented on the Austrian industrial structure.⁹⁵ Some thought might even be given to completely replacing input goals with output goals, to counter the existing trends towards input-oriented

strengths & weaknesses

93 See Austrian Council (2019): Report on Austria’s Scientific and Technological Capability 2019. Vienna, p. 48.

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

95 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 that would target high R&D intensity in the existing structures, i.e., a high R&D intensity that, for example, supports competitiveness in the steel industry, but does not demand that the steel industry achieve the R&D intensities of the pharmaceutical industry, for example. See Janger, J. / Kügler, A. (2018): Innovationseffizienz: Österreich im internationalen Vergleich. Study commissioned by the Austrian Council. WIFO, Vienna, p. 40.



strengths & weaknesses

control and to focus even more on the effectiveness and efficiency of R&D investments. The OECD also recently emphasised this increased concentration away from inputs and towards outcomes and impact in its “Review of innovation policy” for Austria.⁹⁶

Increased focus will also have to be made in the future on the ratio of direct to indirect research funding⁹⁷. Between 2006 and 2015 indirect funding (research premium in particular) accounted for approximately 60 percent of corporate-related R&D funding. Even if the research premium has benefits due to its comparably simple application process and its R&D incentive structure, with this mechanism important forthcoming topical priorities such as digitisation or climate protection, for example, can only be supported indirectly. The Government should therefore target a balanced policy mix in the new RTI Strategy, in which the ratio between direct and indirect research funding is more balanced and which more closely reflects the future challenges for Austria.

Recommendations for the governance and financing area

The Austrian Council recommends the governance-relevant measures anchored in the government programme be implemented as swiftly and consistently as possible. With the RTI Summit a key basis for essential pointers will be created at the highest political level. The Austrian Council believes the regular coordination of all ministries, and especially those departments that are not primarily involved in shaping the RTI landscape, is indispensable. The Austrian Council therefore recommends the quickest possible institutionalisation of the RTI

Summit with the goal of anchoring regular communication to define relevant prioritisations at the highest political level.

In the context of creating new legal framework conditions with the research funding act and a structural reorganisation of the RTI governance, the Austrian Council recommends the required financial provisions for research funding specified in the government programme be actually sustainably secured and the complexity in the funding system be further reduced. In accordance with the relevant aspects of the research funding act, a new RTI Strategy must therefore also concentrate on the efficiency barriers repeatedly referred to by the Austrian Council and specifically address overlapping multi-structures, over-regulation, fragmentation, unclear responsibilities and a complicated, non-harmonised set of rules for individual mechanisms in the funding system.⁹⁸

The Austrian Council welcomes the adoption of the research funding act specified in the government programme, which, in accordance with the new RTI Strategy, will secure the medium to long-term stability of RTI funding in Austria. The Austrian Council also welcomes the RTI package anchored in the government programme as a mechanism for research financing and definition of research priorities. The Austrian Council believes here that the definition of a multiannual financing agreement based on transparent measures planning must be enabled and binding financing certainty must be guaranteed. The Austrian Council recommends it focus in this respect on the German package for research and innovation, which projects a regular budget growth of currently three percent per year for the preferred research institutions and funding agencies.⁹⁹

⁹⁶ OECD (2018): OECD Reviews of Innovation Policy: Austria 2018. OECD Publishing, Paris, p. 20.

⁹⁷ OECD (2018): OECD Reviews of Innovation Policy: Austria 2018. OECD Publishing, Paris, p. 19.

⁹⁸ See, inter alia, Austrian Council (2019): Report on Austria's Scientific and Technological Capability 2019. Vienna, p. 54 and pp. 60 f.; idem (2013): White paper on controlling research, technology and innovation. Vienna.

⁹⁹ <https://www.bmbwf.de/de/pakt-fuer-forschung-und-innovation-546.html>

Due to the low output efficiency compared with the innovation leaders (with given above-average high inputs), the Austrian Council again recommends an inspection of the appropriate use of funding in the Austrian RTI system and the analysis of the input-output ratio with the goal of realigning RTI funding and therefore improving innovation efficiency. In this respect the Austrian Council also recommends the ratio between awarded in competition and core-financed public funds should also be shifted in favour of the awarded in competition share. At the same time, as indicated by the OECD, the ratio between direct and indirect research funding must also be arranged more evenly and balanced.

As part of the new RTI Strategy, ultimately the Austrian Council recommends a reformulation of the quota target, which is oriented on the

Austrian industrial structure and completely replaces input goals with output goals, to counter the existing trends towards input-oriented control and to focus even more on the effectiveness and efficiency of R&D investments. Finally the Austrian Council supports the setting up of an all-Austria research funding database, which would enable access to and scientific use of the available data of the ministries and funding agencies, with all confidentiality obligations complied with, which, however, is not mentioned in the government programme.¹⁰⁰

To leverage the value of science and research among the general public the Austrian Council refers to its previous recommendations to improve the dialogue between science and society.¹⁰¹

strengths & weaknesses

100 Austrian Council (2018): Recommendation for setting up a nationwide database to illustrate research inputs and outputs of 22 Mar. 2018. Vienna.

101 See Austrian Council (2019): Report on Austria's Scientific and Technological Capability 2019. Vienna, p. 54; idem (2019): Recommendations for the RTI policy in the 27th legislative period of 16 Oct. 2019, Vienna, p. 10.



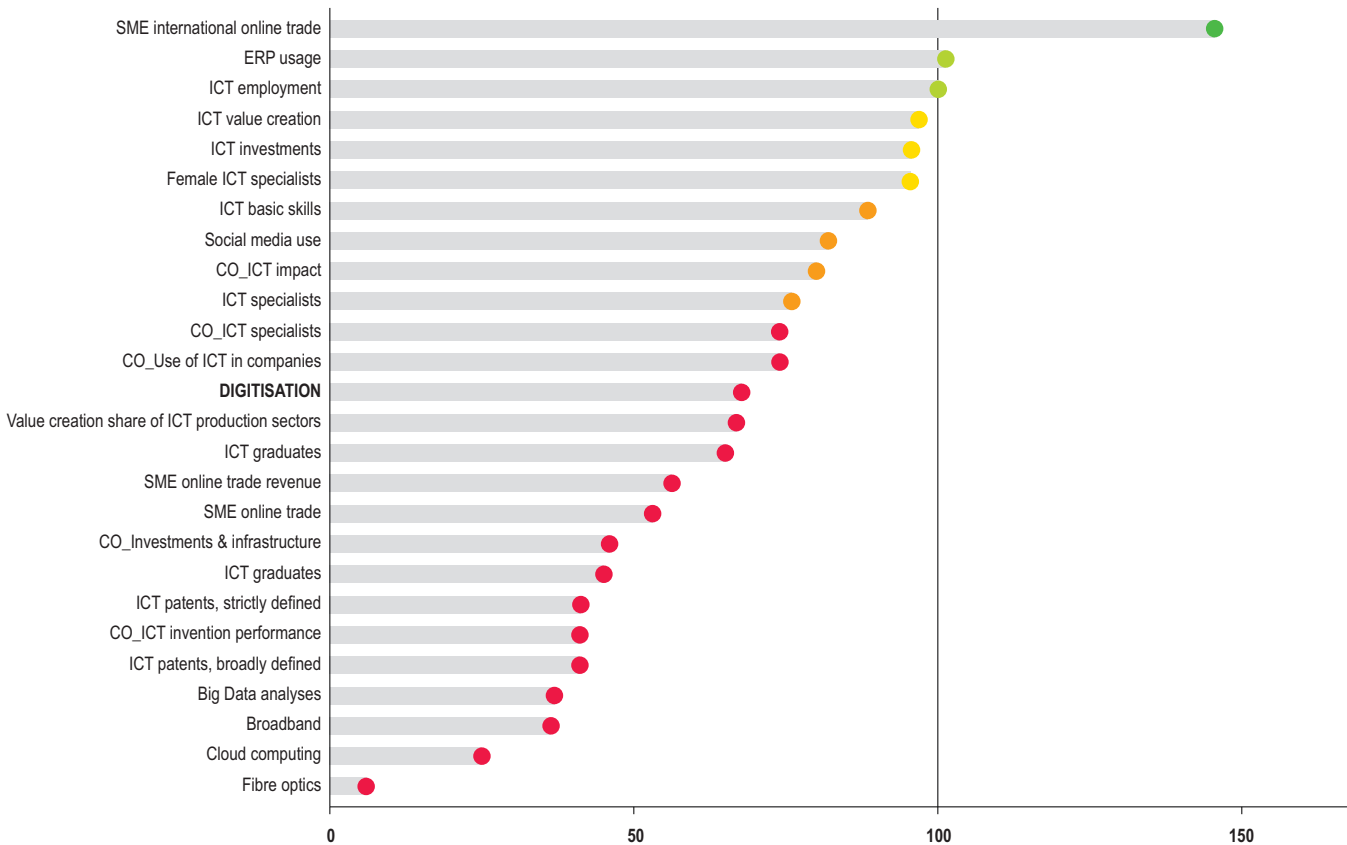
RTI cross-cutting issues

Digitisation

Along with climate change, digitisation is the global megatrend that will massively affect and change all life and work areas in the coming years. Especially the new possibilities for collecting and processing data of all kinds will have an important influence on economic and social struc-

tures, with forecast positive effects on future innovation growth.¹⁰² Along with this, digitisation can also contribute to meeting global challenges such as climate change, environmental pollution or resource scarcity and consequently also go a good way toward securing a sustainable future for our planet.

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



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with "CO_" prefix (= "Composite").

¹⁰² OECD (2019): Digital Innovation. Seizing Policy Opportunities, OECD Publishing, Paris; for this see Austrian Council (2019): Recommendation for the establishment of a holistic industry and technology policy strategy for platform economy in Austria of 6 June 2019. Vienna.

It is therefore currently undisputed that the potential of the digital transformation will also have to be realised completely in Austria to meet the grand challenges of our time on one hand and to guarantee the competitiveness of the domestic economy and therefore secure social prosperity on the other.¹⁰³ Along with the European Commission with its policy guidelines¹⁰⁴ in this respect, the Austrian Government has therefore also attributed significant importance to digitisation in its current government programme – with the priority objective of making Austria one of the leading digital nations within the EU.¹⁰⁵

However, if we consider the indicators for the progress of digitisation in the Austrian RTI system currently used for this report, on the whole and measured on the leading innovation countries, Sweden, Finland, Denmark and the Netherlands, we see only a negative result with considerable catch-up requirement. This applies on both the input and the output side, as shown by figure 12 (details in table 11 in Annex 2).

With the inputs in particular Austria does not come near the level of the innovation leaders in any area. While the level of ICT investments (high gross investments in the assets area) is still comparatively close to that of the leading countries, the distance with the infrastructures required for digitisation, such as ultra-fast broadband and fibre glass cables, is consistently below the level of the leading innovation

countries, and also significantly below that of the EU average.¹⁰⁶

The outlook in the ICT specialist area compared with the leading countries is also correspondingly poor. With the basic competences and with the number of ICT specialists and ICT graduates, for example, Austria is therefore clearly below the level of the comparison countries. With the number of ICT university graduates, Austria not only ranks significantly below the level of the leading innovation countries, but rather also below that of the EU average, and this although, with regard to basic ICT competences and the employment of ICT specialists, Austria scores better than the average of the European comparison countries. These partially opposing trends therefore contribute to the increasing lack of ICT specialists on the Austrian labour market.¹⁰⁷

On the output side in particular we can see a striking distance between Austria and the comparison countries with patent activities in the ICT area. The considerable distance to the two global leading and high-performance countries, South Korea and Sweden, is unsurprising. Austrian performance is, however, only almost satisfactory in comparison with both the leading innovation nations and in comparison with the EU average, and in no way corresponds with the outputs that can be expected for a technologically highly advanced country such as Austria (details in table 11 in Annex 2).

strengths & weaknesses

103 OECD (2017): Investing in Climate, Investing in Growth. OECD Publishing, Paris.

104 EU Commission (2020): Announcement. Shaping Europe's digital future. COM (2020) 67 final; see also Austrian Council (2019): Report on Austria's Scientific and Technological Capability 2019. Vienna, pp. 21-22.

105 EU Commission (2020): 6 Commission priorities for 2019-24. Brussels; Austrian Government (2020): Aus Verantwortung für Österreich. Regierungsprogramm 2020–2024. Vienna, p. 316.

106 It must however be emphasised that Austria has an above-average high percentage of mobile broadband. More than three quarters of all broadband connections (smart phones and mobile broadband) are already set up in mobile networks, and private use is playing a major role here (see RTR [2019]: RTR Internet Monitor 2019. Vienna, p. 6 and pp. 26 f.).

107 EU Commission (2019): Index for the digital economy and society (DESI). Country report, 2019, Austria, p. 7.



strengths & weaknesses

It looks somewhat better in the area of ICT use in companies and the area of ICT economic impact. In relation to the use of ICT the fact that Austrian SMEs in international online trade are in the top three and even clearly ahead of the innovation leaders is certainly a positive development.¹⁰⁸ In electronic information exchange (ERP – Enterprise Resource Planning) Austrian companies also score on the level of the leading innovation countries – with strong growth within the last ten years, whereby the distance to the globally leading countries – Belgium, the Netherlands and Lithuania – is decreasing, too. With regard to the use of big data, cloud services, social media and online trade in the SME sector, Austria by contrast has a consistently growing distance to the leading innovation countries. According to the Digital Scoreboard 2019, large-scale Austrian companies have significantly better digital intensity than SMEs, which could entail the longer-term risk of a digital gap forming within the country.¹⁰⁹ There is also a conspicuous demand gap, in particular manifested by low private use of modern broadband services and applications in the international comparison.¹¹⁰

In relation to the economic effects of ICT, from an economic viewpoint the picture is largely negative. With the employment share in industries that use ICT intensively, Austria is actually more or less at the level of the leading innovation countries and with the value creation

share just below. But in raising the value creation share of ICT-producing industry branches (material goods and services) and the revenue generated by SME online trade (e-commerce) to the level of the leading innovation countries, Austria scores strikingly poorly.

