Steering Group for the Pilot Study Research Rating
on behalf of the
German Council of Science and Humanities

Research Performance of German Universities and non-university Institutions in Chemistry

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Results of the Pilot Study Research Rating

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Preface

The present study on the research performance of German universities and non-university institutions in chemistry goes back to the recommendations on rankings in the science system, adopted by the German Council of Science and Humanities [in the following also referred to as the Wissenschaftsrat or the Council] in November 2004.[1] Starting from these recommendations, the Council decided in July 2005 to conduct a pilot study on research rating in two disciplines, chemistry and sociology. This pilot study was intended to serve as a basis for the decision whether the research rating procedure could be established and continualized for all disciplines. The Council expects to present recommendations in this respect in May 2008. These will also include a comprehensive assessment of the experiences from the pilot study.

The results of the pilot study “Research Rating Chemistry” are based on a wide range of data and detailed assessment conducted through a so-called informed peer review by an assessment board. The data basis is highly informative and allows differentiated assessments. However, it must be kept in mind that the ratings are based on a procedure that was tested only for the first time in this pilot study. Therefore, in Chapter A.II (p. 9) this report also offers comments concerning the interpretation of the ratings.

The present report was prepared by the assessment board for chemistry and presented to the steering group, which passed it on November 12, 2007.

[1] Wissenschaftsrat: Recommendations for rankings in the system of higher education and research. Part 1: Research, in: Recommendations and Reports 2004, Cologne 2005, p. 159 – 220.

Summary

A steering group commissioned by the German Council of Science and Humanities conducted a pilot study on a research rating procedure for chemistry and sociology. The procedure tested in this pilot study had been recommended by the Council in 2004.[2]

For the pilot study in chemistry, the performance of 77 universities and non-university institutions was assessed through an informed peer review. The results of this assessment process are not just computed from quantitative data, but reflect the judgment of a board of reviewers, based on various quantitative as well as qualitative indicators and contextual information on each institution. Here lies one of the strengths of this procedure: It can adequately assess even novel and highly specialized types of performance that may not be reflected e.g. by bibliometric data. The assessments cover the three dimensions research, promotion of young researchers and knowledge transfer, embracing the six assessment criteria research quality, research impact, research efficiency, promotion of young researchers, knowledge transfer, and the promotion of the public understanding of science. Chapter A.II of this report contains a detailed account of the data assigned to the respective criteria. Specific issues of method brought up by the pilot study concerning individual criteria are also discussed there. Overall, due to the informative value of the underlying data, the criteria research quality and impact/effectiveness produced the most robust ratings.

The grades for the individual criteria are not aggregated to an overall score, and the ratings do not result in rankings or a league table. Rather, the rating procedure produces an individual assessment profile for each institution, which reveals the strengths and weaknesses in the respective performance dimensions. Consequently, the institution profiles shown in Chapter D.II must always be interpreted with each institution's specific mission in mind.

The steering group decided that the assessment by the "research quality" criterion had to differentiate further between individual "research units". These units were defined by the universities and non-university-institutions themselves. Due to the

[2] Wissenschaftsrat: Recommendations for rankings in the system of higher education and research. Part 1: Research, in: Recommendations and Reports 2004, Cologne 2005, p. 159 – 220.

novelty of the procedure, not all of the questions arising in the process could be brought to a binding settlement in advance of the survey. Where difficulties in the definition of research units could have influenced the assessment, this is disclosed in the assessment notes for the respective institutions.

The context of the research rating procedure as a pilot study, at this stage, must be considered when interpreting the results. Nevertheless, the comprehensive, very informative data basis and the assessment procedure chosen for the study, informed peer review, offer clear advantages over approaches such as exclusively indicator-based analysis or reputational survey. Hence it can be concluded that the pilot study in chemistry provides well-founded and differentiated information about the performance of chemical research in Germany.

The study shows that the universities and non-university establishments engaged in chemical research in Germany perform well, with a well-balanced profile. There is a broad basis of good and very good research, which is the vital foundation for top-ranking research. Many institutions can be rated as “excellent” by individual assessment criteria, especially regarding the criterion “Promotion of young researchers”. This strength should not only be maintained but enhanced even further. Knowledge transfer in chemistry, on the other hand, often depends on the institution’s individual mission. In this, applied-science institutions are particularly strong. Finally, it should be noted that publications from German chemical research show a strong impact and presence in international comparison. Unfortunately, due to their exclusive focus on universities, the existing international rankings do not adequately reflect this, since they disregard the strong input by non-university research in Germany.

