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Study and Research on Sustainability in Germany

RESEARCH

Igniting ideas!

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Contents

Sustainability Science

"The world's present development path is not sustainable. Efforts to meet the needs of a growing population in an interconnected but unequal and human-dominated world are undermining the Earth's essential life-support systems. (...) Above all, a response has begun to emerge from science itself and the growing recognition across many disciplines of the need for synthesis and integration – needs that are being reflected in many new multidisciplinary research efforts and institutions. These various scientific efforts to promote the goals of a sustainability transition – meeting human needs while preserving the life support systems of the earth – are leading to the emergence of a new field of sustainability science." (Kates, Robert W. et al.: Sustainability Science. In: Science (2001) No. 292, p. 641et seq.).

It is hence not surprising that the topic of sustainable development is also reflected worldwide in education and research. The aspects of sustainability have been added to traditional sciences, but equally new technical disciplines and combinations of different sciences are emerging. In this context, the term of "sustainability science" was created. This is a rather young science which is ideally interdisciplinary organised and which deals with ecological, social and economic changes within its interdependencies.

There are various reasons for the emergence of sustainability science: climate change and its consequences, the global discussion on renewable energies, the ever-growing environmental pollution in many developing and newly industrialising countries, and the warnings against a loss of biodiversity are essential factors from the field of environment. In the economic sector, an increase in the demand for organically grown products in industrial nations, and for fair trade goods in affluent countries can be observed. Consumers show more and more interest in the conditions under which consumer goods are produced (worksafety, adequate wages, rejection of child labour) and in production processes that make optimal use of resources. The pursuit of justice, democracy and participation in civil society, complaints about poverty, a lack in educational opportunities for people in the developing world, hunger and the absence of medical care in many poor countries are clear indicators of a growing interest in the social aspects of a sustainable development.

Innovations on the basis of intelligent strategies of problem solving are required for both, treating problems of non-sustainable development, as well as positive changes. New technologies need to be designed, further knowledge on the relations between the biosphere and human activities needs to be obtained, and innovative strategies for the production and distribution of goods need to be developed. At the same time, new political strategies and the support of a humane life are asked for; a modified management will be necessary, and new forms and contents in the formal as well as in the informal field of education is in demand. All these innovations, as well as the analyses and strategies associated with them, are impossible without science and research.

This, however, does not clearly define what exactly is to be understood by sustainability, in particular by sustainability science. Basically, the goals are research and innovation, which create an ideal interaction between the individual and social development on the one hand, and the respect of natural resources and the resilience of eco-systems, or in other words the preservation of biocoenoses, on the other hand. This does not only require basic research and technological innovations, but also new political strategies, changes in economics and a profound and global change of the way of thinking.

In Germany, 1.5 million people, i.e. 3.8 % of all employees, are working in the field of environmental protection and sustainability. This is more than for example in the automotive industry. In 2003, Germany exported goods related to environmental protection worth about € 31 bn. With a share of 18.8 %, Germany is leading the global market in this area.

Germany is also one of the leading nations in terms of the opportunities to study sustainability sciences, and to do research in this field, which is proven in this guide. The guide lists 325 opportunities to study sustainability, and furthermore recorded 200 research institutes that focus on sustainability. In contrast to this: The Association of University Leaders for a Sustainable Future (ULSF), whose task it is "to support sustainability as a critical focus of teaching, research, operations and outreach at colleges and universities worldwide through publications, research, and assessment", records far less opportunities to study in countries such as Australia, the Netherlands, Canada, Norway, Ireland, Sweden, Italy, United Kingdom, Mexico and United States, namely only approximately 120 (cf. www.ulsf.org/index.html).

The guide at hand sums up all study opportunities in Germany and records numerous research institutions active in the field of sustainability, in order to provide those interested in studies and research in sustainability science with a detailed review. This does not only provide orientation for the various study opportunities and places of study. It also indicates where to find internships, and it depicts the research landscape, also outside universities, in this science.