If the Austrian Government intends to actually achieve its declared goal of making Austria a leading digital nation within the EU, then a massive catch-up process must be initiated immediately, as the distance to the leading innovation countries is sizeable for the most part. In many areas Austria also ranks significantly below the EU average (see Annex 2, table 11). This result, for example, is also reflected in the European Commission's index for the digital economy and society (DESI).¹¹¹ This shows that despite moderate improvements in Austria's sub-areas, the distance to high-performance countries is increasing on the whole, and especially in areas such as connectivity, Internet use and integration of digital technology. In these areas Austria has only been able to achieve below-average results in DESI 2019, which is why it is only at 13 from 28 places in the EU comparison here.

Recommendations for the digitisation area

In view of the key importance of digitisation for the Austrian RTI system, the Austrian Council recommends the swiftest possible establishment of suitable framework conditions in close coordination with the EU.¹¹² The strategic value cre-

108 It should be noted here that the cross-border online trade of Austrian SMEs scores above-average well due to Austria's geographical position and the resulting disproportionately strong economic interconnections (see also the "International ties" section). For this see European Commission (2019): Index for the digital economy and society (DESI). Country report, 2019, Austria, p. 11.

109 For this see European Commission (2019): Index for the digital economy and society (DESI). Country report, 2019, Austria, p. 11; Digital Scoreboard 2019 (progress scoring in 2019 for the Digital Agenda).

110 Peneder, M. / Firgo, M. / Streicher, G. (2019): Stand der Digitalisierung in Österreich. Austrian Institute of Economic Research. Vienna, p. 9.

111 EU Commission (2019): Index for the digital economy and society (DESI). Country report, 2019, Austria, p. 3.

112 EU Commission (2020): Announcement. Shaping Europe's digital future. COM (2020) 67 final; see also Austrian Council (2020): Wie geht es weiter? Vorschläge für die Gestaltung der Forschungsdekade 2020–2030. Vienna, pp. 4–5.

ation chains in Europe¹¹³ and the new value creation practices connected with the platform economy¹¹⁴ must also be considered here. Instead of merely increasing investments in the ICT area, the Austrian Council would rather recommend that a wide range of coordinated economic and socio-political measures for digitisation be implemented in Austria with the greatest possible efforts.¹¹⁵ On one hand these should be targeted on various levels (e.g. companies, industry branches, regions) and on the other they should contribute to the strengthening of various digitisation functions in the domestic innovation ecosystem, such as, R&D, private and commercial use of digital technologies, training of appropriate ICT specialists, competition and regulation, for example.¹¹⁶ An integrative regional structure policy will have to play a more important role here to be able to counter a further (digitisation-intensified) divergence of regional development trends.¹¹⁷ In addition to guaranteeing a high-performance digital infrastructure and sufficient training of ICT specialists to meet the future rising

requirements for integrated social processes and applications (Industry 4.0), the Austrian Council also believes that the increase in the number of ICT university graduates should be accelerated, as planned for, among others, in the all-Austrian university development plan (GUEP)¹¹⁸. Special emphasis is given here to the promotion of positively perceived STEM job descriptions with teachers, parents and pupils, to an improvement in advice and career orientation in schools and to an optimisation of study information especially for girls. In the output area the Austrian Council believes the exploitation of intellectual property in the ICT area in global terms must be increased as a priority.¹¹⁹ With regard to the development and use of digital technologies (e.g. cloud services, big data, ERP) the Austrian Council also recommends SMEs in particular be supported more, especially because on the whole Austria and Europe to date have not been in a position to fully exploit the latest technological revolutions connected with digitisation.¹²⁰

strengths & weaknesses

113 See Austrian Council (2019): Recommendation for Austria's efficient integration into the European industry policy of 22 Mar. 2019. Vienna.

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

115 Peneder, M. / Firgo, M. / Streicher, G. (2019): Stand der Digitalisierung in Österreich. Austrian Institute of Economic Research. Vienna, pp. 10-11.

116 Ibid., pp. 10–11; see Austrian Council (2019): Council recommendation for the establishment of a holistic industry and technology policy strategy for platform economy in Austria. Vienna.

117 Firgo, M. / Mayerhofer, P. / Peneder, M. / Piribauer, P. / Reschenhofer, P. (2018): Beschäftigungseffekte der Digitalisierung in den Bundesländern sowie in Stadt und Land. Austrian Institute of Economic Research. Vienna, p. 21.

118 For this see GUEP 2019–2024, system goal 4c, and GUEP 2022–2027, system goal 3d, for increasing graduate numbers, especially in the parts of the STEM area that are in high demand on the labour market.

119 See Austrian Council (2019): Recommendation for increasing the protection and exploitation of intellectual property rights. Vienna, pp. 4-5.

120 OECD (2019): Measuring the Digital Transformation. OECD Publishing, Paris. According to the OECD, most recently five economies – China, Taiwan, Japan, South Korea and the United States – were primarily responsible for the majority of the development of leading digital top technologies; European Commission (2019): The Digital Economy and Society Index 2019. Integration of Digital Technology, pp. 5 and 8. According to DESI less than one fifth of European companies utilise the benefits of digital technologies.

strengths & weaknesses

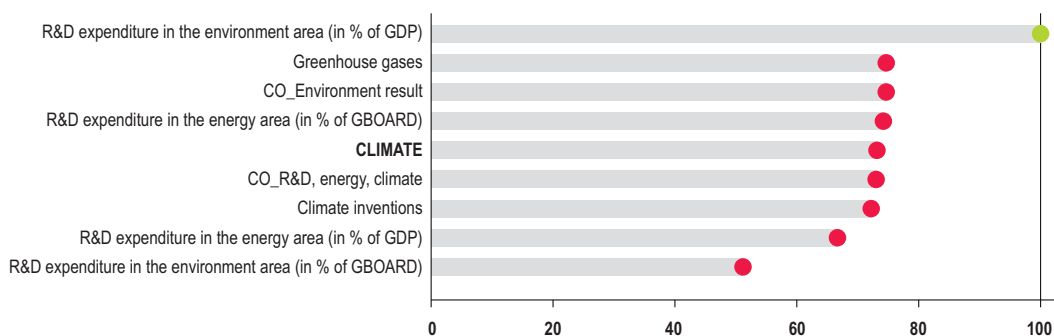
Climate and environment

Climate and environmental protection are among the priority objectives on the global political agenda.¹²¹ The issue also took on key importance in the government programme for Austria when the new Austrian Government took office. The indicators for research and innovation in the climate and environmental protection area used for this report, however, indicate that a substantial improvement is required to effectively support the policy priorities in this respect (see figure 13). Three of the four indicators for R&D expenditure in the environment and the energy research sector used for this report, for example, are therefore below the level of the leading innovation nations, Sweden, Finland, Denmark and the Netherlands.¹²² In relation to patent activities in the areas of energy and climate protection we can also see a sub-

stantial distance to the innovation leaders. There is therefore considerable catch-up requirement in the domestic RTI system on both the input and the output side, in order to guarantee a moderate contribution by RTI activities to climate and environmental protection.

The fact that Austria scores poorly with the key environment indicator, “greenhouse gas emissions”, in relation to the leading countries must in particular be emphasised. With greenhouse gas emissions Austria is the only one of the comparison countries that continues to be above the 1990 reference value.¹²³ Although on the whole an improvement of the performance in this respect since 2010 can be verified, the development is far less dynamic than that of the leading countries (details in table 12 in Annex 2). In per capita terms Austria scores even poorer with greenhouse gas intensity. With approximately

Figure 13: Strengths and weaknesses in the environment and climate area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

121 For this see, for example, European Commission (2020): 6 Commission priorities for 2019-24. Brussels; European Strategy and Policy Analysis System (2019): Global Trends to 2030: Challenges and Choices for Europe. World Economic Forum (2020): The Global Risks Report 2020. Geneva.

122 For this, see also Indinger, A. (2019): Energieforschungsausgaben im internationalen Vergleich 2018. Share and development of public sector expenditure in the International Energy Agency (IEA) member states. Study commissioned by the Austrian Ministry of Transport, Innovation and Technology. Vienna.

123 See Austrian Council (2019): Report on Austria’s Scientific and Technological Capability 2019. Vienna, pp. 20 f.

ten tons of CO₂ equivalent Austria only ranks in the midfield and also just below the OECD countries' average. The fall since 2000 in relation to countries such as Denmark, the UK, Sweden or Switzerland is also substantially lower.¹²⁴ Austrian performance in relation to the EU member states is also below-average (see table 12 in Annex 2). This also has negative effects in conjunction with the impact of innovation efforts (see also the “Effectiveness of RTI activities” section).

This means that Austria – contrary to popular belief – does not score particularly well in the climate and environmental protection area. With the EU's climate protection ranking, for example, Austria only manages place 19 out of 28.¹²⁵ The four innovation leaders are all in the top ten, with Sweden at number one. In Germanwatch's 2020 global climate protection index, Austria ranks in the fourth of five ratings (“poor”) and on the whole only at 38 of the 60 countries studied, which is explained by an, “on the whole poor performance, particularly in the greenhouse gas emissions, energy consumption and climate policy categories”.¹²⁶ The innovation leaders Sweden and Denmark lead the ranking, and Finland is among the top ten.

Location attractiveness

A country's location attractiveness is measured on several factors.¹²⁷ These include, for example, political stability and rule of law, research-intensive academic institutions and well-trained graduates, as well as supportive framework conditions for companies, such as funding, taxes and regulations (see also the “Regulation and taxes”

Recommendations for the environment and climate area

The Austrian Council recommends a significant acceleration of the climate and environment-relevant RTI activities. First and foremost public R&D expenditure must be raised to the level of the comparison countries for this. Along with this significant increase in R&D expenditure for environment and climate-relevant research including energy research, increased incentives to stimulate patent activities in the area of environment and energy technologies should also be introduced.

The Austrian Council also recommends innovation diffusion be specifically increased and already existing energy-efficient technologies be used more intensively than has previously been the case. In this context existing approaches for innovative and sustainable public procurement must also be accelerated. This means a strategic superstructure must be developed, with which the objectives of the government programme in this respect can be achieved efficiently and effectively, and the issue can be anchored in the new RTI Strategy 2030. A detailed recommendation on reducing greenhouse gas intensity with taxation measures is provided in the “Regulation and taxes” section.

section).¹²⁸ Some of the more important location factors are illustrated in figure 14. This shows how on the whole Austria scores better in relation to location quality than the innovation leaders, but certain deficits are clearly visible. Austria is above or on the level of the innovation leaders with a large part of the indicators.

strengths & weaknesses

124 OECD (2020): Environment at a Glance 2020. OECD Publishing, Paris, p. 19.

125 Climate Action Network Europe (2019): Off target. Ranking of EU countries' ambition and progress in fighting climate change. Brussels.

126 Germanwatch (2019): Climate Protection Index: The most important results, 2020. Bonn/Berlin, p. 10.

127 See, for example, Hölzl, W. / Friesenbichler, K. S. / Kügler, A. / Peneder, M. / Reinstaller, A. (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.

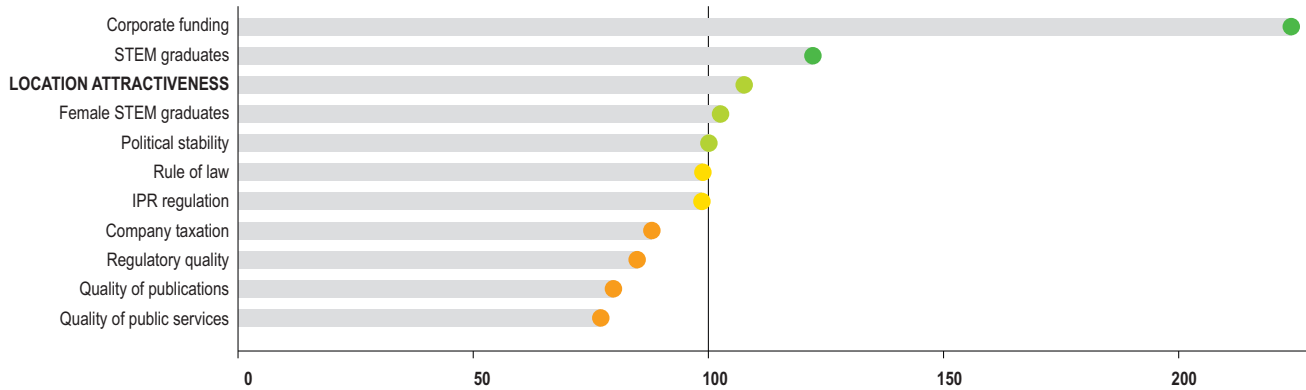
128 See also Keuschnigg, C. / Ecker, B. / Sardadvar, S. / Rainer, C. (2017): Innovationsland Österreich F&E: Unternehmensentwicklung und Standortattraktivität. Study commissioned by the Austrian Council. Vienna, pp. 67 ff.

strengths & weaknesses

Austria scores best here in the corporate funding area and with the availability of STEM graduates. Political stability and rule of law in Austria are high and on the same level as the leading innovation nations. This also applies for the IP regulation area (see the “Regulation and taxes” section). The results for company taxation on the other hand (measured as effective average taxation rates), regulation quality, the quality of publications and the quality of public services are below-average. With the latter indicator in particular Austria exhibits a clear trend towards deterioration (details in table 13 in Annex 2).¹²⁹ Some further essential points in relation to location attractiveness have already been named in the study by the *Wirtschaftspolitisches Zentrum*

commissioned by the Austrian Council¹³⁰: Excellent university and non-university research institutions and well-trained graduates and specialists are highly relevant for the location’s attractiveness. The improvement potential topicalized in the “Tertiary education” and “Research at universities and non-university Institutions” sections must be realised here. The removal of taxation discrimination with risk capital is also a top priority for increasing location attractiveness (see the “Start-ups” section). Ultimately, as also topicalized in the “Regulation and taxes” and “Start-ups” sections, an expansion of risk financing is extremely important for Austria as a business location. In this context, reinforcing the capital market and the stock exchange merit special mention.

