

# Why You Should Research in Austria: Research Location Austria

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# Why You Should Research in Austria

Innovative companies from across the globe enjoy optimal conditions in Austria



# Mozart Kugels and Microelectronics, Lipizzaner and Lightweight Construction

Maybe unexpected: Austria is a top research location

Austria is famed for music, high culture and culinary delights. However, Mozart, Lipizzaner stallions and Sachertorte are only the traditional side of the story. As a "strong innovator", Austria, with a research ratio of 3.14 percent of GDP, takes second place in Europe (behind Sweden) in research investment. Global players, such as BMW, Bosch, Infineon and Novartis, concentrate their R&D activities in Austria. These activities are supplemented by innovative spin-offs and a lively startup scene in a creative, interdisciplinary ecosystem. Clusters and centres of excellence with regional focuses foster active collaboration between science and business in university and non-university research. Diversity and strong networking characterise the research community: Top researchers and "serial entrepreneurs" work side by side, companies and intellectual property find each other through idea portals, and incubators support entrepreneurial visionaries. Precision medicine, artificial intelligence, autonomous driving, alternative drive systems and lightweight construction supplement such traditionally strong segments as machine, vehicle and plant construction and industrial goods.



### Surging Ahead

### Raise of research premium increases R&D expenditures

With a research ratio of 3.14 percent of GDP (2017), Austria is in second place in the EU (right after Sweden) and thus in the top tier in Europe. Since 1995, Austria has more than doubled its R&D ratio.

While the aggregate research ratio for the EU 28 rose barely 3 percentage points from 2005 to 2015, Austria's research ratio increased by seven percentage points. In 2017, research expenditures are about EUR 11.3 billion (2017 global estimate). About half of R&D investments come from domestic and foreign companies, of which half are from companies with parent companies abroad.

Austria's research premium, which was raised to 14 percent in 2018, is responsible for the increase in R&D. In 2017, an approximate EUR 230 million in research premiums was distributed to companies. More than 71,000 persons are currently employed as researchers in Austria (full time/full-time equivalent throughout the year). About 70 percent of them do research for companies and about 25 percent for colleges.



Development of R&D expenditures in Austria,

**R&D investment in Austria** In million Euro, estimate 2017 Total: 11,325.42 m. Euro



Source: Eurostat, Statistics Austria

**Germany und EU-28** As a percentage of GDP

Source: Statistik Austria, 2017



## From the Virtual Test Labs to the Most Diverse Test Tracks

Highlight: Autonomous driving

 $\rightarrow$  www.v2c2.at  $\rightarrow$  www.alp-lab.at A vehicle must drive 150,000 test kilometres before it comes to market. Today this can only be efficiently managed using virtual test methods. The specialist in this is the Virtual Vehicle Research and Development Centre in Graz, which was founded in 2002 and concerns itself with application-oriented vehicle development and future concepts for street and railway vehicles. Its 90 industrial partners include Audi, AVL, BMW, MAN, Porsche, Siemens and Volkswagen. About 100 research projects with leading international research partners are currently being implemented. Virtual Vehicle participates in 25 EU projects.

The peculiarities of the alpine driving environment, such as winter road conditions, tunnels and toll stations, make ALP.Lab the most diverse test environment for autonomous driving in Europe. In addition to a full simulation environment and dedicated test tracks, Austria's test laboratory for automated driving offers real-life tests: on public streets and a section of the Autobahn. The members of the consortium are AVL List, Magna, the Technical University of Graz, Virtual Vehicle and the research organisation, Joanneum Research.

# A Heavy-weight in Light-weight Construction

### Highlight: New materials

Every extra kilo lowers the range of an electric drive vehicle. Therefore, emphasis is being placed on research into lighter materials. Every 55th innovation in light-weight construction originates in Austria. The region of upper Austria focuses on light-weight construction. In the LKR Light Metals Centre of Excellence in Ranshofen, research is conducted on a range of topics from materials to process technology to material-based structural design. The team concentrates on light metals, such as aluminium and magnesium, for automotive vehicles. The research projects include material-based crash design to increase vehicle safety.