This guide is certainly not only addressed to those who wish to study in Germany or who might consider postgraduate studies. It also addresses teachers and researchers in the field of su-

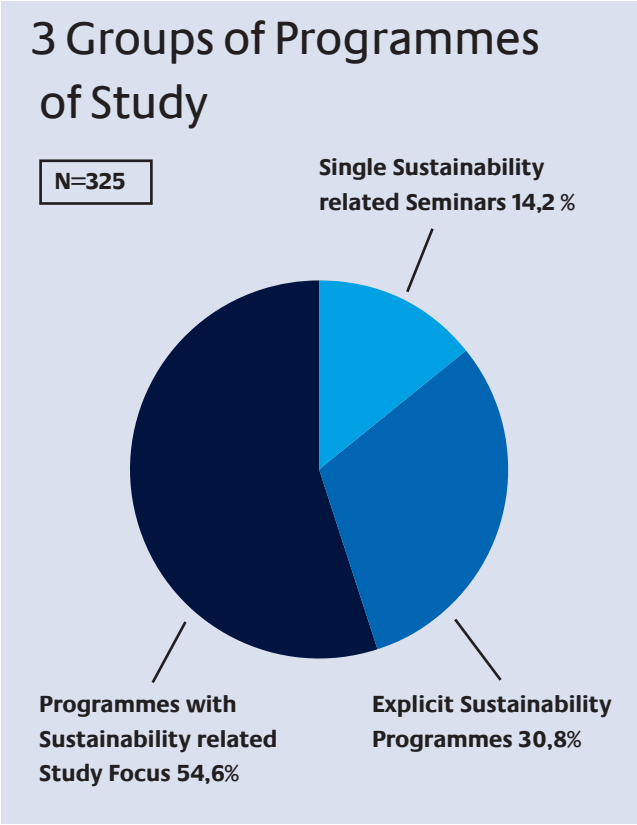
stainability science. For the first time, it is possible to gain more detailed information on where study opportunities are offered, and on who is doing research on what in the field of sustainability science. This allows for synergies and facilitates international cooperation in the field of education and development.

If you look at sustainability science as an interdisciplinarscience, where natural, technical, social sciences and humanities ideally come together equally, then there is still a long way to go, both internationally as well as in Germany. Environmental sciences are still dominating everywhere, and they are very often still strongly focused on their own field od studies, despite rapidly increasing interdisciplinary offers (cf. details further below). It is not only here where a clear change is visible. When the Federal Environment Agency (FEA) in 1977 firstly published a study guide for environment protection, post-treatment strategies were still dominating: waste disposal, regeneration of polluted rivers, in short, end-of-pipe strategies were the focus of attention in education and research. The study opportunities in this field increased quickly. So the FEA's last issue of the study guide, in 1993, had already recorded 290 environment-related courses. The field has changed by now. Today we talk about integrated environmental protection, meaning environmental pollution should be prevented right from the beginning. Minimising the use of resources, developing products that can be optimally recycled and properly disposed of, and improving the production conditions for people and nature are at the forefront of discussions. All this is no longer limited to German markets. A German Master courses as for example the one at the University of Dortmund, entitled "Spatial Planning for Regions in Growing Economies", indicates that the global problem of a sustainable development has been taken up.

Structure of Available Courses

We sub-divided courses related to sustainability into three groups: those courses that explicitly integrate aspects of sustainability, those with a focus in the field of sustainability, and finally those that offer single seminars and other activities in this field. Their individual share in the whole of the 325 study opportunities is as follows:

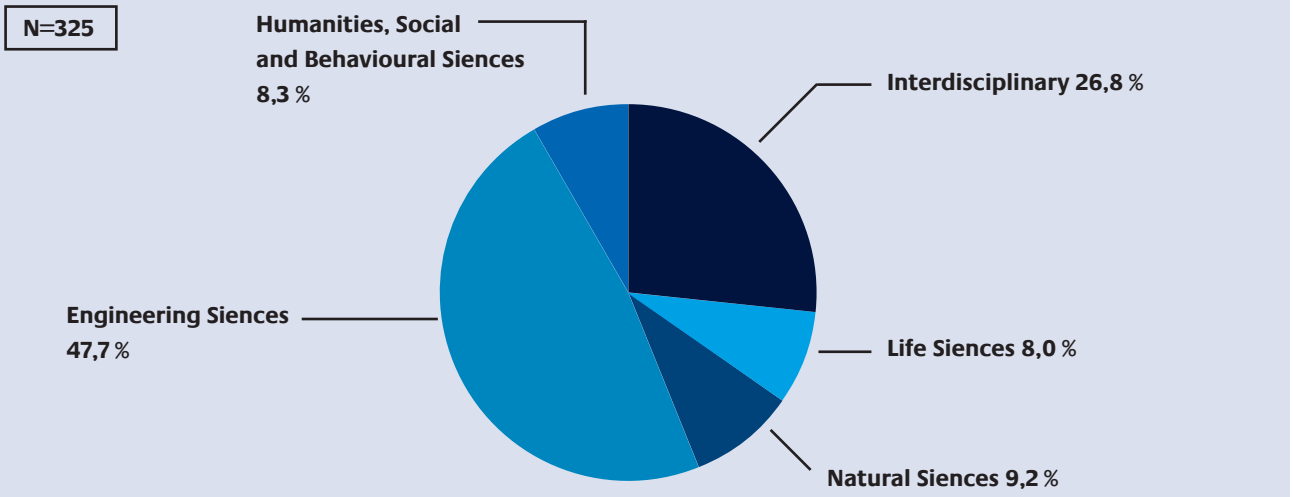
Of the courses recorded, almost one third, i.e. about 100, fall into the group with explicit sustainability courses. There are postgraduate courses as well as graduate ones (for example Bachelor of Science und Master of Science in "Waste Management and Past Pollution"; Bachelor of Science in "International Environmental Engineering"). In these cases, an elaborated curriculum and independent study and examination regulations are available or under way. Compared to an environment study guide from 1999 (cf. de Haan/Donning/Schulte 1999, p. 14), the proportion remained the same.



On the one hand, this comes as a surprise, considering the growing importance which is being attached to environment sciences, and especially its continuing differentiation. On the other hand, there are also careful recommendations against a course which is completely dedicated to aspects of environment on the – quite reasonable – grounds that more generally oriented basic courses and a specialising graduate programme or further qualifying courses would cover a broader job spectrum. More than half of the recorded study opportunities are those courses that have their designated focus on sustainable development or related topics and problems. In the course of the studies, they also offer corresponding courses for specialising in specific areas as well as special sustainability related modules or optional courses students can choose from (for example: the course "Chemical Engineering" offers specialising in "Environmental Engineering"). About 14 % of the recorded study opportunities are courses where single courses are sustainability related. They offer single seminars, field trips and so on, which are related to topics of sustainable development.

Regarding the courses available in terms of areas of science, the clear dominance of engineering sciences is striking. However, compared with the environmental study guide of 1999, their share in the total number of courses offered is going down. In 1999, 55 % of the courses offered were actually dedicated to this area of science, followed by 17 % that were allocated to natural science – presently, it is approximately 9 %. Concerning their share in the total number of courses offered, the offers in social sciences are also slightly decreasing. Data