Figure 14: Strengths and weaknesses in the location attractiveness area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

129 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.

130 See Keuschnigg, C. / Ecker, B. / Sardadvar, S. / Rainer, C. (2017): Innovationsland Österreich F&E: Unternehmensentwicklung und Standortattraktivität. Study commissioned by the Austrian Council. Vienna.

Recommendations for the location attractiveness area

A detailed recommendation on improving study conditions and further increasing graduate numbers is provided in the “Tertiary education” section. A detailed recommendation on increasing the quality of the scientific output is provided in the “Research at universities and non-university institutions” section.

A detailed recommendation on reinforcing the capital market and the stock exchange is provided in the “Regulation and taxes” section.

A detailed recommendation on the issue of risk capital intensity is provided in the “Start-ups” section.

A detailed recommendation on the IPR regulation issue is provided in the “Regulation and taxes” section.

strengths & weaknesses

Gender equality

High catch-up requirement with gender equality remains an issue due to the continuing low percentage of women in many professions. This in particular applies to some areas in science, research, technology and innovation, as well as generally with management positions.¹³¹ Technical and some scientific specialist areas are in particular affected by the lack of women. This situation also presents a significant obstacle to a country’s innovation performance and consequently its economic growth.¹³² A highly developed innovation nation such as Austria must therefore specifically combat such a situation in the domestic RTI system in order to better utilise the potential of the female population in the future.

The gender equality indicators in the Austrian RTI system show that in relation to the leading innovation countries, on the whole Austria scores significantly below-average (see figure 15). Even in the comparison with the EU average with individual indicators there is a sizeable distance, but of course the distance to the best performers is even greater (details in table 14 in Annex 2).

Austria scores especially poorly with the “PISA mathematics difference” indicator, which measures the performance difference in mathematics according to gender. In other words: Girls in

this country achieve worse results with the PISA maths tests than boys of the same age. A further problem is the fact that female researchers are under-represented in the corporate area in particular. Austria is significantly behind both the innovation leaders and the EU average here.

Positive here, on the other hand, is the fact that the number of female STEM graduates and female technology graduates is on the level of the innovation leaders, although those women that successfully attended a higher technical institute are also included among the female technology graduates. Also welcome is the fact that with the Glass Ceiling Index, which measures the promotion chances of women on university scientific staff to management positions, Austria is on the same level as the innovation leaders.

With regard to the percentage of women in research, in recent years on the whole Austria has seen a positive trend, which is why the distance to the leading innovation nations has fallen successively. With the percentage of female specialists in the ICT area the trend is, however, going in the opposite direction, so that the distance to the innovation leaders continues to grow. It must also be mentioned here that the number of female graduates and researchers in the ICT area in Austria is relatively low (see the “Digitisation” section).¹³³

131 OECD (2017): The Pursuit of Gender Equality: An Uphill Battle, OECD Publishing, Paris.

132 OECD (2012): Closing the Gender Gap: Act Now. OECD Publishing, Paris, pp. 23 ff.

133 For this, see OECD (2017): OECD Science, Technology and Industry Scoreboard 2017: The digital transformation. OECD Publishing, Paris, pp. 103 f.

strengths & weaknesses

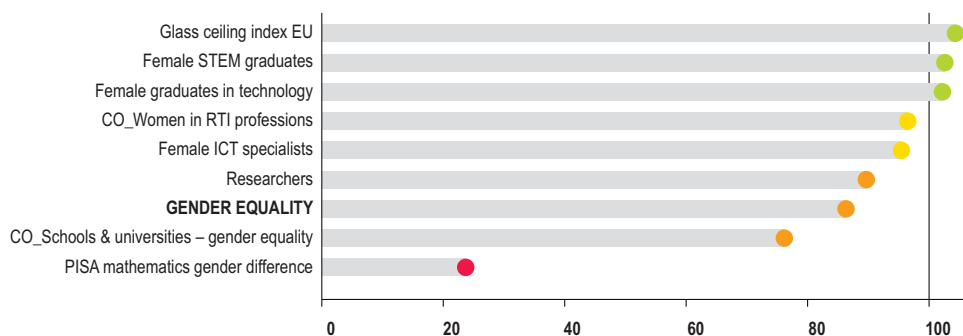
Recommendations for the gender equality area

To further accelerate gender equality in the Austrian RTI system the Austrian Council repeats its recommendation to push forward the development of more attractive career models for women, both at universities and in non-university areas, and especially in the industrial research area.¹³⁴ This in particular requires a gender equitable culture change in the education and research institutions, and an examination of the selection processes and the indicators for performance measurement used

therein.¹³⁵ The development of more flexible work time models must also be supported and additional offers for better job and family compatibility must be made. This would also require specific investments in high-quality childcare. Furthermore, suitable measures to improve school performances by girls in the maths area must be implemented, whereby an increase in gender competence with teachers must be targeted (see also the “Education” section).

A detailed recommendation on increasing the number of female STEM graduates and specialists is provided in the “Digitisation” section.

Figure 15: Strengths and weaknesses in the gender equality area compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with “CO_” prefix (= “Composite”).

134 See Austrian Council (2015): Report on Austria’s Scientific and Technological Capability. Vienna, p. 34 and p. 38.

135 For this, see European Commission (2020): Gender strategy for gender equality, 2020-2025. Brussels.

Efficiency and effectiveness of RTI activities

Figure 3 in the “Strengths and weaknesses of the Austrian in the international comparison at a glance” section shows how with regard to the efficiency and effectiveness of RTI activities in relation to the leading innovation nations there is still improvement potential. This finding is not new and was topicalized by the Austrian

Council in detail both with regard to innovation efficiency¹³⁶ and in terms of the effects of RTI activities¹³⁷. The relevant databases were updated and expanded for this report, which corroborates the known result even more.

strengths & weaknesses

Efficiency of RTI activities

On the whole the efficiency of the Austrian RTI system is clearly, if only slightly, below the level of the innovation leaders (see figure 16). Compared with the European average Austria scores significantly better, but compared with the global top three – Sweden, Denmark and the Netherlands – considerably worse (details in table 15 in Annex 2). The Austrian Council has topicalized this fact several times, most recently in the Report on Austria’s Scientific and Technological Capability 2019. The results of a specific efficiency analysis were presented in this report, which maps Austria’s relative efficiency in science, technology and innovation in the international comparison and also shows how Austria is not among the most efficient countries in any of the three areas, but nor is it in the bottom third in any area.¹³⁸ This finding and the increase potential of the Austrian RTI system’s efficiency that it entails were also confirmed by the OECD in its “Review of Innovation Policy: Austria 2018”.¹³⁹

The results of the strengths-weaknesses analysis, on which this report is also based, are provided in detail in table 15 in Annex 2. The Austrian RTI system in the innovation area is therefore more or less on the level of the innovation leaders. This is mostly due to a strong above-average performance by existing companies. Aus-

tria therefore has some highly innovation-intensive industries, which are exceedingly export-strong and successful on the global market with knowledge-intensive products. In the science area and the technology area on the other hand the Austrian RTI system is less efficient compared with the leading innovation nations. This is primarily due to the fact that very high inputs are met with comparably moderate outputs – with an R&D quota estimated by Statistik Austria at 3.19 percent for 2019, in the international comparison Austria invests an above-average high amount in its RTI system. The number of scientific publications and their quality despite considerable increase rates are therefore still below the level of the leading countries, and even more so below that of the global best performers such as Switzerland, Denmark or the Netherlands (see Annex 2, table 15). Patent activity in Austria, especially in relation to the technologically more demanding triadic patents, is also below the level of the innovation leaders. On a global level, Japan, Switzerland and the Netherlands lead the field here (for details see table 15 in Annex 2).

A particular problem that the Austrian Council has addressed several times, and which has a severe negative effect on efficiency in the science area, is the imbalance associated with students’

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

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

138 For details on methodology, see Austrian Council (2018): Report on Austria’s Scientific and Technological Capability 2018. Vienna, pp. 23 ff.

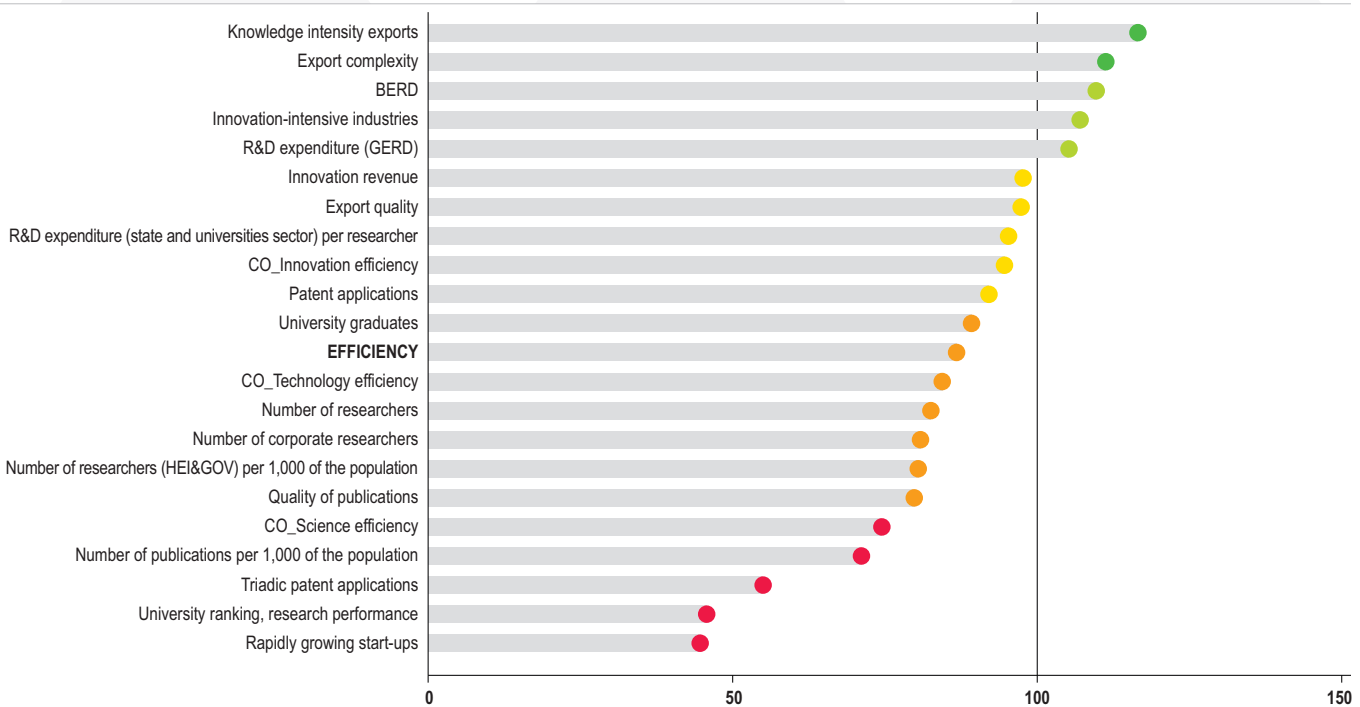
139 OECD (2018): OECD Reviews of Innovation Policy: Austria 2018. OECD Publishing, Paris, p. 13 and pp. 52 ff.

strengths & weaknesses

access to universities and universities of applied sciences.¹⁴⁰ The percentage of students at public universities in Austria is approximately 78 percent, while those at universities of applied sciences account for only 15 percent.¹⁴¹ The costs per student at universities here are significantly higher than in the technical college sector. A look at the leading innovation nations shows that more students are trained at universities of ap-

plied sciences in these countries.¹⁴² The burdening of the universities with the relatively high number of students and the comparably low financial and human resources is immense. Little wonder then that research performance also suffers here, as a disproportionately high amount of resources are tied up in administrative costs and coping with excessive teaching requirements (see also the “Tertiary education” and “Research at universities and non-university Institutions” sections).

Figure 16: Efficiency of Austria's RTI activities compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with "CO_" prefix (= "Composite").

140 See Austrian Council (2017): Recommendation on the way to the forefront of innovation of 30 Nov. 2017 Vienna.

141 The rest are distributed across teacher training colleges and private universities. It should, however, be noted that the statistic for study beginners indicates a slow shifting of this ratio, as in the 2018/19 winter semester approximately 26.9 percent of all study beginners in Austria began their studies at a technical college and 54.3 percent at a university.

142 The share of students at universities of applied sciences in the Netherlands is approximately 60 percent, in Finland it is approximately 50 percent and in Switzerland and Germany it is at least approximately 30 percent. See Austrian Council (2017): Recommendation for the further development of the universities of applied sciences sector in the Austrian education and science system of 30 May 2017.