The Chinese-Austrian FACC in Ried im Innkreis develops and produces light-weight aircraft interiors and structural components for international aircraft manufacturers, such as Boeing and Airbus. In neighbouring Salzburg, the Salzburg Aluminium Group SAG develops high-performance materials from aluminium for the automotive and airline industries, among others. Austria's A2LT Austrian Advanced Lightweight Technology light-weight construction cluster combines the competencies of companies and research facilities nationwide. Its partners include AMAG, Magna Steyr Fahrzeugtechnik, FACC, Pankl Racing Systems, Polytec Group, voestalpine and Siemens Industry Software.

→ www.ait.ac.at → www.facc.com → www.a2lt.at



### A Strong Innovator

Austria on the fast track

Measurable progress: On the recent European Innovation Scoreboard (EIS 2017), Austria took a significant leap forward, improving its position as a "strong innovator" to seventh place within the EU 28. In the area of "intellectual capital," Austria occupies fourth place in 2017 – before Sweden and Denmark. With respect to innovation by small and medium-sized enterprises (SMEs), Austria is in fifth place, also in the top tier in Europe.

The 2017 Innovation Indicator also gave Austria a high position, and Austria is in ninth place internationally in terms of strong innovation. Business, science, education, government and society in 35 countries were examined.



#### Innovation Indicator 2017 Index

Source: Fraunhofer Institute for System and Innovation Research (IS), Centre for European Economic Research (ZEW)

## 14 Euros for 100 Euros of R&D Investment

### Suitable funding for good ideas

Research is conducted in many places. Therefore, small and medium-sized enterprises and large companies are equally supported with research grants in Austria. Thanks to generous research premiums, research companies can claim 14 percent of their R&D expenditures for tax purposes as of 1 January 2018. Research premiums are an effective supplement to direct research grants.

In addition, Austria offers other attractive tax benefits. For example, there is an immigration allowance [Zuzugsfreibetrag] for scientists and researchers, which covers 30 percent of research income and can be used for up to five years. An apprentice-ship allowance [Lehrlingsfreibetrag], the ability to carry forward losses, the ability to transfer hidden reserves and a corporate tax rate of 25 percent are also among the tax benefits for companies. With an average effective corporate tax burden of 22.4 percent, Austria is in the middle range in Europe.

### Direct grant programmes for R&D champions

The Research Promotion Agency FFG and Austria Wirtschaftsservice (aws) support research companies with direct grant programmes, counselling and services. The FFG supports application-oriented, business-oriented research. In 2016, EUR 615 million were invested, and 3,307 new projects were approved. As a development bank, the aws supports entrepreneurs and established companies in all phases of the corporate life cycle with loans, grants, and guarantees or investments/equity capital. In 2016, financing services amounted to about EUR 811 million. In addition, the Austrian Economic Fund (FWF) supports basic research. The FFG Startup Grant supports startups with project financing of up to 70 percent. The aws Startup Centre offers a comprehensive support package to new companies.

→ www.aws.at
→ www.ffg.at

### **Research Across Borders**

### Non-university research with international reputation

→ www.ait.ac.at

→ www.oeaw.ac.at

→ www.cemm.at

→ www.ist.ac.at

In addition to the research conducted at first-class universities, the non-university research in Austria is also world-renowned. Austria's 65 non-university research facilities include the Austrian Institute of Technology (AIT), the country's largest research and technology organisation. As a specialist in the important infrastructure topics of the future, the AIT devotes itself, inter alia, to the areas of energy, mobility systems, low-emission transport, health & bio-resources, and digital safety & security. 28 research institutions, such as the CeMM (Research Centre for Molecular Medicine) in Vienna, belong to the Austrian Academy of Sciences (ÖAW), Austria's largest academic society. In Southern Austria, Joanneum Research, a sought-after R&D partner for top companies, conducts cutting-edge research on the international level in five fields of research: materials, health, digital, resources and policies. The Institute of Science and Technology Austria (IST Austria) in Lower Austria, an interdisciplinary research institute, seeks to break down the traditional barriers between individual science disciplines. It focuses on basic research in the bio-sciences, the formal sciences as well as physics and chemistry. By 2026, 90 research groups will be domiciled at IST Austria.