Scientific Areas of Programmes of Study Available

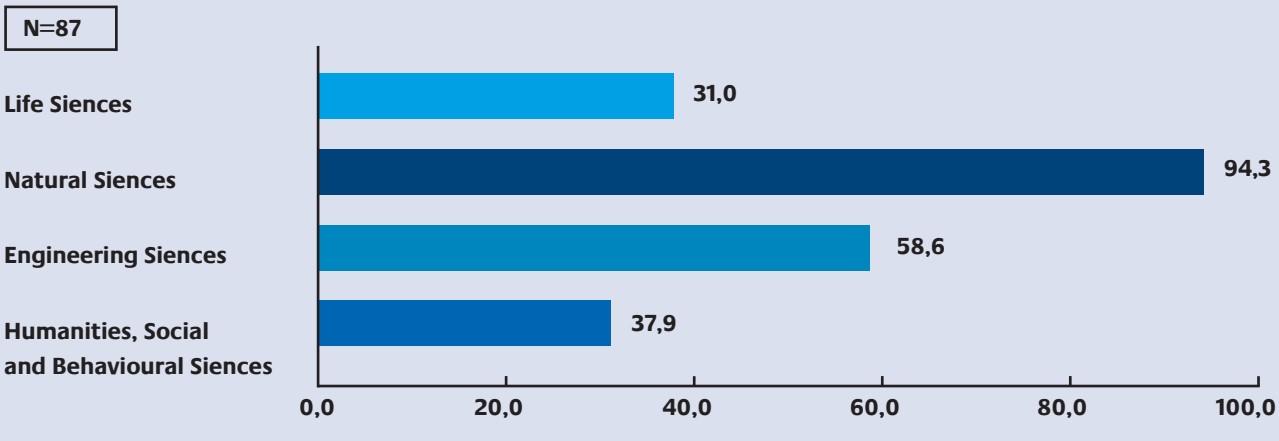


from the 1999 study guide cannot be compared one to one with data from 2007, as the environmental study guide 1999 followed a classification that complied with the study guides for environmental protection, published by the FEA until 1993, whereas the study guide at hand follows the classification of areas of science used by the Deutsche Forschungsgemeinschaft (German Research Foundation). It is, however, remarkable, that the offered interdisciplinary courses, i.e. those with at least two fields of science interacting in a single course offered, were hardly represented in 1999, when their share summed up to a mere 1.6 %. Presently, it amounts to almost 27 %, meaning that one course out of four is organised interdisciplinarily. It hence proves to be highly dynamic – which certainly results from the understanding that issues dealt with in sustainability science can only be dealt with in an interdisciplinary way. Its growing share in the total of recorded study opportunities also delivers an explanation for a decreasing share of individual branches of science.

Due to their share in, and their importance for the discipline, a more detailed analysis of the interdisciplinary courses is worthwhile. The percentages given in the diagram show the links between the different disciplines; thus, it totals more than 100 % due to multiple answers. The values shown in the diagram indicate that especially natural sciences are in demand in terms of interdisciplinary cooperation.

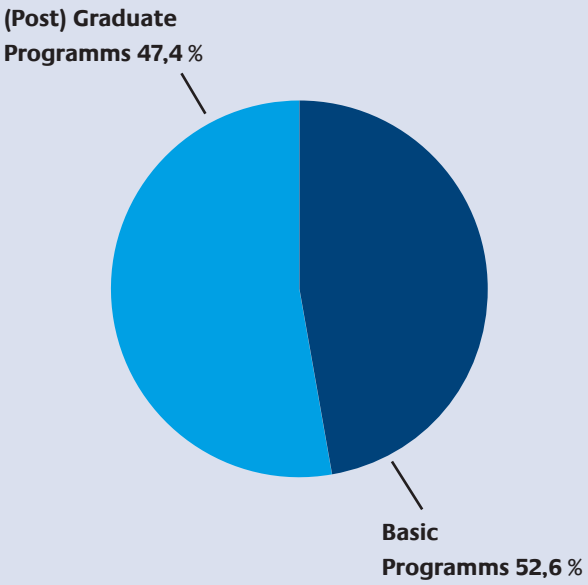
It is not only this cooperation that is pleasing, but also the number of university places made available in this course, where you find the disciplines combined. Each year, about 4,760 interested students can register in this course. In comparison to this, humanities, engineering, life, social and behavioural sciences, which amount to a similarly high percentage concerning their courses, approximately 4,000 university places are available each year.

Interdisciplinary Programmes of Study Sorted by Area of Siences



Looking at the relation of basic and (post)graduate courses, it becomes clear that the graduate courses (including German Master's courses) account for almost half of the courses offered.

The Relation between Basic and (Post) Graduate Programmes of Study



This clearly signalises the specialising character which courses related to sustainability often have. In the technical courses, students first acquire a basic knowledge of the individual area of science in order to develop competencies in specific fields of sustainability later on.