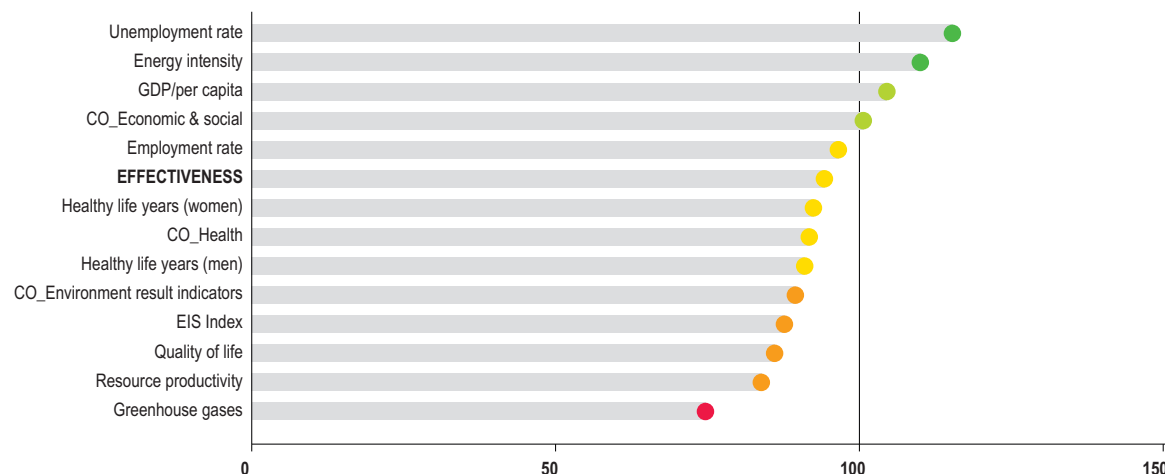
Effectiveness of RTI activities

The effects of RTI activities impact on areas which generally represent the overriding objective of political measures and are especially important for a country's citizens. These in particular include economic capability, performance in the climate and environmental protection area and the areas of quality of life, health and life expectancy.¹⁴³ As previously described, the indicators do not produce any direct causal relation between RTI activities and impact indicators, but they can indicate need for action. In relation to the potential impact of RTI activities on the economic, ecological and social level, Austria is also more or less on a par with the innovation leaders (see figure 17). Only the

performance in the environment area (keyword: greenhouse gas emissions – for details, see the corresponding “Climate and environment” section), is by far not enough to join the leading countries. Although Austria continues to score better with energy intensity¹⁴⁴ than the leading innovation nations, its resource productivity¹⁴⁵ has developed significantly worse than that with the innovation leaders (see also table 16 in Annex 2). Resource productivity in Austria is actually continuously increasing, which means the Austrian economy essentially uses resources more efficiently than in the past. According to calculations by the Ministry of the

strengths & weaknesses

Figure 17: Effectiveness of Austria's RTI activities compared with the innovation leaders



Source: WIFO, 2020. Indicator names in bold map the composed indicators right across the entire area; composed indicators of the sub-areas are identified with "CO_" prefix (= "Composite").

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

144 The indicator shows the development of energy efficiency, i.e. energy consumption, which is related to the Austrian economy's annual production performance.

145 Increases in resource productivity are generally seen as a result of technological progress (Hawken, P. / Lovins, A. / Lovins, L. H. [2008]: Natural Capitalism: Creating the Next Industrial Revolution. Little, Brown and Company, Boston – New York – London). See Austrian Council (2019): Report on Austria's Scientific and Technological Capability 2019. Vienna, p. 18.

strengths & weaknesses

Environment, resource productivity in Austria has improved over the last 50 years by a factor of 1.9, or 165 percent; in 1960, EUR 550 of GDP were generated per ton of material use; in 2012 it had already risen to EUR 1,454.¹⁴⁶ Austria's resource productivity in the European comparison, however, is indeed clearly below the average of EUR 1,730 per ton of material use. The ratio to the innovation leaders, whose level Austria will not approximate despite an almost uninterrupted positive trend since 2000, is even less efficient. In all other areas Austria ranks at the level of the comparison countries and even significantly surpasses this with the economic KPIs, for example. 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, occupied again and again by the innovation leaders – Sweden, Denmark and the Netherlands –, but which Switzerland is also a regular visitor to (details in table 16 in Annex 2).

Recommendations for the efficiency and effectiveness of RTI activities area

The Austrian Council recommends greater attention be paid in the future to how the Austrian RTI system can better convert the high inputs into outputs and impact than was previously the case, in line with its advanced level, and therefore increase its system efficiency. The Austrian Council has made several proposals in this respect in the past¹⁴⁷, and in its Review

of Innovation Policy the OECD also points to the existing potential to increase efficiency.¹⁴⁸ Furthermore the Austrian Council recommends – also in a future RTI Strategy – that research, technology and innovation not be understood as an end in itself, but rather as a contribution to achieving higher priority objectives on social, economic and ecological levels. The efficient use of existing resources and the importance 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.

In the context of developing a new RTI Strategy, the Austrian Council also recommends, in accordance with the corresponding proposals of the OECD¹⁴⁹, a specific expansion of the mission orientation to increase the quality and speed of progress in areas such as innovative economy and society, health, quality of life, digitisation and climate and environmental 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, such as climate change, resource scarcity, the ageing society or digitisation, that exists in Austrian research institutions and companies on a greater level and more systematically than has previously been the case. The Austrian Council also suggests detailed strategies be developed for the innovation-oriented restructuring of the economy to support successful industries of the old economy in Austria in the development of new forward-looking business models – keyword: platform economy – to be supported.¹⁵⁰

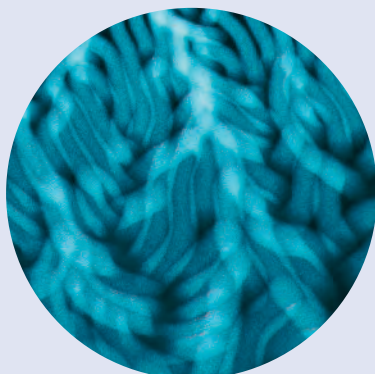
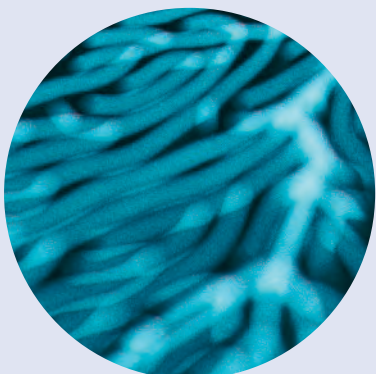
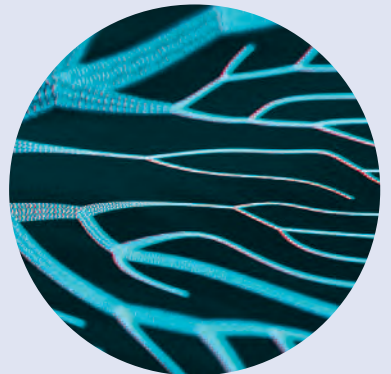
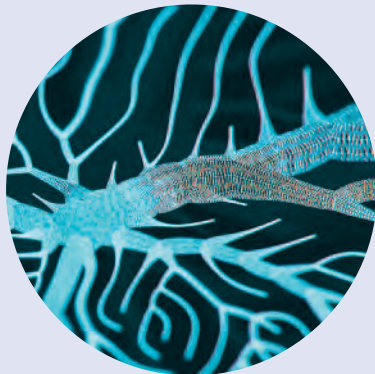
146 Federal Ministry of Agriculture and Forestry, the Environment and Water Management, Federal Ministry of Science, Research and Economic Affairs (2015): Resource Usage in Austria – Report 2015. Vienna, pp. 57 ff.

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

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

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

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



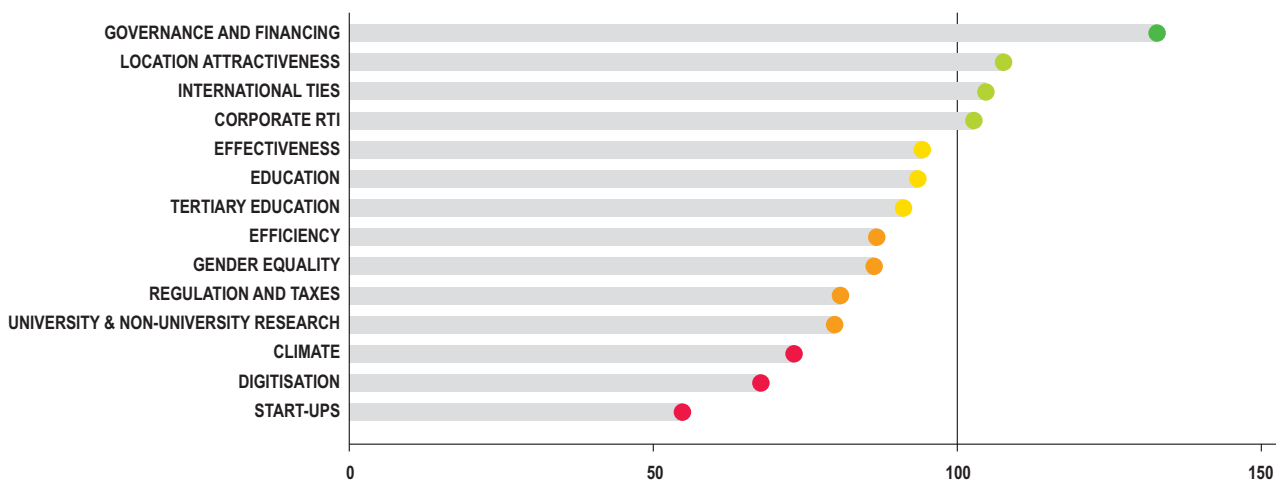
summary

The Austrian RTI system exhibits solid performance in the international comparison. While in comparison with the leading innovation nations, Sweden, Finland, Denmark and the Netherlands, Austria's strengths and weaknesses appear broadly balanced, there are a number of challenges with the framework conditions for RTI, in the core RTI system and with the efficiency and effectiveness of RTI activities. This is the key result of this report by the Austrian Council. Figure 18 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.

In summary we can say that the Austrian RTI system has both significant strengths and key weaknesses compared with the leading innovation nations. The RTI system's known strengths include an extensive international network, a high level of RTI support and the capability of existing companies, the generally above-average

level of R&D financing and the attractiveness of the business location. The greatest weakness in the core RTI system is clearly the area of innovative start-ups. In the cross-cutting issues area in particular the two global megatrends, digitisation and climate and environmental protection, which the new EU Commission and more recently the Austrian Government also set as priority areas of action, are the greatest problem areas. 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 funding, through to start-up activity. These are listed again in the following chart.

Figure 18: Overview of Austria's strengths and weaknesses compared with the innovation leaders



Source: WIFO, 2020.

Strengths of the Austrian RTI system

- **General**
 - Above-average attractiveness of the RTI location and high level of international ties
 - High development dynamic of the R&D quota affords Austria the second highest R&D quota in Europe and the fifth highest worldwide
- **Education system**
 - Above-average good supervision ratios in preschool and primary education
 - Significant reduction in the number of early school leavers
 - Increased level of university graduates in STEM subjects
- **Research at universities and non-university research institutions**
 - Selected universities and non-university research institutes with high scientific reputation and excellent output
 - Number and quality of scientific publications and international co-publications considerably higher
- **Corporate research and innovation**
 - Above-average R&D intensity of the Austrian economy
 - Continuously increasing number of R&D-intensive companies and innovative SMEs
 - Top values with cooperation between science and economy
 - Stronger, more knowledge-intensive, export-oriented production sector with global market leaders and innovators in various sectors and niches

Weaknesses of the Austrian RTI system

- **General**
 - Scientific and technological output moderate in relation to the above-average high input
 - Catch-up requirement in the digitisation area
 - Austria scores poorly with technology-related environment indicators in relation to the leading countries
- **Education system**
 - Above-average high social selectivity and education inheritance
 - Below-average performance level in the secondary education system (lower percentage of pupils with high competences, higher percentage of pupils with lower competences)
 - Insufficient coordination and alignment in the tertiary education sector result, among other things, in an imbalance with the steering of student flows
 - Poor supervision ratio causes high drop-out rates in the tertiary education sector
 - Low level of academics
- **Research at universities and non-university research institutions**
 - Below-average financing of universities and basic research in particular (competitive funding)
 - Research performance that is on the whole too weak results in performance that remains significantly behind its potential with international university comparisons
 - No attractive country of choice for researchers (brain drain vs brain gain) – with the exception of top research institutions
 - Improvement requirement with research infrastructure
- **Corporate research and innovation**
 - Catch-up requirement with innovation performance and inter-sectoral structure change
 - Adverse bureaucratic, regulatory and taxation framework conditions increase expense, costs and time taken for innovative start-ups and result in a low-intensity start-up landscape
 - Insufficient risk capital results in a comparatively lower number of rapidly growing knowledge-intensive companies and necessary scale-ups
 - Low diffusion of digital technologies and deficits with broadband expansion



summary

- **Governance system**

- Complex governance structures result in insufficient controlling performance and low RTI policy effectiveness
- Low-level flexibility, coherence and funding system controlling performance
- Insufficiently coordinated internationalisation strategy
- Insufficient dialogue between science and society
- Restrictive access to databases impedes scientific research, data-based innovations and evidence-based political control

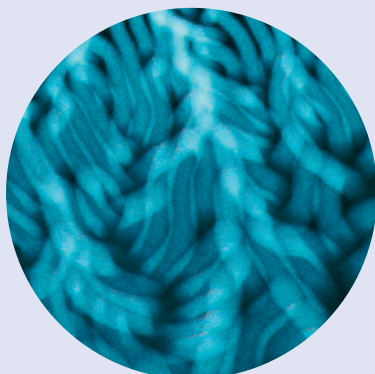
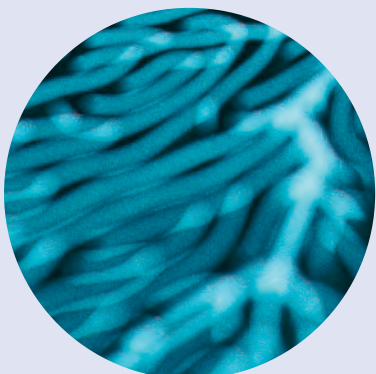
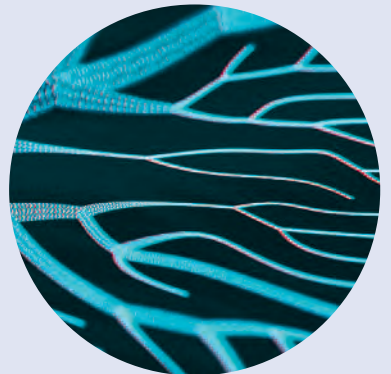
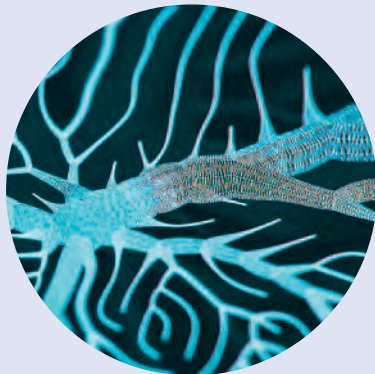
The Austrian Council draws the following conclusions for the RTI system's goal achievement and performance improvement from the results of the evidence-based analysis:

- The Austrian Council believes the Austrian Government's future RTI policy and in particular the new RTI Strategy should incorporate the findings of this strengths-weaknesses analysis of the Austrian RTI system.
- While strength areas of the domestic RTI system should continue to be supported to also generate positive results in the future, those areas in particular that are highly relevant for the RTI system's performance, but whose performance exhibits significant weaknesses in the most diverse sub-areas, must be specifically addressed. The Austrian Council believes this in particular entails:
 - The entire education system from the primary to the tertiary area
 - The higher education area
 - Start-ups activity
 - Efficiency and effectiveness must also be increased further in all RTI system sub-areas.