German chemistry’s performance could be further enhanced if some smaller institutions would develop stronger research profiles. Some institutions have already excelled in this task. Their success shows that a distinctive research profile can be developed and a broad basis in teaching maintained at the same time. Obviously, the creation of more basic/block grant-funded posts dedicated to teaching would facilitate this process. To develop an individual profile, it is important that institutions are able to correctly assess and build on their strengths. In this regard, the tendency towards more autonomy for the universities presents risks as well as opportunities. The

institutions must be effective in their use of the growing independence, which is only possible if their decision-making is based on reliable data. Some universities and most non-university institutions already have such data at their disposal, but many other universities need considerable improvement in this respect. The recommendation that individual institutions should develop more distinctive research profiles is not meant to imply that chemical research in Germany should be more specialized as a whole. Rather, the breadth of research activities must be maintained in order to ensure that competent and excellent researchers will be available in the most diverse sub-disciplines of chemistry in the future, too. This breadth is another notable strength of chemical research in Germany.

The allocation of public funds should not be directly linked to any selective assessment. In the opinion of the assessment board, the benefits from this study could be enhanced considerably again by repeating the research rating exercise after an interval of some years. Such reassessment would provide clear evidence for existing and emerging trends and deliver a proper basis even for far-reaching decisions.

A. Outline of the pilot study Research Rating

Part A outlines the main features of the method developed and applied in the pilot study. Apart from general explanations concerning the organization, implementation and data basis of the procedure, Section A.II also details the individual criteria and the type and quality of data used in each case. Such information is crucial for the understanding of the results. The other sections offer a summary analysis of the assessment results from the pilot study in chemistry (Part B and Part C) and, finally, the actual results (Part D).

The present report was produced by the assessment board for chemistry (see below, A.I.1). The assessment board for sociology will present a corresponding report containing the assessment results in sociology. Additionally, both assessment boards submit a final report, each, to the steering group, offering recommendations regarding the research rating procedure in their respective discipline. On this basis, the steering group is going to draft recommendations for the future of research rating, which are expected to be presented to the German Council of Science and Humanities in spring, 2008.

A.I. Organization, implementation and data basis of the pilot study

I.1. Organization

The decision to conduct the pilot study goes back to the “Recommendations for rankings in the system of higher education and research, Part 1” adopted by the Council in November 2004. In that document the Council recommended to carry out a comparative rating procedure for universities and non-university institutions, in order to support the institutions in their strategic decision making and promote competition by creating more transparency. In view of international experience with comparable ranking procedures, the Council rules out rating procedures exclusively based on quantitative indicators as well as the purely reputational assessment approach. In contrast to such systems, the research rating procedure suggested by the Council is characterized by:

- the “informed peer review“ principle, meaning the assessment is conducted by reviewers and based on standardized quantitative and qualitative data, which are specifically defined for each subject;

- multidimensionality, meaning the assessment is differentiated in terms of various performance criteria, which are not aggregated to an overall score, but take into account the diverse missions of different types of institution;
- the fact that it does not produce rankings or league tables and thus avoids the misleading semblance of precision and consequent missteering effects.

The Council's recommendation to test the procedure, if possible, through a pilot study involving two scientific disciplines, was followed up in 2005 by the resolution to conduct such study for chemistry and sociology. The selection of chemistry as one of the disciplines for the pilot study was suggested by, among other parties, the Gesellschaft Deutscher Chemiker (GDCh, German Chemical Society) and the Verband der Chemischen Industrie (VCI, German Chemical industry Association), which also supported the pilot study in chemistry during its implementation.

The responsibility for implementing the pilot study was assigned to a steering group led by the former chair of the Scientific Commission of the German Council of Science and Humanities. The steering group includes other members of the Scientific Commission, additional experts, and ex-officio representatives, usually at vice president level, of the major scientific organizations: the Hochschulrektorenkonferenz (HRK, German Rectors Conference), the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), the Fraunhofer-Gesellschaft (FhG, Fraunhofer Society), the Helmholtz-Gemeinschaft Deutscher Forschungszentren (HGF, Helmholtz Association of German Research Centres), the Max-Planck-Gesellschaft (MPG, Max Planck Society) and the Leibniz-Gemeinschaft (WGL, Leibniz Association). Six German Länder, the German Federal Government, the VCI and the head offices of the major scientific organization have sent guest participants to the steering group. For the subject-specific operationalization of the research rating procedure, and for the implementation of the assessments as an informed peer review, the steering group appointed two assessment boards.