# A Milk Carton in Space

Highlight: Aerospace

For its size, Austria is amazingly active in space research and the aerospace industry. 114 companies are directly or indirectly involved in the Austrian aerospace industry. The country makes a disproportionately strong contribution to European Space Agency (ESA) projects and contributes technologies to NASA missions.

The Graz Institute of Space Science (IWF) has studied the physics of (exo-) planets and space plasma for over 40 years. With about 100 employees from 20 nations, it is one of the largest institutes of the Austrian Academy of Sciences (ÖAW) and develops and builds space-worthy measuring instruments, e.g. for laser distance measurements or on-board computers. The IWF is currently involved in 17 international space missions, which range from satellite fleets in near-earth space to solar observation to planetary exploration.

The Institute for Communications Networks and Satellite Communications of the Technical University of Graz is building a new small satellite for the ESA in collaboration with RUAG Space. The "Cubesat" named PRETTY (Passive REflecTomeTY) is a nanosatellite consisting of three cubes of 10x10x10 cm respectively and thus a little larger than a milk carton. Its task is to be the first nanosatellite to measure and record ice in glaciers or at the poles and the movements of the waves in the ocean as part of environmental and the weather observation.

- → www.iwf.oeaw.ac.at
- $\rightarrow$  www.tugraz.at
- → www.ruag.com

### Application-oriented Training

Highly motivated and productive staff

Austria is significantly above the OECD average in expenditures on education. About 90 percent of young adults in Austria hold a secondary level II qualification (OECD average: 83 percent), and 70 percent of secondary level II students pursue vocational training (OECD average: 46 percent). This dual training won Austria a top place in the "2017 Young Workers Index" prepared by PriceWaterhouseCoopers (PWC). Austria was ranked fourth behind Switzerland, Germany and Iceland. Both the teaching and the guarantee of education until the age of 18 are responsible for the good results.

Austria's companies place a high priority on continued training for their employees – in the 2017 World Competitiveness Report, Austria took first place above Denmark and Switzerland. High motivation and productivity are the positive results. Austria is in fourth place in productivity per worker in comparison to the 28 EU countries. With the red-white-red card, key employees, such as technicians and top researchers from non-EU states and university graduates from non-EU states who have studied in Austria, can find employment more readily.

#### **Employee training**

a high priority in companies

Austria	1	7.0	69
Denmark	2	7.5	59
Switzerland	3	7.4	6
Germany	4	7.4	4
Japan	5	7.10	
Netherlands	6	7.04	
Luxembourg	7	7.02	
Estonia	8	6.92	
Norway	9	6.87	
Taiwan	10	6.80	

Source: 2017 IMD World Competitiveness Yearbook

#### Employee motivation

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employee motivation is high

Norway	1	8.0	07
Denmark	2	8.0	)6
Switzerland	3	7.8	3
Austria	4	7.57	
letherlands	5	7.33	
Hong Kong	6	7.28	
Ireland	7	7.23	
UAE	8	7.21	
Sweden	9	7.15	
Germany	10	7.09	

Source: 2017 IMD World Competitiveness Yearbook

# The Man Who Came in from the Cold

### With laser-cooled atoms towards miniaturisation

2017 Wittgenstein Award winner and quantum physicist, Hanns-Christoph Nägerl, conducts outstanding basic research at the Institute for Experimental Physics at the University of Innsbruck. His travels took the native German to Innsbruck, then to the USA and then back again. His colleagues in Innsbruck include the theoretical physicist, Peter Zoller, who became world famous for his pioneering work with quantum computers, as well as the quantum physics pioneer, Rainer Blatt.

As part of his research work with laser-cooled atoms, he and his team conduct experimental quantum simulations, which would be difficult to achieve with electrons in crystal lattices, to elucidate complex quantum multi-particle processes. Since the effects only occur at extremely low temperatures, the research is conducted at absolute zero temperature, -273.15 ° Celsius. The rapid progress in the miniaturisation of electronic components, such as the semiconductors in microchips, means that in about 20 years conducting paths will be only one atom wide. This means that a fundamental limit will have been reached. Hanns-Christoph Nägerl is currently researching what the effects will be then.