For a low raw material, high wage country like

Austria, a successful RTI system is an essential basic requirement to also be competitive in the future. Austria is not in a bad position in this respect. The results of the Austrian Council's report do, however, clearly indicate potential for improvement. It is also evident that in recent years Austria has gone some way to following the "path to becoming an innovation leader" embarked on by the Austrian Government in 2011.¹⁵¹ The dynamic that this triggered, however, is on the whole insufficient to actually also achieve the level of the leading countries in most of the areas of the RTI system, but in particular those of the core RTI system. Compared with the leading European innovation nations, Denmark, Finland, the Netherlands and Sweden, but also Switzerland, there is therefore still a good way to go to join the group of leading innovation nations. Aspirations in this direction are not an end in itself, but rather necessary steps to also secure economic development, well-being, quality of life and quality of the environment in the future. The Austrian Council therefore also believes that additional efforts must be continued to bolster the Austrian RTI system's performance.

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



Appendix 1: Indicator Set

appendix

	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	Venture capital in % of 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)

appendix

	Indicator (long name)	Short name
Education		
Overall system	Composed indicator	Overall 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 education
	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	
Input	OECD	
Output	PISA, TIMMS, PIRLS	Average value of the percentage of students in TIMMS, PIRLS and PISA with high competencies
Output	PISA, TIMMS, 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	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 (not assistants) of the same education area and similar educational institutions
		Average of all individual indicators in the primary education sub-area
Input	Eurostat	
Input	Eurostat	
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	PIRLS/TIMMS average value of pupils with high/very high competence
Output	PIRLS	PIRLS/TIMMS average value of pupils with high/very high competence
Output	PIRLS	
Output	PIRLS	
Output	PIRLS	
Output	PIRLS	

	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 school 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	TIMMS (note: value for AT is from 2011)	
Output	TIMMS (note: value for AT is from 2011)	
Output	TIMMS (note: value for AT is from 2011)	
Output	TIMMS (note: value for AT is from 2011)	
		Average of all individual indicators (career-oriented graduates not included) in the secondary education sub-area
Input	Eurostat	
Input	Eurostat	
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	
Output	PISA	
Output	PISA	
Output	PISA	
Output	PISA	
Output	PISA	
Output	PISA	

appendix

	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	
Output	PISA	
Output	PISA	
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).

appendix

	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
	Foreign students/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	Eurostat	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 calculation	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 2019, 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 2019, 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 2019, 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	Eurostat	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	Eurostat	Total of exports and imports relative to GDP
	Eurostat	A gauge for integration into global value creation chains – percentage of domestic value creation, which is mapped in foreign final demand
	Eurostat	A gauge for integration into global value creation chains – percentage of intermediate products in total exports
	Eurostat	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.

	Indicator (long name)	Short name
»» Tertiary education		
Graduates	Composed indicator – Teaching outputs	University graduates as a whole
	Percentage of 25 to 30-year-old university graduates in % of the 25-34 age cohorts of the population	University graduates
	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
	Foreign doctoral students	International doctoral students
Research performance, universities & non-university institutions		
Research	Composed indicator	Research at universities and non-university institutions
Inputs	Composed indicator – Inputs average	Expenditure and HR in research at universities & non-university institutions
	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, universities & non-university institutions
	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	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 area
Input		Indicator composed of the following individual indicators
Input	OECD MSTI	
Input	OECD MSTI	
Input	OECD MSTI	
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.

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	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 SMEs	Innovative SMEs
	SME innovation revenue	Innovation revenue
	SMEs with innovation cooperations	SMEs & cooperation
Inputs for RTI in companies	Composed indicator	Corporate RTI expenditure and HR
	R&D spending in the corporate sector, in % of GDP	BERD
	Innovative companies	Innovative companies
	Foreign-funded R&D	Foreign-funded R&D
	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	
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	Eurostat	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	
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	
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.

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	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 exports in the high price segment from all exports	Export quality
	Complexity score of exported products	Export complexity
Innovation impact – structural change	Composed indicator	Innovation impact – structural change
	Percentage of medium-high to high technology intensity exports from total exports	Knowledge intensity exports
	Percentage of innovation-intensive sectors in value creation, in %	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	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 2019, World Bank, WIFO calculation	
Output	PATSTAT, autumn 2019, World Bank, WIFO calculation	
Output	PATSTAT, autumn 2019, World Bank, WIFO calculation	Calculation is relative to the EU
		Average of two subsequent indicators
Output	Eurostat	The export quality can be interpreted as a gauge for the improvement of the product structure
Output	BACI	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 the three 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	Eurostat	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.

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	Indicator (long name)	Short name
Start-ups		
Overall system	Composed indicator	Start-ups and their growth
Regulation, financing and funding	Start-up regulation (Doing Business)	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
Starting and growth of innovative start-ups	Employment in rapidly growing companies in innovation-intensive sectors	Rapidly growing start-ups
Governance and financing		
Total	Composed indicator	Governance& financing
National level	R&D rate	R&D rate
	Percentage of private financing in R&D expenditure	Private sector funding in R&D expenditure
	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 governance and 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 university and basic research funding sub-area
Input	OECD MSTI	
Input	OECD MSTI	
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).
Input	OECD	Average of all individual indicators in the corporate financing sub-area
Input	OECD	Direct and indirect corporate funding in % of GDP
Input	OECD	
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	EUKLEMS	
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	
		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 2019; 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 2019; 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.

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	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	RTI climate
R&D, energy, 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 GBOARD)
	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 GBOARD)
Environment & energy inventions	Patents in energy and climate	Climate inventions
Impact on climate	Greenhouse gas emissions	Greenhouse gases

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 climate area
Input		Average of all individual indicators in the R&D, energy, climate sub-area
Input	Eurostat	
Input	Eurostat	
Input	Eurostat	
Input	Eurostat	
Output	PATSTAT, autumn 2019; OECD 2015, 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	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.

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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 and secondary school
	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

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 area
		Average of all individual indicators in the schools & universities sub-area
Output	PISA	
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.

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	Indicator (long name)	Short name
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 in FTE in the university and state sector, 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 in FTE in all sectors, 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	
	Percentage of innovative SMEs in the SME population in the CIS	
	Percentage of innovation-intensive sectors in value creation, in %	
	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	

Input/ Output	Source		Explanation
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
BERD	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	Input		OECD
Output indicators			
University ranking, research performance	Output		CWTS Leiden
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, autumn 2019; World Bank; WIFO calculation
Triadic patent applications	Output		PATSTAT, autumn 2019; World Bank; WIFO calculation
Innovation revenue	Output		Eurostat
Innovation-intensive industries	Output		OECD, Eurostat, WIFO calculation
Rapidly growing start-ups	Output		European Innovation Scoreboard
Knowledge intensity exports	Output		BACI, WIFO calculation
Export complexity	Output		BACI, WIFO calculation
Export quality	Output		Comtrade, WIFO calculations (similar to EIS European Innovation Scoreboard)

appendix

	Indicator (long name)	Short name
Efficiency of RTI activities		
Total	Composed indicator	Effectiveness & impact
Innovation	EIS Index	EIS Index
Economic & social	Composed indicator – Economic & social	Economic & social
	GDP/per capita	GDP/per capita
	Employment rate	Employment rate
	Unemployment rate	Unemployment rate
Quality of life	Better Life	Quality of life
Health	Composed indicator – Health	Health
		Healthy life years (F)
		Healthy life years (M)
Environment	Composed indicator – Environment	Environment result indicators
		Greenhouse gases
		Energy intensity
		Resource productivity

Input/ Output	Source	Explanation
		Average of all individual indicators in the effectiveness area
	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 (e.g. human resources, research spending, patents, structural change).
Output		Average of all individual indicators in the economic & 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 overlaps. 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.
		Average of all individual indicators in the health sub-area
Output	Eurostat	This indicator reflects challenges related to population ageing. Healthy life years can be influenced by both medical-technological advances and social innovations, such as new occupational prevention models.
Output	Eurostat	
		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.

Appendix 2: Results of the strength weakness analysis

Table 1: Strengths and weaknesses of the Austrian RTI system in the international comparison at a glance

	AT compared to ...			Top Countries	Countries for composite calculation
	EU	IL	Top 3		
Framework conditions for RTI					
Regulation and taxes	92	81	69	(1) DK (2) IE (3) SE	17
Education	107	92	70	(1) FI (2) UK (3) SE	17
International ties	111	106	66	(1) LU (2) BE (3) EE	24
Core RTI system					
Tertiary education	105	91	61	(1) DK (2) PL (3) SE	21
Research at universities and non-university institutions	145	80	67	(1) CH (2) DK (3) NL	15
Corporate RTI	154	103	76	(1) SE (2) FI (3) AT	21
Start-ups and their growth	72	55	47	(1) DK (2) SE (3) NL	21
Governance & financing	165	143	105	(1) BE (2) AT (3) FR	24
RTI efficiency and effectiveness (impact)					
Innovation efficiency	122	95	68	(1) SE (2) DK (3) NL	13
Effectiveness & impact	112	94	68	(1) SE (2) DE (3) UK	22
RTI cross-cutting issues					
Digitisation	84	68	50	(1) SE (2) IE (3) DK	19
RTI climate	86	73	32	(1) DE (2) SI (3) RO	31
Location attractiveness	134	108	74	(1) IE (2) FI (3) CH	27
Gender equality	91	86	57	(1) RO (2) PL (3) LT	26

Table 2: Strengths and weaknesses of the Austrian RTI system in the international comparison in detail

	AT compared to ...			Top Countries
	EU	IL	Top 3	
Framework conditions for RTI				
Regulation and taxes	92	81	69	(1) DK (2) IE (3) SE
Regulation	101	86	97	(1) UK (2) NZ (3) AU
Finance system	84	66	54	(1) DK (2) SE (3) CZ
Tax system	87	91	42	(1) IE (2) CH (3) TR
Education	107	92	70	(1) FI (2) UK (3) SE
Early childhood care	102	89	79	(1) CA (2) NZ (3) MT
Primary education	116	94	67	(1) FI (2) IE (3) UK
Secondary school level	105	94	59	(1) EE (2) NL (3) FI
Further training	131	60	51	(1) CH (2) SE (3) FI
International ties	111	106	66	(1) LU (2) BE (3) EE
Labour market interconnections	89	91	59	(1) LU (2) NL (3) CY
University interconnections	130	80	48	(1) LU (2) BE (3) NL
Innovation interconnections	107	123	86	(1) LT (2) LV (3) SK
Economy interconnections	101	109	61	(1) BE (2) SI (3) IE

	AT compared to ...			Top Countries
	EU	IL	Top 3	
Core RTI system				
Tertiary education	105	91	61	(1) DK (2) PL (3) SE
University teaching expenditure and support	105	86	53	(1) LU (2) DK (3) SE
University graduates as a whole	105	93	63	(1) PL (2) IE (3) DK
Research at universities and non-university institutions	145	80	67	(1) CH (2) DK (3) NL
Expenditure and HR in research at universities & non-university institutions	155	92	85	(1) CH (2) NO (3) DK
Research performance, universities & non-university institutions	137	70	53	(1) CH (2) DK (3) NL
Corporate RTI	154	103	76	(1) SE (2) FI (3) AT
RTI in SMEs	130	115	67	(1) UK (2) EE (3) FI
Corporate RTI expenditure and HR	151	104	95	(1) SE (2) IS (3) AT
Cooperation between science and economy	176	115	70	(1) IS (2) AT (3) UK
Corporate invention performance	214	74	56	(1) SE (2) NL (3) DK
Innovation impact – upgrading	137	104	84	(1) DE (2) SE (3) FI
Innovation impact – structural change	107	104	73	(1) DE (2) CH (3) CZ
Start-ups and their growth	72	55	47	(1) DK (2) SE (3) NL
Governance & financing	165	143	105	(1) BE (2) AT (3) FR
R&D rate	180	95	151	(1) KR (2) IL (3) SE
University and basic research funding	122	83	100	(1) CH (2) FI (3) SE
Corporate financing	200	209	76	(1) FR (2) BE (3) IE
RTI efficiency and effectiveness (impact)				(1) SE (2) DK (3) NL
Innovation efficiency	122	95	68	(1) SE (2) UK (3) IE
Science efficiency	128	74	64	(1) CH (2) DK (3) NO
Technology efficiency	171	68	54	(1) CH (2) SE (3) IL
Effectiveness & impact	112	94	68	(1) SE (2) DE (3) UK
EIS Index	128	88	81	(1) CH (2) SE (3) FI
Economic & social	119	101	72	(1) IS (2) NO (3) LU
Health	91	92	80	(1) MT (2) SE (3) NO
Environment result indicators	112	90	52	(1) UK (2) NL (3) LU
RTI cross-cutting issues				
Digitisation	84	68	50	(1) SE (2) IE (3) DK
Investments & infrastructure	66	46	38	(1) SE (2) LT (3) DK
ICT specialists	95	74	55	(1) FI (2) IE (3) EE
ICT invention performance	52	41	26	(1) IE IL (3) SK
Use of ICT in companies	94	74	58	(1) IE (2) BE (3) NL
ICT impact	85	80	56	(1) CZ (2) SK (3) LU
RTI climate	86	73	32	(1) DE (2) SI (3) RO
R&D, energy, climate	88	73	27	(1) JP (2) KR (3) DE
Climate inventions	85	72	42	(1) CY (2) DK (3) MX
Greenhouse gases	78	75	42	(1) LT (2) LV (3) RO
Location attractiveness	134	108	74	(1) IE (2) FI (3) CH
Gender equality	91	86	57	(1) RO (2) PL (3) LT
Schools & universities – gender equality	81	76	47	(1) PL (2) EL (3) SE
Women in RTI professions	101	96	67	(1) LT (2) RO (3) EE

