

SPOTLIGHT ON BERLIN-BRANDENBURG

Research sectors collide

Substantial funding and a collaborative environment have revived the Berlin-Brandenburg region as a European science hub.

"The density of research institutes in Berlin means it has real potential to be exceptional."

Daniel Schwaag, *Elegant Embellishments*

IF CITIES were fairground rides, Berlin would be a big dipper. After riding high as the birthplace of modern Germany in the 19th century, it hit a low after World War Two. Since reunification, the city has been rebuilding its reputation as a research and higher-education powerhouse.

In recent years Berlin has re-established itself as one of the most important centres of science in Europe. It is home to the highest concentration of universities and research institutes in Germany. Given the turbulent decades the Berlin-Brandenburg capital region experienced during the 20th century, its rapid re-emergence is a remarkable feat.

A troubled history

As the capital of Prussia and then the German Empire since its formation in 1871, Berlin was already becoming an important industrial and scientific centre in the late 19th century. Emperor Wilhelm II, who ruled from 1888 to 1918, set up institutes for biology, brain research, physical chemistry and electrochemistry, physiology of work and physics in the city.

It fell from pre-eminence in the second half of the 20th century as a result of World War Two, the division of Germany and the Cold



Founder of Humboldt University, Wilhelm von Humboldt, in front of the main university building.

War. The impetus for the city's modern revival dates back to the 1991 decision to make it the capital of the newly-reunited Germany.

"There has been a strong drive by both the federal and local governments to help Berlin recover its position as a global scientific hotspot," says Volker Hauke, director of the city's Leibniz Institute for Molecular Pharmacology.

A city revived

Today Berlin boasts four general universities, seven universities of applied science, four arts academies, some 26 state-approved private

colleges, more than 20 technology parks and more than 60 non-university research institutes. It is also home to the Charité, a large teaching and research hospital affiliated to two of the universities.

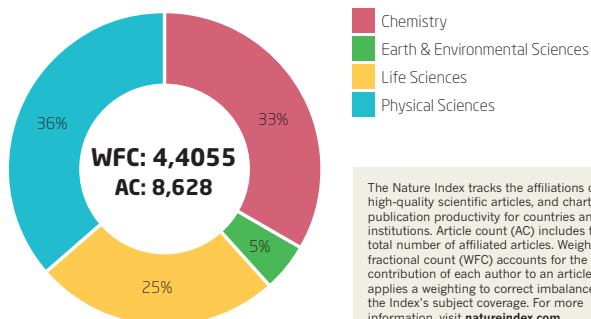
The most ambitious recent addition to the city's research landscape is the Berlin Institute of Health, a major collaboration between the Charité and the Max Delbrück Center for Molecular Medicine. Launched in 2013, it seeks to apply an interdisciplinary approach that considers the human body as an integrated whole to basic and

GERMANY BY NUMBERS

DATA: NATUREINDEX.COM

Germany's research output by subject area (2014 WFC)

Behind the US and China, Germany has the third highest annual output of Nature Index articles.



The Nature Index tracks the affiliations of high-quality scientific articles, and charts publication productivity for countries and institutions. Article count (AC) includes the total number of affiliated articles. Weighted fractional count (WFC) accounts for the relative contribution of each author to an article and applies a weighting to correct imbalances in the Index's subject coverage. For more information, visit natureindex.com.

Top ten institutions

Germany's independent research institutions work closely with universities — and with industry — to drive innovation and growth.

	INSTITUTION	WFC 2014	AC 2014
1	Max Planck Society	671.23	3,118
2	Helmholtz Association of German Research Centres	453.49	1,788
3	Leibniz Association	152.34	656
4	Ludwig Maximilian University of Munich (LMU)	150.45	629
5	Technical University Munich (TUM)	118.66	495
6	Heidelberg University (Uni Heidelberg)	110.00	630
7	University of Münster (WWU)	105.25	229
8	University of Göttingen	98.80	371
9	University of Würzburg	97.42	265
10	University of Erlangen-Nuremberg (FAU)	87.02	252

translational life sciences research.

Brandenburg, which has three general universities and four universities of applied science, has also seen growth in capacity. The proximity of Berlin and its growing pool of graduates have lured many businesses to set up facilities in Brandenburg. Last year, for example, business software giant SAP set up an innovation centre for teams of designers, engineers, product experts and business developers to work on new ideas in areas such as smart traffic solutions and personalized medicine.

Berlin's rich and varied research ecosystem is the product of the modern public research funding model which emerged from the post World War Two federal political system. University funding is primarily the responsibility of the 16 German states. The federal government contributes towards the non-university research institutes run by the Max Planck Society, Fraunhofer Society, Leibniz Association and the Helmholtz Association.

In 2013 Berlin spent 0.85% of its GDP on R&D at higher education institutions and 1.23% on R&D at research institutes — the highest proportions on both counts of all the states. Brandenburg spent 0.74% of its GDP on R&D at research institutes — significantly higher than the national average of 0.42%.

Research incentives

The most important, recent policy intervention to have helped Berlin become a global scientific hotspot is widely seen as the Excellence Initiative, a scheme introduced by the federal government in 2006 to promote high-quality university research. In total €4.6 billion of extra federal funding has been awarded under the initiative, with the Free University of Berlin and the Humboldt University of Berlin among 14 elite universities selected to receive between €9.6 million and €13.4 million per year each to add to the grants they get from the states. Nine of 51 grants of an extra €1 million per year for graduate schools have gone to Berlin under the initiative. Teams based in the city's three largest universities are also involved in five multi-institution Clusters of Excellence, receiving an additional €6.5 million per year, in the fields of catalysis (see **Catalyzing innovation**) and the treatment of neurological disorders, among others.