Hanns-Christoph Nägerl Professor for Experimental Physics, University Innsbruck

→ www.uibk.ac.at

# Tight-knit Networks

### Close cooperation between business and science

- → www.acstyria.com
- → www.automobil-cluster.at
- $\rightarrow$  www.acib.at
- → www.cdg.ac.at
- → www.acr.ac.at

More than 60 industrial clusters of more than 7,000 companies with over 800,000 employees and an average research ratio of 7.5 percent strengthen Austria's innovative capacity. In the automotive sector, they include the ACstyria Autocluster and the Upper Austria Business Auto-Cluster (AC). In life sciences, LISAvienna, among others, makes a contribution as a platform for further development of life sciences in Vienna. In the area of mechatronics, for example, the Tyrol Mechatronic Cluster supports its member companies. In addition, with the COMET (Competence Centres for Excellent Technologies) Programme, Austria supports the development of Centres of Excellence, whose core element is high level research programmes jointly defined by business and science. The "K2 Digital Mobility" Programme, which starts in 2018, will include disruptive digitisation, human-centred approaches and context-embedded vehicle technologies. "ACIB, Austrian Centre for Industrial Biotechnology" uses concepts and tools from nature to research and develop new industrial production processes.

The more than 70 Christian Doppler (CD) Laboratories devoted to application-oriented basic research for companies. As a network of research institutes, which conduct applied research and development specifically for small and medium-sized enterprises (SMEs), Austrian Cooperative Research (ACR) supports about 500 research projects every year.





### Networking

### Silicon Austria - joint research on microelectronics

Microelectronics permeates all areas of life – from electric tooth brushes to smartphones to assistance systems in autos to digitised factories. Today the microelectronics industry is by far the most research-intensive and innovative industry in Austria. With Silicon Austria, Austria has created a research centre for microelectronics at three locations, which combines Austrian competencies in microelectronics. Villach researches sensors and sensor systems as well as power electronics and develops high-performance sensors and energy-efficient microchips. Linz works in the high frequency area to securely send and receive large volumes of data. Graz combines these topics with a focus on system integration and investigates the smooth interaction between different components, such as radar sensors, GPS reception and Internet connections in self-driving autos.

# From the Garage to a Global Corporate Group

Highlight: E-mobility

→ www.kreiselelectric.com

The battery will be the "core element" of future generations of vehicles. Therefore, great research efforts are being made worldwide to make energy storage systems as small and low-costs as possible, but with a safe design. This effort includes Austria. A passion for speed and electromobility was the basis for the success story of the three Kreisel brothers from Upper Austria, which began in the proverbial garage: Since 2014, they have been developing the lightest and most efficient high-capacity batteries for electromobility in the world. The spectrum of applications implemented with their partners ranges from e-carts, e-rollers and e-bikes to private cars and busses to ships and airplanes. Together with their industrial partners, the Kreisels have also realised complex projects, including powertrains, charging technology and software, and brought the Kreisel Power Charger, an innovative fast charging tower, to market. Its first own new plant for volume manufacturing was recently put into operation in Upper Austria. In July 2017, Frost & Sullivan honored the company for offering the world's best battery technology.



## The Right Therapy at the Right Time for the Right Patient

Highlight: Precision medicine

Precision medicine, "personalised medicine", is the most important medical trend of the 21st century. The "right therapy at the right time for the right patient" is based on the results of genome research and diagnostic testing and will permanently improve the chance of curing cancer and rare diseases in the future. The Centre for Precision Medicine, which will house the leading programme for personalised medicine in Europe, will be developed at Vienna General Hospital, the largest hospital in Europe, by 2025. The General Hospital shares a large contiguous campus with the Medical University of Vienna, where basic research, translational and clinical research and teaching can grow closer together.