	Indicator	AT compared to...			Top 3
		Current AT value	EU	IL	
Table 3: Regulation and taxes					
Total	Regulation and taxes	–	92	81	69
Regulation	Regulation	–	101	86	97
	Labour market regulation – individual	2.4	95	103	104
	Labour market regulation – collective	3.3	98	78	79
	Labour market regulation – temporary	2.2	103	69	143
	Product market regulation	1.5	90	83	66
	IPR regulation	5.9	117	99	93
Finance system	Finance system	–	84	66	54
	Size of the capital market	167.1	78	50	37
	Investor protection	35.0	104	106	83
	VC funds financing structure	68.8	92	78	69
	Venture capital intensity	0.2	60	31	29
Tax system	Tax system	–	87	91	42
	Company taxation	23.1	86	88	48
	Wage and salary charges	47.6	87	83	32
	Tax and levies ratio	42.2	88	101	47

Table 4: Education

Overall system	Education	–	107	92	70
	Education spending in % of GDP	3.1	96	78	86
	Education spending per student	13,930.8	150	126	279
	School performances – high competence	8.7	110	79	61
	School performances – low competence	22.2	106	78	54
Early childhood care	Early childhood care	–	102	89	79
	Early childhood care	95.6	103	101	96
	Early childhood teacher-child ratio	13.8	102	77	62
Primary education	Primary education	–	116	94	67
	Spending per pupil (primary education)	8,824.1	155	120	80
	Spending relative to GDP – primary education	0.9	78	57	46
	Supervisory relationship in primary education	11.3	122	127	84
	Primary education – top	8.0	71	63	40
	Primary education – low	2.0	226	100	86
	Primary education reading – top	8.0	71	63	40
	Primary education reading – average	84.0	103	95	93
	Primary education reading – low	2.0	226	100	86
	Primary education reading – average	541.0	100	98	96
	Maths & Science VS – top	5.0	62	63	16
	Maths & Science VS – average	74.5	96	92	79
	Maths & Science VS – low	4.5	99	144	33
	Maths & Science VS – average	520.0	99	98	88

	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) IE (3) SE	-	-	-	-
	-	-	-	(1) UK (2) NZ (3) AU	-	-	Average of all individual indicators in the Regulation sub-area	-
	-1.00	-1.14	2.8	(1) US (2) CA (3) UK	39	2000–2013	OECD Employment Protection Database	yes
	0.60	0.00	3.3	(1) NZ CL (3) FI	39	2000–2013	OECD Employment Protection Database	yes
	-2.02	0.00	2.2	(1) CA (2) US (3) UK	39	2008–2013	OECD Employment Protection Database	yes
	-	-	1.5	(1) UK (2) ES (3) DK	33	2018–2018	OECD Indicator for Product Market Regulation	yes
	1.91	0.34	5.9	(1) FI (2) CH (3) NL	41	2017–2019	World Economic Forum	no
	-	-	-	(1) DK (2) SE (3) CZ	-	-	-	-
	-6.82	19.44	147.6	(1) LU (2) CZ (3) NL	28	2000–2018	World Bank, World Development Indicators	no
	0.00	0.00	35.0	(1) NZ (2) UK CA	42	2013–2019	World Bank, Doing Business	no
	-14.28	-1.22	70.0	(1) RO DK (3) PT	21	2007–2018	Invest Europe	no
	-0.03	-0.09	0.3	(1) DK (2) NL (3) UK	22	2007–2018	Invest Europe	no
	-	-	-	(1) IE (2) CH (3) TR	-	-	-	-
	0.97	-6.60	29.7	(1) BG (2) HU (3) CY	33	2000–2018	Eurostat/OECD	yes
	5.43	0.32	47.3	(1) CL (2) NZ (3) MX	36	2000–2018	Eurostat/OECD	yes
	1.97	-0.10	42.3	(1) MX (2) CL (3) IE	36	2000–2018	Eurostat/OECD	yes
	-	-	-	(1) FI (2) UK (3) SE	-	-	-	-
	-0.36	0.00	3.1	(1) NO (2) NZ (3) IS	36	2012–2015	OECD	no
	-0.32	3.73	12,481.4	(1) LU (2) NO (3) AT	36	2012–2015	OECD	no
	2.22	1.23	7.5	(1) KR (2) JP (3) CA	42	2000–2018	PISA, TIMMS, PIRLS	no
	-4.47	2.87	19.3	(1) EE (2) CN (3) JP	42	2000–2018	PISA, TIMMS, PIRLS	yes
	-	-	-	(1) DE (2) IS (3) LV	-	-	-	-
	-0.43	11.00	84.6	(1) FR UK IE	32	2000–2017	Eurostat	no
	-1.41	-1.84	18.2	(1) NZ (2) DE (3) FI	34	2002–2017	Eurostat	yes
	-	-	-	(1) FI (2) IE (3) UK	-	-	-	-
	3.03	4.17	7,494.6	(1) LU (2) CH (3) NO	31	2012–2016	Eurostat	no
	0.09	0.03	0.9	(1) IS (2) CY (3) SE	31	2012–2016	Eurostat	no
	-1.73	-1.29	11.9	(1) LU (2) EL (3) NO	31	2013–2017	Eurostat	yes
	0.50	0.00	8.0	(1) IE (2) UK (3) BG	33	2006–2016	PIRLS	no
	-0.19	0.00	2.0	(1) LV NL (3) AT IE SE IT FI	33	2006–2016	PIRLS	yes
	0.75	0.00	8.0	(1) IE (2) UK (3) BG	27	2006–2016	PIRLS	no
	1.50	0.00	84.0	(1) FI (2) LV (3) IE	27	2006–2016	PIRLS	no
	-0.25	0.00	2.0	(1) LV NL (3) IE FI IT SE AT	27	2006–2016	PIRLS	yes
	0.11	0.06	538.0	(1) IE (2) FI (3) UK	27	2006–2016	PIRLS	no
	-0.75	-1.00	6.0	(1) KR (2) CN (3) JP	27	2007–2015	TIMMS (NB: the value for Austria is from 2011)	no
	1.50	2.00	72.5	(1) KR (2) JP (3) CN	27	2007–2015	TIMMS (NB: the value for Austria is from 2011)	no
	-2.00	-2.50	7.0	(1) TR (2) NZ (3) SK	27	2007–2015	TIMMS (NB: the value for Austria is from 2011)	no
	0.12	0.11	515.5	(1) KR (2) CN (3) JP	28	2007–2015	TIMMS (NB: the value for Austria is from 2011)	no

	Indicator	AT compared to...			Top 3
		Current AT value	EU	IL	
»» Education					
Secondary school level	Secondary school level	–	105	94	59
	Spending per pupil (secondary education)	23,618.0	168	126	91
	Spending relative to GDP – secondary education	2.2	128	127	84
	Secondary education school performances – top	8.7	110	79	61
	Secondary education school performances – low	22.2	94	129	48
	PISA reading – top	7.2	99	71	52
	PISA reading – low	23.6	102	76	50
	PISA reading – average	484.4	101	96	93
	PISA reading gender difference	28.1	116	128	61
	PISA performance difference – origin	62.5	67	125	3
	PISA mathematics – top	12.6	122	93	65
	PISA mathematics – low	21.1	112	76	57
	PISA mathematics – average	498.9	102	98	95
	PISA mathematics gender difference	13.3	49	24	5
	PISA Science – top	6.3	105	69	50
	PISA Science, low	21.9	106	81	50
	PISA Science, average	489.8	101	97	93
	Inheritance of education 1	40.1	94	95	64
	Inheritance of education 2	13.0	96	78	50
Early school leavers	7.3	127	120	54	
Percentage of work-related graduates*	79.3	172	155	107	
Further training and life-long learning	Further training	15.1	131	60	51

	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) NL (3) FI	–	–	–	–
	-0.24	2.41	21,474.0	(1) LU (2) CH (3) AT	31	2012–2016	Eurostat	no
	18.45	-1.86	2.3	(1) BE (2) CY (3) FI	32	2012–2016	Eurostat	no
	1.98	0.85	7.5	(1) KR (2) JP (3) CA	41	2000–2018	PISA	no
	-1.62	0.77	19.3	(1) MX (2) BG (3) RO	42	2000–2018	PISA	no
	1.17	-0.22	7.5	(1) CA (2) FI (3) NZ	41	2000–2018	PISA	no
	-1.46	4.31	19.3	(1) EE (2) IE (3) CN	42	2000–2018	PISA	yes
	0.09	-0.09	492.1	(1) EE (2) CA (3) FI	41	2000–2018	PISA	no
	12.00	11.57	20.2	(1) MX (2) CL (3) UK	41	2015–2018	PISA	yes
	–	–	62.5	(1) MT (2) NZ (3) CA	37	2018–2018	PISA	yes
	4.98	-1.72	14.3	(1) KR (2) NL (3) JP	41	2003–2018	PISA	no
	-1.13	2.31	18.8	(1) EE (2) JP (3) DK	41	2003–2018	PISA	yes
	0.12	-0.09	505.6	(1) JP (2) KR (3) EE	41	2003–2018	PISA	no
	-0.01	-8.22	22.2	(1) EL (2) SI (3) SE	41	2012–2018	PISA	yes
	-0.67	-3.68	10.0	(1) JP (2) FI (3) EE	41	2006–2018	PISA	no
	0.83	5.51	16.3	(1) EE (2) JP (3) FI	41	2006–2018	PISA	yes
	-0.07	-0.35	510.8	(1) EE (2) JP (3) FI	41	2006–2018	PISA	no
	-6.15	-4.19	44.3	(1) MX (2) TR (3) CY	41	2000–2018	PISA	yes
	-0.74	-3.65	16.6	(1) EE (2) IS (3) CA	41	2000–2018	PISA	yes
	-0.82	-2.90	10.2	(1) HR (2) SI (3) CH	32	2000–2018	Eurostat	yes
	2.47	-1.30	80.6	(1) AT (2) SK (3) HR	32	2013–2017	Eurostat	no
	0.22	6.80	8.3	(1) CH (2) SE (3) FI	32	2000–2018	Eurostat	no

	Indicator	AT compared to...			Top 3
		Current AT value	EU	IL	
Table 5: International ties					
Overall system	International ties	–	111	106	66
Labour market interconnections	Highly-qualified immigrants	29.7	89	91	59
University interconnections	University interconnections	–	130	80	48
	International co-publications	1,735.2	137	73	52
	International doctoral students	30.3	156	89	50
	EU returns	115.4	97	76	41
Innovation interconnections	Innovation interconnections	–	107	123	86
	Foreign-owned patents	42.6	130	170	49
	Austria-owned foreign patents	86.7	107	107	87
	Patent applications with domestic and foreign inventors	23.5	82	94	63
	Foreign R&D financing	16.0	110	123	147
Economy interconnections	Economy interconnections	–	101	109	61
	Openness	81.1	92	97	47
	GVC integration 1	34.5	93	112	55
	GVC integration 2	24.1	109	100	60
	GVC integration 3	22.5	110	127	80

Table 6: Tertiary education

University teaching	Tertiary education	–	105	91	61
Inputs	University teaching expenditure and support	–	105	86	53
	University expenditure	18,424.1	112	88	51
	Supervisor-student ratio at universities	16.2	98	83	55
University graduates	University graduates as a whole	–	105	93	63
	University graduates	40.5	94	89	63
	University graduates, ISCED 6-8	25.7	67	58	46
	STEM graduates	22.0	124	122	83
	Female STEM graduates	11.9	98	103	61
	Female graduates in technology	0.5	86	95	69
	Female graduates in technology	0.3	96	102	74
	Doctorate holders, STEM	0.9	121	82	56
	International doctoral students	30.3	156	89	50