The reviewers on the assessment board for chemistry were put forward by the major scientific organizations, the GDCh and the VCI. Apart from the subject experts, each assessment board includes as a guest reviewer one steering group member from outside the respective discipline. The chairs of the two assessment boards, in turn,

have guest status in the steering group.[3] Apart from the assessment boards, a sub-working group of the steering group, which develops the survey questionnaires, is involved in setting up the procedure.

I.2. Subject-specific operationalization

To be able to register the institutions engaged in chemical research, the discipline as such had to be properly defined. To this end, 10 research sub-disciplines were identified, which together define the subject of chemistry against other disciplines. These sub-disciplines are: analytical chemistry, inorganic chemistry, biochemistry and biological chemistry, organic chemistry, food chemistry, medical/pharmaceutical chemistry, physical chemistry, polymer chemistry, technical chemistry and theoretical chemistry.[4]

Once the discipline was defined, the assessment board adapted the matrix of criteria recommended by the Council to the particular research practices in chemistry by compiling the main aspects of each criterion and assigning to them the quantitative indicators and qualitative information required for an assessment (see Section A, p. 9 ff.). At this stage the number of criteria in the dimension “Promotion of young researchers” was reduced from two to one, while the “Knowledge transfer” dimension was reduced from four criteria to two.

Based on the assessment matrix[5] generated this way, the requisite data sources could be determined. To ensure comparability, a considerable fraction of the data had to be collected through direct inquiry from the institutions participating in the study. Therefore, questionnaires were developed and initially trialed in a pre-test with, for chemistry, one university and three non-university institutions. The questionnaires were revised according to the experiences from this pre-test before being used in the subsequent survey of all participating institutions.

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3 The full lists of assessment board members and members of the steering group have been published on the Internet at: http://www.wissenschaftsrat.de/pilot_start.htm.

4 The area of medical/pharmaceutical chemistry was limited to such research that is predominantly chemical rather than medical or pharmaceutical in its nature. The entire area of chemical engineering is excluded because, in Germany, it is usually regarded as a discipline quite separate from chemistry.

5 The complete assessment matrix can be viewed at: http://www.wissenschaftsrat.de/texte/Bewertungsmatrix_Chem.pdf. (Excerpts are shown in Section A.II).

I.3. Data collection and analysis

All universities and non-university institutions engaged in chemical research in Germany were invited to take part in the survey and be assessed by the research rating procedure. This invitation was accepted by 57 universities and 20 non-university institutions, of which only the “chemical” parts were assessed, not the entire university or institution. For the non-university establishments, this meant that chemical research groups could take part even if the main focus of their institution was not on chemistry.

Data collection within the participating institutions was coordinated by “subject coordinators” appointed by the institutions’ management bodies. The appointment of a suitable subject coordinator and providing efficient administrative support for him were of great importance for the internal implementation of the data collection stage. Insufficient support and poor internal controlling at some universities meant that data collection was only possible by burdening the subject coordinator with an extreme personal workload. In some isolated cases, data collection had to remain incomplete. This is declared in the results part of this report, in cases where no rating could be given because of lack of data.

The assessment required data at two levels of aggregation: institution (chemistry as a discipline at a university or within a non-university institution) and research unit. Consequently, the survey was carried out in two stages. First the research units were defined, and the senior scientists conducting the research were named. This stage was implemented in the summer of 2006. The second stage, from mid October 2006 to end of January 2007, involved the collection of the data that were relevant for rating according to the assessment matrix (see A, p. 9 ff.). All data collected at this stage referred to the research output of the scientists registered by the institutions during the first stage of the survey. Data were collected via questionnaires including a tabular section.[6] The questionnaires were segmented according to the two survey levels (entire institution and research units). Although the survey meant higher costs and effort for institutions that had not already collected the required data for self-steering purposes, it was appreciated by these institutions as an opportunity to create a data basis that would benefit future, internal purposes.

[6] The questionnaires are available on the Council’s web page at www.wissenschaftsrat.de/pilot_start.htm, “Dokumenten-archiv”.