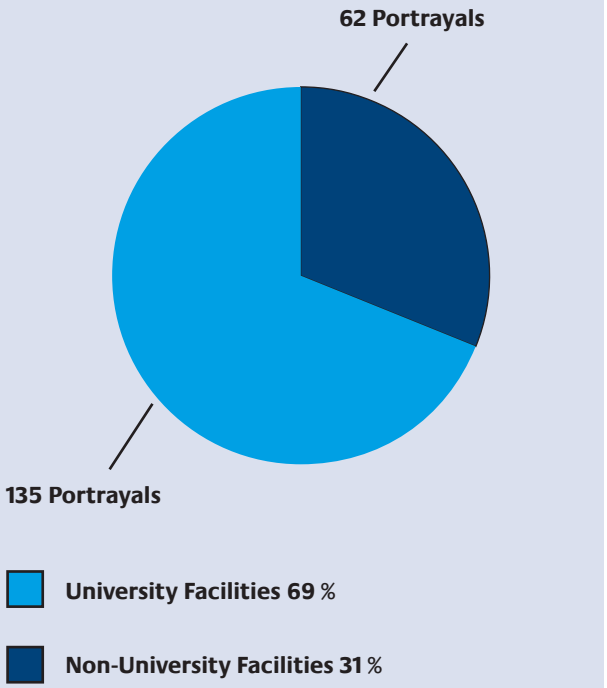
You will find more details about the modes of the survey, the criteria for the selection of studying opportunities and about the structure of our presentation of study opportunitiesat the beginning of the specific chapter.

About the Research Facilities

It is new that German research facilities from the field of sustainability are presented in a synopsis. In this part of the guide, we would like to give a systematic overview of the area of sciences, their set priorities and the institutions' capabilities. In our research, we systematically included all universities. Yet, we also included non-university research facilities, the latter referring in particular to research institutes, as well as to the open market. Here, it was not possible to obtain a survey as exhaustive as the one made for the universities, as the market is not transparent enough for this. Nevertheless, we believe to be able to grant a good insight, not least because of the fact that we were able to portray almost 200 institutions.

We were surprised by the high number of research facilities we found at universities. Although it is often lamented that universities leave research more and more to non-universityinstitutions, this proves not to be true for sustainability research, as you can see in the following diagram:

Portrayals of Research Facilities

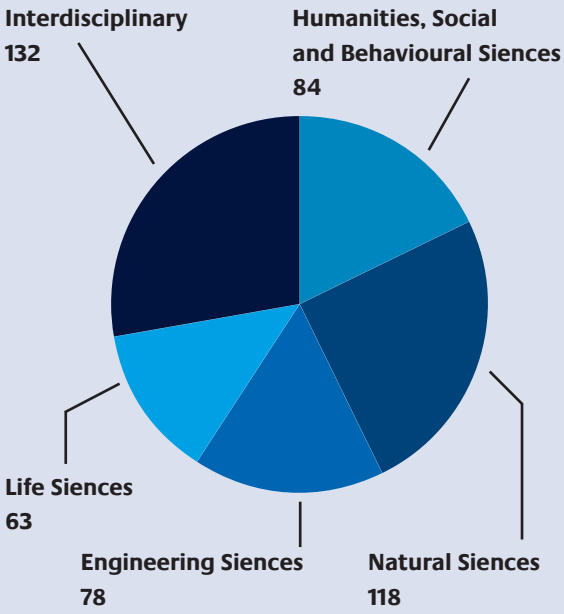


Summing up to 69 %, universities claim a considerable share. On the one hand, this might be due to our survey. As already pointed out, we were not able to carry out an exhaustive survey concerning non-university sustainability research. However, our research showed that almost half of all German universities and universities of applied sciences, namely 136 out of 279, include at least one field of research in the field of natural sciences.