	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) EE	–	–	–	–
	4.20	11.50	18.2	(1) PL (2) IE (3) UK	32	2004–2018	Eurostat	no
	–	–	–	(1) LU (2) NL (3) CY	–	–	–	–
	-1.37	4.22	1,299.1	(1) IS (2) CH (3) DK	33	2011–2018	Eurostat	no
	-7.70	4.33	26.0	(1) LU (2) CH (3) NL	31	2008–2017	Eurostat	no
	-1.49	-0.74	124.3	(1) BE (2) NL (3) CY	28	2008–2018	EU-Budget, WIFO calculations	no
	–	–	–	(1) LT (2) LV (3) SK	–	–	–	–
	-0.11	0.86	36.6	(1) BG LU (3) AU	41	2000–2018	PATSTAT (autumn 2019), WIFO calculations	no
	6.11	4.69	82.0	(1) EL AU EE HU CL PL TR IS PT IT CZ	41	2000-2018	PATSTAT (autumn 2019), WIFO calculations	no
	23.11	-0.47	25.6	(1) BG LU EE	41	2000-2018	PATSTAT (autumn 2019), WIFO calculations	no
	-8.81	-3.88	19.9	(1) LV (2) CZ (3) IS	38	2000–2017	Eurostat	no
	–	–	–	(1) BE (2) SI (3) IE	–	–	–	–
	7.18	12.47	68.6	(1) SK (2) BE (3) CZ	28	2000–2018	Eurostat	no
	3.12	2.45	32.1	(1) LU (2) IE (3) MT	43	2005–2016	Eurostat	no
	-0.81	0.37	23.8	(1) IE (2) FI (3) LU	28	2000–2018	Eurostat	no
	2.79	2.75	19.8	(1) BE (2) IT (3) SI	28	2000–2018	Eurostat	no
	–	–	–	(1) DK (2) PL (3) SE	–	–	–	–
	–	–	–	(1) LU (2) DK (3) SE	–	–	–	–
	0.34	3.36	10,850.5	(1) LU (2) US (3) CA	35	2000–2016	OECD Education at a Glance	no
	5.12	-1.05	16.9	(1) LU (2) NO (3) MT	28	2013–2017	Eurostat	yes
	–	–	–	(1) PL (2) IE (3) DK	–	–	–	–
	-3.28	9.98	30.5	(1) KR (2) CA (3) JP	38	2004–2018	OECD	no
	-1.33	4.79	20.9	(1) LT (2) CH (3) LU	34	2004–2018	Eurostat	no
	8.08	14.80	7.2	(1) IE (2) FR (3) PL UK	33	2000–2017	Eurostat	no
	-0.73	0.30	11.6	(1) PL (2) IE (3) UK	32	2013–2017	Eurostat	no
	-0.03	-0.02	0.5	(1) PL (2) CY (3) HR	30	2005–2017	Eurostat	no
	0.04	0.06	0.2	(1) PL (2) RO (3) CY	30	2005–2017	Eurostat	no
	-0.05	0.30	0.6	(1) CH (2) UK ES	34	2000–2017	Eurostat	no
	-7.70	4.33	26.0	(1) LU (2) CH (3) NL	31	2008–2017	Eurostat	no

	Indicator	AT compared to...			Top 3
		Current AT value	EU	IL	
Table 7: Research at universities and non-university institutions					
Research	Research at universities and non-university institutions	–	145	80	67
Inputs	Expenditure and HR in research at universities & non-university institutions	–	155	92	85
	Number of researchers (HEI&GOV) per 1,000 of the population	2.0	109	80	91
	R&D expenditure (state and universities sector) per 1,000 of the population	0.5	208	95	69
	R&D expenditure (state and universities sector) in % of GDP	0.9	146	96	118
	Basic research (expenditure as a percentage of GDP)	0.5	156	95	61
	Competitive funding in basic research*		53	38	32
Research performance	Research performance, universities & non-university institutions	27.8	137	70	53
	University ranking, research performance	73,670.7	76	46	29
	Number of publications per 1,000 of the population	2.6	123	71	57
	Quality of publications	11.5	123	80	73
	ERC grants	3.4	224	82	54
	International co-publications	1,735.2	137	73	52

Table 8: Corporate research and innovation in existing companies

Overall system	Corporate RTI	–	154	103	76
	Corporate RTI (reduced indicators set)	–	164	101	80
	Inputs in corporate RTI (including cooperations)	–	162	111	87
	Corporate RTI outputs	–	137	97	66
SMEs	RTI in SMEs	–	130	115	67
	Innovative SMEs	45.0	135	103	81
	Innovation revenue	9.5	76	98	33
	SMEs & cooperation	22.1	181	143	85
Inputs for RTI in companies	Corporate RTI expenditure and HR	–	151	104	95
	BERD	1.1	261	110	94
	Innovative companies	62.0	131	108	88
	Foreign-funded R&D	16.0	110	123	147
	Number of corporate researchers	3.6	180	81	77
	Female researchers	29.5	81	90	60
	Industry structure-adjusted R&D intensity	1.0	146	112	105

	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) NL	-	-	-	-
	-	-	-	-	-	-	-	-
	3.70	4.82	1.0	(1) IS (2) NO (3) DK	41	2002–2017	OECD MSTI	no
	1.08	5.09	0.2	(1) NO (2) DK (3) LU	41	2002–2018	OECD MSTI	no
	0.12	0.25	0.7	(1) DK (2) NO (3) SE	38	2002–2017	OECD MSTI	no
	2.39	2.67	0.4	(1) CH (2) KR (3) DK	33	2002–2017	OECD MSTI	no
	-1.78	3.19	19.7	(1) CH (2) FI (3) SE	5	2007–2018	Funds' annual reports, WIFO calculations	no
	-	-	-	(1) CH (2) DK (3) NL	-	-	-	-
	1.99	4.53	51,671.9	(1) CH (2) NL (3) AU	26	2009–2017	CWTS Leiden Ranking, WIFO calculations	no
	0.12	3.79	1.6	(1) CH (2) IS (3) DK	41	2005–2018	Scimago	no
	-0.08	0.77	10.7	(1) DK (2) NL (3) CH	40	2009–2016	European Innovation Scoreboard	no
	-1.98	9.27	1.7	(1) CH (2) IL (3) NL	33	2009–2017	European Research Council	no
	-1.37	4.22	1,299.1	(1) IS (2) CH (3) DK	33	2011–2018	European Innovation Scoreboard	no
	-	-	-	(1) SE (2) FI (3) AT	-	-	-	-
	-	-	-	(1) SE (2) DE (3) AT	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	(1) UK (2) EE (3) FI	-	-	-	-
	-0.20	5.48	-39.6	(1) PT (2) NO (3) FI	39	2009–2016	European Innovation Scoreboard	no
	2.15	2.54	7.0	(1) UK (2) SK (3) IE	29	2004–2016	Eurostat	no
	8.78	7.38	14.7	(1) UK (2) EE (3) IS	33	2009–2016	European Innovation Scoreboard	no
	-	-	-	(1) SE (2) IS (3) AT	-	-	-	-
	2.49	6.04	0.4	(1) SE (2) DK (3) AT	41	2002–2018	OECD MSTI	no
	-1.12	5.77	56.2	(1) CH (2) NO (3) BE	32	2008–2016	Eurostat CIS	no
	-8.81	-3.88	19.9	(1) LV (2) CZ (3) IS	38	2000–2017	OECD MSTI	no
	0.20	3.86	2.0	(1) SE (2) DK (3) NL	41	2002–2018	OECD MSTI	no
	5.05	8.78	20.7	(1) LV (2) LT (3) RO	32	2002–2015	OECD MSTI	no
	0.23	2.14	0.9	(1) AT (2) SE (3) BE	39	2008–2015	Eurostat, OECD	no



	Indicator	AT compared to...			Top 3
		Current AT value	EU	IL	
Corporate research and innovation in existing companies					
Cooperation between science and economy	Cooperation between science and economy	–	176	115	70
	Companies with innovation cooperations	23.2	174	145	94
	Leiden Ranking – cooperation with companies	34,431.1	259	76	50
	University financing by companies	5.3	96	123	67
Invention quality and quantity	Corporate invention performance	–	214	74	56
	Patent applications	0.2	243	92	70
	Triadic patent applications	0.025	174	55	26
	Super patents	1.8	226	75	71
Innovation impact – upgrading	Innovation impact – upgrading	–	137	104	84
	Export quality	80.8	127	97	93
	Export complexity	1.8	147	111	76
Innovation impact – structural change	Innovation impact – structural change	–	107	104	73
	Knowledge intensity exports	57.4	114	117	80
	Innovation-intensive industries	0.3	109	107	75
	Employment in knowledge-intensive sectors	15.0	106	90	58
	Innovation-intensive service exports	76.4	101	104	80

Table 9: Start-ups

Overall system	Start-ups and their growth	–	72	55	47
Start-up regulation, financing and funding	Start-up regulation	83.2	93	89	85
	Venture capital intensity	0.24	60	31	29
	VC funds financing structure	68.8	92	78	69
	Motivation for entrepreneurial activity	2.7	75	31	26
Starting and growth of innovative start-ups	Rapidly growing start-ups	2.1	43	45	26

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	–	–	–	(1) IS (2) AT (3) UK	–	–	–	–
	16.31	13.19	10.0	(1) UK (2) FI (3) AT	32	2004–2016	Eurostat CIS	no
	2.77	9.20	17,029.2	(1) IS (2) DK (3) SE	37	2009–2017	CWTS Leiden Ranking	no
	1.49	1.24	4.1	(1) CN (2) KR (3) DE	38	2002–2017	OECD	no
	–	–	–	(1) SE (2) NL (3) DK	–	–	–	–
	2.27	2.35	0.1	(1) CH (2) SE (3) DE	40	2000–2016	PATSTAT (autumn 2019), World Bank, WIFO calculations	no
	0.16	-2.54	0.038	(1) JP (2) CH (3) NL	40	2000–2016	PATSTAT (autumn 2019), World Bank, WIFO calculations	no
	3.55	2.45	1.2	(1) SE (2) FI (3) DE	28	2000–2017	PATSTAT (autumn 2019), World Bank, WIFO calculations	no
	–	–	–	(1) DE (2) SE (3) FI	–	–	–	–
	4.62	0.76	80.0	(1) SE (2) FI (3) DE	28	2010–2018	Eurostat	no
	0.94	0.31	1.7	(1) JP (2) CH (3) DE	42	2000–2017	BACI	no
	–	–	–	(1) DE (2) CH (3) CZ	–	–	–	–
	3.58	2.08	55.3	(1) JP (2) KR (3) MX	41	2005–2018	Eurostat	no
	0.00	-0.01	0.3	(1) HU (2) CZ (3) DE	41	2008–2017	Eurostat	no
	-0.05	0.60	14.4	(1) IL (2) LU (3) CH	33	2010–2017	European Innovation Scoreboard	no
	5.49	2.80	73.6	(1) IS (2) LU (3) NO	38	2010–2018	Eurostat	no
	–	–	–	(1) DK (2) SE (3) NL	–	–	–	–
	-0.06	0.37	78.7	(1) NZ (2) CA (3) AU	43	2004–2019	World Bank	no
	-0.03	-0.09	0.33	(1) DK (2) NL (3) UK	22	2007–2018	Invest Europe	no
	-14.28	-1.22	70.0	(1) RO DK (3) PT	21	2007–2018	Invest Europe	no
	-8.71	-3.78	3.5	(1) DK (2) IS (3) FI	32	2011–2018	European Innovation Scoreboard	no
	-0.09	-0.78	2.9	(1) HU (2) IE (3) BG	30	2009–2016	European Innovation Scoreboard	no

	Indicator	AT compared to...			Top 3
		Current AT value	EU	IL	
Table 10: Governance and financing					
Total	Governance& financing	–	165	143	105
National level	R&D rate	3.2	180	95	151
	Private sector funding in R&D expenditure	70.5	106	97	103
	Public sector funding of R&D	0.9	161	113	189
	EU returns	115.4	97	76	41
University and basic research funding	University and basic research funding	–	122	83	100
	Public HERD financing, in % of GDP	0.6	196	97	163
	Percentage of public HERD financing	85.4	116	112	105
	Competitive funding in basic research*	27.8	53	38	32
Corporate financing	Corporate financing	–	200	209	76
	Corporate funding	26.7	215	224	73
	Direct corporate funding	11.9	241	172	74
	Indirect corporate funding	14.8	208	295	54
	Foreign financing of corporate R&D	20.6	134	145	102

Table 11: Digitisation

Total	Digitisation	–	84	68	50
Investments and infrastructure	Investments & infrastructure	–	66	46	38
	ICT investments	14.4	122	96	77
	Broadband	14.0	66	36	33
	Fibre optics	2.5	9	6	3
ICT specialists	ICT specialists	–	95	74	55
	ICT basic skills	67.0	117	88	81
	ICT specialists	4.5	114	76	69
	Female ICT specialists	18.4	110	95	72
	ICT graduates	2.1	77	65	32
	Female ICT graduates	0.7	57	45	22
ICT invention capacity	ICT invention performance	–	52	41	26
	ICT patents, strictly defined	0.4	52	41	26
	ICT patents, broadly defined	0.4	52	41	26
Use of ICT in companies	Use of ICT in companies	–	94	74	58
	ERP usage	40.0	118	101	81
	Social media use	50.0	107	82	72
	Big Data analyses	6.0	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) BE (2) AT (3) FR	–	–	–	–
	1.30	1.27	1.9	(1) KR (2) IL (3) SE	38	2000–2017	OECD MSTI	no
	7.85	8.51	62.0	(1) JP (2) BE (3) KR	37	2000–2017	OECD MSTI	no
	0.21	0.21	0.7	(1) KR (2) NO (3) AT	38	2000–2017	OECD MSTI	no
	-1.46	-0.74	124.3	(1) BE (2) NL (3) CY	28	2008–2018	EU-Budget, WIFO calculations	no
	–	–	–	(1) CH (2) FI (3) SE	–	–	–	–
	-0.03	0.07	0.5	(1) CH (2) DK (3) NO	35	2002–2017	OECD MSTI	no
	2.73	-5.96	91.4	(1) LU (2) NO (3) MT	35	2002–2017	OECD MSTI	no
	-1.78	3.19	19.7	(1) CH (2) FI (3) SE	5	2007–2018	Funds' annual reports, WIFO calculations	no
	–	–	–	(1) FR (2) BE (3) IE	–	–	–	–
	0.08	0.09	17.3	(1) FR (2) BE (3) IE	39	2002–2016	OECD	no
	0.06	0.05	7.2	(1) IL (2) SE (3) KR	42	2002–2016	OECD	no
	0.00	0.04	11.1	(1) BE (2) FR (3) IE	39	2000–2016	OECD	no
	-13.65	-9.30	29.9	(1) IL (2) LV (3) IS	38	2002–2015	OECD MSTI	no
	–	–	–	(1) SE (2) IE (3) DK	–	–	–	–
	–	–	–	(1) SE (2) LT (3) DK	–	–	–	–
	0.12	0.61	13.0	(1) NL (2) US (3) CZ	27	2000–2017	EUKLEMS	no
	-16.25	2.00	12.0	(1) DK (2) SE (3) PT	30	2011–2018	European Innovation Scoreboard	no
	-22.22	1.51	1.0	(1) KR (2) JP (3) LT	36	2012–2018	OECD	no
	–	–	–	(1) FI (2) IE (3) EE	–	–	–	–
	0.50	3.00	64.0	(1) LU IS (3) NL	32	2015–2017	Eurostat	no
	0.05	1.70	2.8	(1) FI (2) SE (3) EE	32	2004–2018	Eurostat	no
	-3.20	-4.20	22.6	(1) BG (2) LT (3) RO	32	2004–2018	Eurostat	no
	-1.10	0.23	1.8	(1) IE (2) FI (3) IS	32	2005–2017	Eurostat	no
	-0.33	0.13	0.6	(1) IE (2) IS (3) EE	32	2005–2017	Eurostat	no
	–	–	–	(1) KR (2) SE (3) CY	–	–	–	–
	1.26	-0.23	0.4	(1) KR (2) SE (3) CY	41	2000–2015	PATSTAT (autumn 2019), Inaba, Squicciarini 2017 (OECD), WIFO calculations	no
	1.25	-0.19	0.4	(1) KR (2) SE (3) CY	41	2000–2015	PATSTAT (autumn 2019), Inaba, Squicciarini 2017 (OECD), WIFO calculations	no
	–	–	–	(1) IE (2) BE (3) NL	–	–	–	–
	4.00	15.00	25.0	(1) BE (2) NL (3) LT	27	2010–2017	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_ERP1)	no
	-10.25	12.00	38.0	(1) MT (2) IE (3) CY	27	2013–2017	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_SM1_GE2)	no
	-2.25	0.00	6.0	(1) MT (2) NL (3) BE IE	27	2018–2018	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_BD)	no