 $\rightarrow$  www.meduniwien.ac.at

### More Than a Billion Chips

Infineon relies on Austrian research

→ www.infineon.com

Electronics and microelectronics are among the key technologies worldwide. Infineon Technologies Austria is one of the most research-intensive companies in this field in Austria. Established with the goal of low-cost production in 1970, the Austrian subsidiary of Infineon developed into the Group's innovation centre for power electronics. Each month, more than a billion chips leave the "innovation plant" in Villach, which specialises in the production of semiconductors. Employees from 60 nations contribute to its success.

As part of its current "PowerBase" Project, Infineon Austria is developing the next generation of energy-saving chips with 39 partners from nine countries. PowerBase is the largest European microelectronics research project to be coordinated from Austria to date. In the "SemI40" research project (Power Semiconductor and Electronics Manufacturing 4.0), 37 partners under the leadership of Infineon Austria are doing research to further develop self-controlled factories. With a volume of EUR 62 million, "SemI40" is one of the largest Industry 4.0 projects in Europe. In addition, Infineon is working on such future-oriented projects as space travel, LEDs for urban farming and safer automobiles. The company maintains 120 research cooperations with universities and research facilities in Austria and worldwide.

		Net turnover, in m. Euro	R&D expenditures, % of turnover
1	ams AG	549.90	25.20
2	Infineon Technologies Austria AG	1,839.50	22.39
3	Frequentis AG	252.20	17.01
4	Boehringer Ingelheim RCV GmbH & Co KG	1,209.70	16.53
5	Bernecker + Rainer Industrie Elektronik GmbH	600.00	11.83
6	Trumpf Maschinen Austria GmbH & Co KG	229.92	11.33
7	AVL List GmbH	1,400.00	10.00
8	Anton Paar GmbH	282.00	9.86
9	Kapsch Group Bet.GmbH	1,046.80	9.38
10	Epcos OHG	287.60	8.34

Source: Goldener trend 2017



# When Humans and Computers Encounter Each Other in Everyday Life

New technologies for a better quality of life

The native Australian, Univ. Prof. Dr. Geraldine Fitzpatrick, already held a degree in nursing and was a midwife when she commenced her studies at the University of Queensland in 1989. After starting late, she obtained a PhD in computer science and electrical engineering and started as a senior researcher in the area of computer-assisted cooperation and medical informatics. She currently heads the Human Computer Interaction (HCI) Work Area at the Technical University of Vienna. Geraldine Fitzpatrick is particularly interested in tangible applications that fit into the everyday context of work, play and daily life, such as telehealth applications, which help the elderly to live at home. Her approach to research is largely interdisciplinary. Her demand is that technologies must meet human needs, enhance the quality of life and provide the necessary results to this end. In particular, she is interested in how these requirements can be met using ubiquitous computing technologies.



Geraldine Fitzpatrick, HCI, Technical University Vienna

→ www.tuwien.ac.at



## Pilot Factories for the Industries of Tomorrow

Highlight: Industry 4.0

→ www.jku.at

→ www.tuwien.ac.at

→ www.tugraz.at

In the pilot factory at the Technical University Vienna, research and testing are conducted on what the industries of tomorrow should look like. For this, one needs a realistic testing environment, including a real product – in the case of the pilot factory in the seaside town of Aspern, this product is 3D printers. The demonstration factory for smart production and cyber-physical production systems works with new concepts and solutions for multi-variant serial production. By contrast, smartfactory@ tugraz at TU Graz researches new production methods by which even small quantities can be manufactured profitably and flexibly, e.g. customised cars. A special focus is placed on data security and the reliability of computer-controlled production systems. The LIT Factory at Johannes Kepler University in Linz is working on novel, at times prototypical, frontier technologies ("frontier production technologies"). In one of its first projects, a fibre-reinforced light-weight component is being manufactured for Audi for affixing the gearbox in the engine compartment.