Taking all institutions in and outside universities, we can draw the following picture, sorted by areas of science :

Areas of Science of Research Institutes

N=197; multiple answers possible



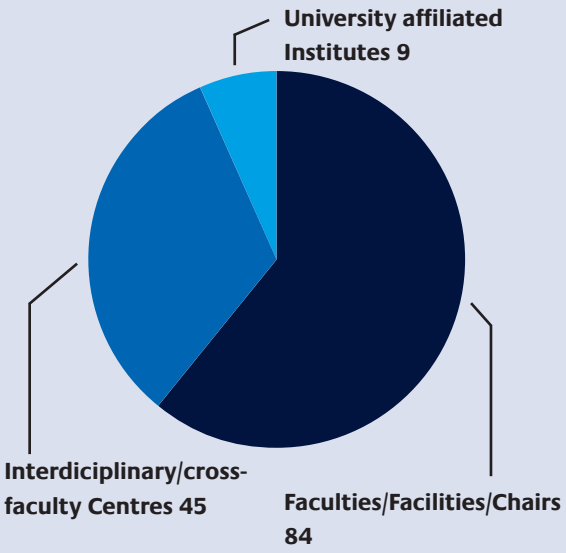
What is most striking in comparison to the offered courses is the research facilities' relatively low share in the engineering sciences (47.7 % offered courses compared to 16 % research institutes) and the high share of natural sciences, as well as humanities, social and behavioural sciences. The rather low relative (16 %) and absolute (78 out of 197 research facilities) share in engineering sciences is a result not only of the high share of humanities, natural, social and behavioural sciences in the research institutes recorded by us. It is primarily due to the high share of interdisciplinarily oriented research facilities. 132 out of the 197 recorded research institutes reported they are interdisciplinarily oriented, which means a total of 2/3 of all institutions. Concerning the courses, the ratio is 67 out of 335, i.e. only 1/5 of all study opportunities, are interdisciplinarily oriented (the diagram does not show this, due to multiple answers).

Considering that sustainability science is a rather young discipline, it is probably rather the research facilities than the courses that reflect the trend concerning interdisciplinarity best. In the field of research, which is highly dependent on subsidies and often offers application-oriented projects, students are normally closer to the market – whereas offered courses very often develop rather slowly from existing disciplines, and procedures on fixing their priorities usually take more time until they are established. As a consequence, interdisciplinary research is clearly in line with the trend in sustainability sciences.

In universities, only 1/3 of the research facilities are oriented interdisciplinarily or across faculties. Most research is done in individual branches of science, often at single chairs therein, which is an indicator for a still underdeveloped cooperation between the different branches of sciences. Networks within universities are still poorly developed. Hence, it is not surprising that complex, problem-oriented sustainability research is rather found in non-university facilities than in universities.

Distribution of University Facilities

N=135; 3 double entries



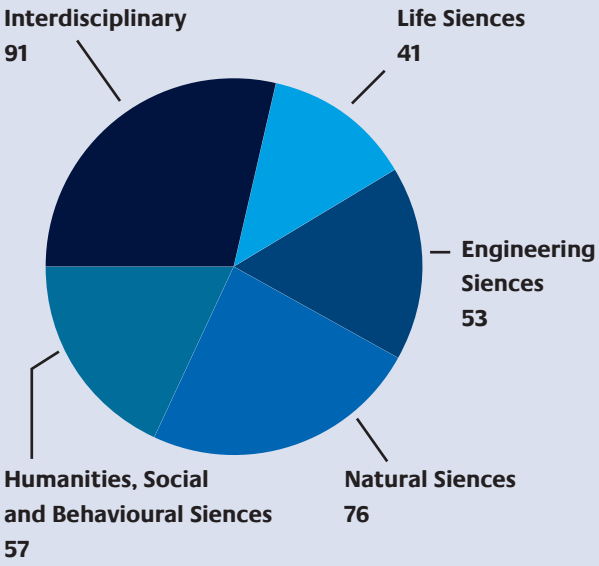
Taking a closer look at the areas of science at universities, a significant dominance of natural and life sciences, as well as humanities, social and behavioural sciences can be observed. Engineering sciences, on the other hand are, both relatively and absolutely, less represented in research than in the study opportunities. As to non-university institutions (not graphically displayed), results of the survey do not differ much in terms of their distribution to the different areas of science. However, non-university institutions do research far more often in more than one area of science at the same time.

Considering the fact that research at universities is mostly carried out in faculties, departments and individual chairs, we assume a closer interaction of education and research

in the strongly represented areas of science . Unfortunately, this seems not to hold true for interdisciplinary research, as education – as shown above – is scarcely active in an interdisciplinary context.