Catalyzing innovation

The idea that advances in knowledge and technology come through interdisciplinary research and collaboration underpins the thinking behind BasCat, a 1,000 m² laboratory jointly set up by chemicals giant BASF and UniCat, a consortium of four universities and two Max Planck institutes in Berlin and Potsdam.

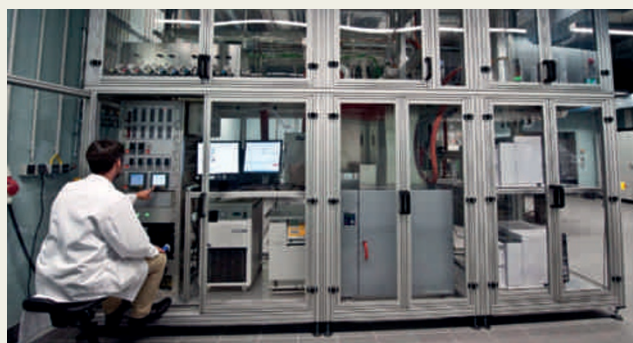
BasCat focuses on heterogeneous catalysis - a process that, in most cases, involves adding a solid to a reaction between fluids to make the reaction faster and more efficient. Its long-term goal is to find catalysts that allow alternatives to crude oil to be used as a source of the raw materials for the chemical and pharmaceutical industries.

The lab's origins lie in BASF's interest in research carried within the UniCat consortium on the conversion of methane in natural gas into ethylene — a compound of key importance in the production of a wide range of chemicals. This was led by scientists at the Berlin Institute of Technology (TU Berlin) and the Fritz-Haber Institute of the Max Planck Society.

This "oxidative coupling of methane" is one of the major focuses of the 15 scientists currently working at the \$14.6 million BasCat lab, which opened its doors on the TU Berlin Charlottenburg campus in July 2014.

"What is so unique is that the coworkers engaged in the synthesis, physical measurement and theoretical modeling undertake their research under one roof," says Matthias Driess, a scientific director at BasCat.

Catalysts and processes that show potential are taken to BASF facilities for further testing on larger scales. According to Driess, the German capital was the perfect place to establish BasCat. "Berlin is unique because it has a high density of scientists with advanced expertise, it has the facilities and the vibrant atmosphere to attract good people."



Scientists at BasCat work across industry and academia to understand the processes behind heterogeneous catalysis.

"When you have separate universities and public research institutions as we do, it is especially important to provide incentives for these organizations to combine their strengths," says Günter Stock, former president of the Berlin-Brandenburg Academy of Sciences and Humanities. "The Excellence Initiative really comes into its own in encouraging interdisciplinary and inter-institutional work."

The Senate of Berlin, the city state's executive, has traditionally allowed higher education and research institutions a high degree of autonomy. "Rather than a clear plan made up of strict programmes, they see what institutions and academics need and give them room to breathe and develop," says Wolfgang Schulz, director of the

Alexander von Humboldt Institute for Internet and Society (HIIG), which uses money raised from industry to fund research on how the internet is changing societies.

That's not to say the city state government takes no interest. Many teams in Berlin receive funding from the Einstein Foundation, a 2009 initiative by the Senate that crosses institutional, discipline and national boundaries. It is currently funding 28 Einstein Fellows and Professors, as well as 33 research projects to the tune of €11.2 million and plans to spend some €7 million on funding international scientists over the next three years. The Foundation also recently announced plans for two new Einstein centres for neurosciences and catalysis in Berlin, receiving combined funding of

€16 million for set-up and running costs over five years. These will begin operations in January 2016.

Multidisciplinary approaches

Another facilitator of collaborations is Hybrid Platform, jointly launched in 2011 by the Berlin University of the Arts and the Berlin Institute of Technology (TU Berlin), to encourage multidisciplinary approaches to addressing societal problems.

"Artists and designers approach research questions in quite different ways to scientists and engineers," says Barbara Stark, co-head of the Hybrid Platform. "Getting them together can help broaden perspectives and uncover new ways to tackle the important problems facing our societies."

One project facilitated by Hybrid Platform is an ongoing attempt by design bureau Elegant Embellishments and Arne Thomas, a chemist at TU Berlin, to produce carbon-negative building materials from agricultural waste product biochar. The group has already produced a decorative rainscreen cladding product, and is currently investigating biochar-based insulation and electromagnetic shielding for facilities that need to protect sensitive equipment and data from external electromagnetic interference.

"Cross-disciplinary dialogue isn't always easy for those outside the traditional institutions in Germany, however the density of research institutes in Berlin means it has real potential to be exceptional in that context," says Daniel Schwaag, a director at Elegant Embellishments.

As elsewhere in the world, there remains an inherent suspicion among some German academics towards working with industry. Such attitudes are less prevalent in Berlin, in part because of the progressive outlook of its youthful population. There are more than 790,000 people aged under 25 in the city — almost a quarter of the total inhabitants. Some believe this more pro-business environment has been key in the unemployment rate going from 19% in 2005 to 10.4% today.

That Berlin has learnt the value of accepting different perspectives is no surprise. "This mix of cultures brings openness and diversity, and diversity drives innovation," says Stefan Franzke of the Berlin Partner for Business and Technology economic development agency.

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GROUP LEADER POSITION

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Since 2014 the 'Institut Universitaire du Cancer de Toulouse-Oncopole' (IUCT-O) hosts a 300-bed hospital dedicated to cancer and a 14 000 m² research lab, the CRCT, affiliated to Inserm, University of Toulouse III and CNRS. Fundamental and translational research at CRCT (17 research teams & 8 platforms + animal facility) deals with oncogenesis, genetic instability, signal transduction, molecular biology of tumors, cancer metabolism, tumor immunology, gene therapy, pharmacogenomics and radiobiology.

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