	Indicator	AT compared to...			Top 3
		Current AT value	EU	IL	
Digitisation					
Use of ICT in companies	Cloud computing	11.0	55	25	24
	SME online trade	13.0	76	53	43
	SME international online trade	8.0	161	145	98
Economic impact of ICT	ICT impact	–	85	80	56
	ICT value creation	13.2	89	97	64
	ICT employment	10.0	98	100	67
	Value creation share of ICT production sectors	5.7	77	67	57
	SME online trade revenue	9.0	78	56	38

Table 12: Environment and climate

Total	RTI climate	–	86	73	32
R&D, energy, climate	R&D, energy, climate	–	88	73	27
R&D expenditure in the environment area	R&D expenditure in the environment area (in % of GDP)	0.010	85	100	33
	R&D expenditure in the environment area (in % of GBOARD)	0.7	27	51	10
R&D expenditure in the energy area	R&D expenditure in the energy area (in % of GDP)	0.020	133	67	32
	R&D expenditure in the energy area (in % of GBOARD)	2.8	105	74	31
Patents in energy and climate	Climate inventions	1.0	85	72	42
Impact	Greenhouse gases	106.2	78	75	42

Table 13: Location attractiveness

Total	Location attractiveness	–	134	108	74
	Corporate funding	0.3	215	224	73
	Company taxation	23.1	86	88	48
	IPR regulation	5.9	117	99	93
	Quality of publications	11.5	123	80	73
	STEM graduates	22.0	124	122	83
	Female STEM graduates	11.9	98	103	61
	Political stability	0.9	136	100	64
	Quality of public services	1.5	134	77	74
	Regulatory quality	1.5	132	85	78
	Rule of law	1.9	172	99	95

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	-11.25	5.00	6.0	(1) FI (2) SE (3) NL	27	2014–2018	Eurostat – Community survey on ICT usage and eCommerce in Enterprises	no
	-3.25	0.00	13.0	(1) DK (2) IE SE	27	2010–2018	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_ESELL)	no
	2.00	4.00	4.0	(1) IE (2) AT (3) HR BE CY	31	2011–2019	Eurostat – Community survey on ICT usage and eCommerce in Enterprises (E_AESEU)	no
	–	–	–	(1) CZ (2) SK (3) LU	–	–	–	–
	-0.01	0.00	13.5	(1) CZ (2) SK (3) HU	30	2007–2017	Eurostat	no
	0.01	0.01	9.2	(1) SI (2) LU (3) CZ	30	2007–2017	Eurostat	no
	0.00	-0.01	6.6	(1) CH (2) BG (3) HU	30	2005–2017	Eurostat	no
	-2.33	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) SI (3) RO	–	–	–	–
	–	–	–	(1) JP (2) KR (3) DE	–	–	–	–
	0.00	0.00	0.010	(1) DE JP SI NO	35	2004–2018	Eurostat	no
	-0.22	-0.67	1.4	(1) PL (2) RO (3) SI	35	2004–2018	Eurostat	no
	0.02	0.02	0.000	(1) JP (2) FR DE	35	2004–2018	Eurostat	no
	1.68	2.06	0.7	(1) JP (2) FR (3) NL	35	2004–2018	Eurostat	no
	-4.32	-2.42	1.5	(1) CY (2) DK (3) MX	41	2000–2017	PATSTAT (autumn 2019), OECD 2015, WIFO calculations	no
	1.52	0.17	103.2	(1) LT (2) LV (3) RO	31	2000–2017	Eurostat	yes
	–	–	–	(1) IE (2) FI (3) CH	–	–	–	–
	0.08	0.09	0.2	(1) FR (2) BE (3) IE	39	2002–2016	OECD	no
	0.97	-6.60	29.7	(1) BG (2) HU (3) CY	33	2000–2018	Eurostat/OECD	yes
	1.91	0.34	5.9	(1) FI (2) CH (3) NL	41	2017–2019	World Economic Forum	no
	-0.08	0.77	10.7	(1) DK (2) NL (3) CH	40	2009–2016	European Innovation Scoreboard	no
	8.08	14.80	7.2	(1) IE (2) FR (3) PL UK	33	2000–2017	Eurostat	no
	-0.73	0.30	11.6	(1) PL (2) IE (3) UK	32	2013–2017	Eurostat	no
	3.61	0.60	0.8	(1) NZ (2) IS (3) LU	43	2000–2018	WGI	no
	-1.14	-1.56	1.9	(1) CH (2) FI (3) NO	43	2000–2018	WGI	no
	-0.13	0.04	1.5	(1) NL (2) NZ (3) AU	43	2000–2018	WGI	no
	-0.02	0.10	1.8	(1) FI (2) NO (3) CH	43	2000–2018	WGI	no

	Indicator	AT compared to...			Top 3
		Current AT value	EU	IL	
Table 14: Gender equality					
Total	Gender equality	–	91	86	57
Schools & universities	Schools & universities – gender equality	–	81	76	47
	PISA gender difference in mathematics	13.3	49	24	5
	Female STEM graduates	11.9	98	103	61
	Female graduates in technology	0.3	96	102	74
Occupational differences	Women in RTI professions	–	101	96	67
	Female ICT specialists	18.4	110	95	72
	Female researchers	29.5	81	90	60
	Glass Ceiling Index EU	1.5	112	104	71

Table 15: Efficiency of RTI activities

DEA efficiency	Science efficiency	–	128	74	64
	Technology efficiency	–	171	68	54
	Innovation efficiency	–	122	95	68
Input indicators	Number of researchers	5.8	145	83	77
	R&D expenditure (state and universities sector) per researcher	0.5	208	95	69
	BERD	1.1	261	110	94
	Number of corporate researchers	3.6	180	81	77
	R&D expenditure (GERD)	1.6	242	105	91
	Number of researchers (HEI&GOV)	2.0	109	80	91
	University graduates	40.5	94	89	63
Output indicators	University ranking, research performance	73,670.7	76	46	29
	Number of publications per 1,000 of the population	2.6	123	71	57
	Quality of publications	11.5	123	80	73
	Patent applications	0.2	243	92	70
	Triadic patent applications	0.025	174	55	26
	Innovation revenue	9.5	76	98	33
	Innovation-intensive industries	0.3	109	107	75
	Rapidly growing start-ups	2.1	43	45	26
	Knowledge intensity exports	57.4	114	117	80
	Export complexity	1.8	147	111	76
	Export quality	80.8	127	97	93

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	–	–	–	(1) RO (2) PL (3) LT	–	–	–	–
	–	–	–	(1) PL (2) EL (3) SE	–	–	–	–
	-0.01	-8.22	22.2	(1) EL (2) SI (3) SE	41	2012–2018	PISA	yes
	-0.73	0.30	11.6	(1) PL (2) IE (3) UK	32	2013–2017	Eurostat	no
	0.04	0.06	0.2	(1) PL (2) RO (3) CY	30	2005–2017	Eurostat	no
	–	–	–	(1) LT (2) RO (3) EE	–	–	–	–
	-3.20	-4.20	22.6	(1) BG (2) LT (3) RO	32	2004–2018	Eurostat	no
	5.05	8.78	20.7	(1) LV (2) LT (3) RO	32	2002–2015	OECD MSTI	no
	-1.38	-3.54	2.4	(1) RO (2) MT (3) BG	33	2004–2016	She Figures	yes
	–	–	–	(1) CH (2) DK (3) NO	–	–	–	–
	–	–	–	(1) CH (2) SE (3) IL	–	–	–	–
	–	–	–	(1) SE (2) UK (3) IE	–	–	–	–
	1.64	4.20	3.0	(1) DK (2) SE (3) FI	41	2002–2018	OECD, Eurostat, WIFO calculations	no
	1.08	5.09	0.2	(1) NO (2) DK (3) LU	41	2002–2018	OECD, Eurostat, WIFO calculations	no
	2.49	6.04	0.4	(1) SE (2) DK (3) AT	41	2002–2018	OECD, Eurostat, WIFO calculations	no
	0.20	3.86	2.0	(1) SE (2) DK (3) NL	41	2002–2018	OECD, Eurostat, WIFO calculations	no
	2.38	5.98	0.6	(1) DK (2) SE (3) NO	41	2000–2018	OECD, Eurostat, WIFO calculations	no
	3.70	4.82	1.0	(1) IS (2) NO (3) DK	41	2002–2017	OECD, Eurostat, WIFO calculations	no
	-3.28	9.98	30.5	(1) KR (2) CA (3) JP	38	2004–2018	OECD	no
	1.99	4.53	51,671.9	(1) CH (2) NL (3) AU	26	2009–2017	CWTS Leiden Ranking	no
	0.12	3.79	1.6	(1) CH (2) IS (3) DK	41	2005–2018	Scimago, World Bank, WIFO calculations	no
	-0.08	0.77	10.7	(1) DK (2) NL (3) CH	40	2009–2016	European Innovation Scoreboard	no
	2.27	2.35	0.1	(1) CH (2) SE (3) DE	40	2000–2016	PATSTAT (autumn 2019), World Bank, WIFO calculations	no
	0.16	-2.54	0.038	(1) JP (2) CH (3) NL	40	2000–2016	PATSTAT (autumn 2019), World Bank, WIFO calculations	no
	2.15	2.54	7.0	(1) UK (2) SK (3) IE	29	2004–2016	Eurostat	no
	0.00	-0.01	0.3	(1) HU (2) CZ (3) DE	41	2008–2017	OECD, Eurostat, WIFO calculations	no
	-0.09	-0.78	2.9	(1) HU (2) IE (3) BG	30	2009–2016	European Innovation Scoreboard	no
	3.58	2.08	55.3	(1) JP (2) KR (3) MX	41	2005–2018	BACI, WIFO calculations	no
	0.94	0.31	1.7	(1) JP (2) CH (3) DE	42	2000–2017	BACI, WIFO calculations	no
	4.62	0.76	80.0	(1) SE (2) FI (3) DE	28	2010–2018	WIFO calculations (by analogy with EIS, European Innovation Scoreboard)	no

	Indicator	AT compared to...			Top 3
		Current AT value	EU	IL	
Table 16: Efficiency of RTI activities					
Total	Effectiveness & impact	–	112	94	68
Innovation	EIS Index	124.8	128	88	81
Economic & social	Economic & social	–	119	101	72
	GDP/per capita	127.0	126	105	64
	Employment rate	73.0	105	97	90
	Unemployment rate	4.9	134	115	50
	Quality of life	6.8	109	86	83
Health	Health	–	91	92	80
	Healthy life years (F)	67.7	91	92	79
	Healthy life years (M)	72.3	91	91	80
Environment	Environment result indicators	–	112	90	52
	Greenhouse gases	106.2	78	75	42
	Energy intensity	4.4	151	110	66
	Resource productivity	1.9	108	84	49

	Growth difference AT vs IL (in %)	Annual growth in %	Initial value AT	Leading countries	Number of available countries	Time series	Source	Inverted value
	–	–	–	(1) SE (2) DE (3) UK	–	–	–	–
	0.44	1.39	113.4	(1) CH (2) SE (3) FI	33	2011–2018	European Innovation Scoreboard	no
	–	–	–	(1) IS (2) NO (3) LU	–	–	–	–
	0.20	-0.13	130.0	(1) LU (2) IE (3) CH	34	2000–2018	Eurostat	no
	1.00	4.50	68.5	(1) IS (2) CH (3) SE	32	2000–2018	Eurostat	no
	1.20	1.00	3.9	(1) CZ (2) JP (3) IS	33	2000–2018	Eurostat	yes
	-2.61	-3.07	7.7	(1) NO (2) DK (3) SE	35	2013–2017	OECD	no
	–	–	–	(1) MT (2) SE (3) NO	–	–	–	–
	-3.68	-5.80	73.5	(1) MT (2) SE (3) BG	31	2004–2017	Eurostat	no
	-2.15	-4.00	76.3	(1) SE (2) MT (3) NO	31	2004–2017	Eurostat	no
	–	–	–	(1) UK (2) NL (3) LU	–	–	–	–
	1.52	0.17	103.2	(1) LT (2) LV (3) RO	31	2000–2017	Eurostat	yes
	0.96	-0.50	4.8	(1) IE (2) DK (3) MT	28	2000–2017	Eurostat	yes
	-0.07	0.96	1.6	(1) NL (2) UK (3) LU	30	2000–2018	Eurostat	no

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