Distribution of Non-University Institutions According to Areas of Science

N=135; multiple answers possible



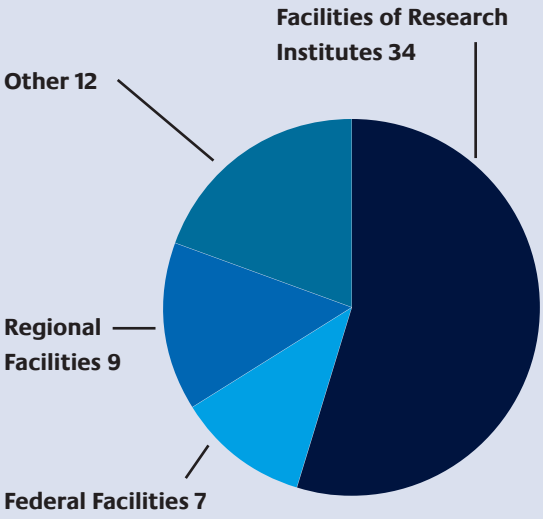
To conclude, a final look at the distribution of research facilities outside universities gives the following structure:

The dominance of research institutes, as reflected in the diagram, should not be overestimated as this is also a result of the selective survey this guide is based on. We comprehensively recorded, for example, the research facilities of the Leibnitz and the Helmholtz Association, as well as the Fraunhofer Gesellschaft and the Max Planck society, using their websites. Websites were also our first datasource for gathering information on the situation at universities. We furthermore primarily used the databases of the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung BMBF), in particular the database of the "FoNa" research programme "Research for Sustainability", the European DataBank Sustainable Development as well as the database of the Centre for Environmental Research at the University of Muenster.

At the beginning of the relevant chapter, you will find further details on the modes used in this survey, on criteria concerning the selection of research institutes and on the structure of our presentation of research institutes.

Non-university Facilities

N=62



Studying Sustainability Science in Germany

German universities are looking forward to welcoming foreign students. All universities wish to increase their number of students from abroad. Unfortunately, most lectures and seminars are still held in German. Some of them, especially those in natural sciences, but also economics, are offered in English. You will find further information on this in the portrayals of the courses. The situation in research facilities is different. In many of these, international teams work together, communicating in English. For more information on general opportunities to study in Germany, please refer to the website of the German Federal Foreign Office (www.auswaertiges-amt.de/diplo/en/WillkommeninD/LernenUndArbeiten/LernenArbeiten.html) and the German Academic Exchange Service (DAAD): www.daad.de/deutschland/index.en.html. You can obtain further details on requirements for a specific course by using the addresses listed in the portrayals or by contacting the university you are interested in. This particularly applies to questions concerning approval of certificates and entry requirements.

Career Prospects in Germany

There is no systematic, all-encompassing international survey on career prospects for scientists in the field of sustainability science. This is not only due to an international labour market situation that is generally rather difficult to survey, but also, first and foremost, to the

strongly varying job branches open to graduates after their studies – job prospects ranging from environmental engineering and landscaping, resource economics and environmental law and even environmental politics to education in sustainable development – job prospects are manifold.

In comparison to other occupational branches, careers in this field have expanded considerably – though they changed their priorities significantly in contrast to the last decades: instead of post-treatment in environmental protection, precaution and innovations in engineering, planning and structuring as well as the integration aspects of environmental protection and sustainability came to the fore. Today, eco-balancing and ecological landscape conservation belong more and more together. Integrating sustainability – as well as environmental protection – into existing professions, hence making them a matter in the daily work routine, can only be consistent when sustainable development becomes an extensive goal nationally and globally – integrating meaning, for example, including environmental aspects in corporate management, or the thought of "Good Governance", which has found its way into corporate philosophy. Concerning this matter, a new way of thinking could be detected in numerous companies during the last years. Sustainability is now considered a strategic orientation making companies achieve greater economic success, improving their reputation and enhancing the marketing of their products. This is not only valid for the increased use of renewable energies and the materials flow management, but also for the social commitment in- and outside companies.