# Deep Learning With Artificial Neuronal Networks

### Soon machines will understand how the world functions

Artificial Intelligence (AI) not only enables the existence of digital assistants, such as Siri and Alexa, but can also predict the optimal time to replace a critical machine part. To combine competencies in the AI area, Johannes Kepler University has established its own AI LAB at the Linz Institute of Technology (LIT), which will include a centre for "Deep Learning". Deep Learning methods permit computers to evaluate huge volumes of data and – like the human brain – analyse the data with gigantic neuronal networks. The head of the LIT AI Lab is Univ. Prof. Dr. Sepp Hochreiter. German by birth, he has worked in Linz since 2006. His inventions relating to LSTM (Long Short-Term Memory) architecture can currently be found in practically every smartphone.

#### Where is Artificial Intelligence going in the automotive sector?

KI systems now recognise road signs better than humans do. These are the beginnings of Artificial Intelligence. However, the systems still lack an understanding of the world. Our research is aimed at going from weak to strong KI: machines that act like humans, that understand how the world functions and recognise what a human, a dog and a child is. There is still enormous potential for the use of KI methods in selfdriving cars, which not only recognise speech but even foresee and respond to the intentions and wishes of passengers.



Sepp Hochreiter, Head of the Institute of Bioinformatics at the Artifical Intelligence Lab (JKU Linz)

→ www.jku.at

# A lively, diverse scene

### Startup hubs and incubators encourage a startup culture

→ www.ffg.at

- → www.inits.at
- → www.wexelerate.com
- → www.vienna.talentgarden.org

A lively and diverse startup scene has developed in Austria in recent years. The Research Promotion Agency FFG has established eight incubators throughout Austria, which provide qualified advice and support to founders from the academic sector. In Vienna, IniTS provides startups with support and access to capital and a network. INiTS is also a valuable partner to investors and companies in cooperations with startups. In November 2015, the Swedish research initiative, UBI Global, added INiTS to the ranks of the "Global Top 10" university incubators. The Pioneers Festival in Vienna is one of the largest startup shows in Europe.

In 2017, weXelerate, Central Europe's largest startup hub, opened its doors in Vienna. Here startups work on new digital business models together with large companies, incubators, venture partners, service and sales partners, investors and service providers. The focus is on such innovative fields as the Internet of Things, FinTech and Media. A Co-Working Campus was also opened in Vienna in 2017. It was jointly realised by Talent Garden and the telecommunications company A1, and offers 500 work spaces for young entrepreneurs on 5,000 m<sup>2</sup>. The biotech scene in Austria is also extremely lively and diverse and is drawing international attention. More than half the Austrian life science companies were founded in the past two decades.

# Brain Robots and 3D-printed High-performance Ceramics

Austrian startups in diverse areas of research

### The brain OP robots from Tyrol

The Tyrolian medical technology company, iSYS Medizintechnik, has presented an innovative robot system for minimally invasive surgery, which is intended to increase the precision of such interventions in the brain and reduce the length of the operation. The mini-robot will come on the market in 2018. It needs very little space as compared to current systems and is easy for the surgeon to use. The acquisition costs for use in the clinical routine should be significantly below the price of commonly used, large operation robots. In all, it took almost 15 years to develop this system. The basic system is conceptualised as a platform and has already been certified in Europe and the USA. iSYS maintains a joint venture with the largest US medical technology company, Medtronic.

#### The automation revolution

The demand for individualised products is growing, especially in high-priced segments, such as the automotive industry, and production processes must keep pace. The Austrian software specialist, nxtControl, is pursuing the goal of revolutionising automation from the ground up. The startup's real-time control software enables the automation of complex industrial systems, buildings and machines – and not only does so in less time than the other currently available technologies, but makes the resulting complexities manageable. In June 2017, the company used this idea to exit with the French billion-euro concern, Schneider Electrics, one of the top 3 players in the energy technology and automation sector.

#### High-performance ceramics from a printer

Lithoz, a spin-off of Technical University, founded in 2011, specialises in the 3D printing of high-performance ceramics. High-performance ceramics is used in industry, bio-medicine and space travel due to its special properties. The Lithography-based Ceramic Manufacturing (LCM) Process developed by Lithoz can be used to quickly manufacture low-cost fully usable prototypes and small series. Lithoz is the only company in the world to offer a generative production system for high-performance ceramics. → www.interventional-systems.com

→ www.nxtcontrol.com

→ www.lithoz.com

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