Some occupational areas allow for an optimistic outlook into the future. According to the survey "Effect of Increased Use of Renewable Energies on the German Labour Market with Special Consideration of Foreign Trade" (www.erneuerbare-energien.de/inhalt/36860), published in September 2006, even the worst-case scenario in the field of renewable energies indicates that 70,000 new permanent jobs will be created by 2020. More optimistic estimations are based upon 130,000 new jobs. The German Renewable Energy Federation (BEE) estimates a growth up to 285,000 jobs by 2020. In Germany, not only engineers are needed, but also managers and staff for marketing consumer goods and for industrial plants (e.g. wind power plants). Of course, not all professions request a university degree. Still, a potential lack in specialised workers in Germany could develop, considering that each year, referring to our figures, only 8,000 university places in all (!) engineering sciences are available in fields related to environmental topics. That is why presently – and in all probability also in the future – there will be a demand for engineers who are able to develop and maintain biogas, solar and wind power plants. The branch of economics concerning renewable energies is presently the most exposed in terms of developing sustainable technology.

The organic branch also belongs to the booming businesses:in Germany, presently about 160,000 people are employed in the fields of agricultural output, food industry, trade and services. This branch shows a significant growth: in 2005, domestic sales went up by 15 %. This was particularly accompanied by a growth of jobs in the fields of food industry and food processing.

What would be reasons for choosing to study sustainability sciences? The answer is ultimately up to you. When asking people who are working in relevant jobs, for example in the field of organic companies, you will find quite a number of good reasons: first of all, to many of them it is important to have an ecologically and socially meaningful profession, meaning they wish to personally make a contribution to sustainable development. As a second point, you can generally make use of a lot of expert knowledge in this profession. As this is a dynamic branch, you will always face new challenges in terms of innovations – not least in order to comply with high quality standards for high-quality products and services. And finally, a third point would be that for respective companies and facilities a good working atmosphere and team spirit are especially important. All this speaks in favour of studying sustainability sciences. It is a field with a future that offers meaningful activities for individuals as well as for the society.

Those who seek to work in Germany in the field of sustainability are well advised to regularly visit the websites of the Science Shop Bonn (Wissenschaftsladen Bonn, www.wila-bonn.de). The Science Shop evaluates job offers in daily and weekly newspapers and other periodicals in terms of offers in the field of environment/sustainability on a regular basis. We wish to point out explicitly that qualified foreign labour are very much welcome in Germany, as we face a significant lack in them in several branches.

The Study Guide on the Internet and Updates

The portrayals can be also found at www.guide-sustainability.de. Offers are regularly updated on the Internet, including additions of other study opportunities as well as research institutes. Furthermore, news on already registered portrayals will be added regularly. Hence, it is worth visiting our website to stay up-to-date. You may also contact us via our website if you have any specific questions.

Staff Members and Gratitude

This publication is the result of the cooperation of the following people:

Gerhard de Haan was responsible for the project itself and for developing a basic concept for data ascertainment and data evaluation.

Heidi Consentius and Diana Grundmann were responsible for the courses; Jonas Kassner and Freya Diepenbrock were responsible for the research institutes. Katharina D. Giesel, supported by Heidi Consentius and Jonas Kassner, led the coordination of the team. Sven Kluge supported the teams in their research and data acquisition.

The IT support and data processing was in the hands of Ralf Bünemann. The database was programmed by Arne Psczolla.

The introductory chapters on the research institutes were written by Jonas Kassner, the relevant chapters on the courses by Diana Grundmann and Katharina D. Giesel. The manuscript (portrayal pages) was elaborated by Jonas Kassner and Ralf Bünemann.

We would like to thank Manuela Roth (brochure) and Geoff Sammon (CD) for the quick and professional translation of the guide into English.

The team would also like to thank all institutions and persons who provided this guide with portrayals of courses and research institutes and who supported us in the concept development for this guide. Our special thanks go to the Federal Ministry of Education and Research (BMBF) that generously subsidised the creation of this guide:

Prof. Dr. Gerhard de Haan

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