The research unit level was introduced to obtain a differentiated assessment of research quality within each individual institution. Usually, a research unit is defined as a group of at least three full-time scientists that had conducted a long-running, continuous research program, and that had existed at the survey deadline date, 2005-12-31. Many research units are identical with departments, institutes, centers or other organizational units, or they were formed by combining such units. The institutions were advised to avoid defining their research units in too much detail (guide number: three to six research units per institution). In the end, the 77 institutions taking part in research rating in chemistry registered 349 research units, equivalent to 4.5 research units per institution, on average. The average research unit on the survey deadline was composed of 6 senior scientists (with 3 at professor/director level).[7]

When the structure of the institutions, i.e. their senior scientists and their assignation to research units were registered, some typical issues emerged. Accordingly, based on the experiences from the pilot study, more binding rules should be framed about:

1. the disciplinary assignation of scientists,
2. how to deal with service units,
3. dealing with transinstitutional collaborations.

Re 1: The institutions were asked to register only such senior scientists who are clearly engaged in chemical research. This was difficult in some cases, especially as there are fringe areas such as analytical chemistry, food chemistry and pharmaceutical chemistry where scientists have contributed substantially with research beyond chemistry, into other scientific disciplines. This can lead to incomplete assessment of the overall research performance.

Re 2: If possible, scientists from service units should be assigned to other research units instead of being registered as distinct research units of their own. However, many service units assist several areas of activity with their work, including areas that belong to other disciplines, even if the service in question clearly is chemistry by its

[7] "Senior scientists" include professors, directors and group leaders. The leadership function must be in research, not in administration. Emeriti, stand-in or visiting or honorary professors, associate professors without tenure, and research associates and post-graduate or student assistants are excluded.

nature. Consequently, for the efficiency assessment, i.e. for quantifying the human resources input, service staff have to be registered with their FTE input to the respective research unit. Difficulties with attributing or quantifying this share result in uncertainties in the efficiency assessment. In one case an institution was classified as “unrateable” for the efficiency criterion, because of the high proportion of service staff that also perform research work for other disciplines.

Re 3: Institutions were offered the option to register close collaborations between a university and a non-university institute, including shared appointments, as “transinstitutional research units”. In these cases all publications by the scientists appointed by both institutions were accounted to both research units. Other research contributions should be registered separately, as far as possible, by the two institutions.

Institutions that could not form research units with at least three scientists engaged in full-time chemical research did not take part in the research rating exercise. Consequently, some professorial chairs, mainly at smaller universities, or individual working groups at non-university institutions could not be registered. Still, with 1038 professors at the survey deadline, considerably more scientists took part in the pilot study for chemistry than the Statistisches Bundesamt counted for “chemistry” as an area of teaching and research (895 in the year 2005 – not counting professors at universities of applied sciences or polytechnics). This means the pilot study achieved a high registration rate, overall. Three universities and three non-university institutions withdrew from the pilot study while it was underway, for various reasons, and individual research units were de-registered at some stage by the 77 institutions with which the study was completed. Those research units are not included in the results presented in this report.

The ratings are based on performance data for the participating institutions in the survey period 2001-01-01 to 2005-12-31. The survey was conducted following the “Work Done At” principle, according to which the research performance of each scientist is always assigned to the institution where it was accomplished. Even if the scientist moves to another institution, their previous contributions are still counted for their old institution instead of their current one. The “Work Done At” principle is more robust against random effects in the analysis of institutions, e.g. due to posts left

vacant for a while, than the alternative “Current Potential” principle, according to which the scientist takes their achievements with them to their new post.[8] Also, the “Work Done At“ approach favors institutions that are good at promoting young researchers and whose scientists deliver sustainedly strong research, whereas “Current Potential“ surveys tend to reward those institutions that manage to recruit strong researchers in time for survey deadlines. Independent of the survey mode, the informed peer review procedure allows detecting major changes, which could affect the future development of an institution, from a synoptic perspective, taking into account various background information.

Apart from the data collected at the institutions, the study also used external data, as far as they could be clearly related to the appropriate level of aggregation. For instance, the GDCh provided (PhD) graduation data, while data on visiting scientists were obtained from the Alexander von Humboldt-Stiftung (AvH). The VCI made available a detailed list of the fellowship awards of the Chemical Industry Fund. Additionally, bibliometric information based on data from the commercial supplier, Thomson Scientific (formerly ISI, Institute for Scientific Information), was collected by the Institut für Wissenschafts- und Technikforschung (IWT, Institute for Science and Technology Studies) at the University of Bielefeld. The bibliometric analysis, which was carried out according to the “Work Done At” principle, covered the publication and citation record of the institutions and research units, defined by the senior scientists registered by them and by the address of the respective institution. The initial lists of publications compiled in this way were sent back to the institutions, with the request to correct and amend the data appropriately, before the “Web of Science” was searched for citation data. Recourse to these databases also entailed the adoption of database-specific standardizations (e.g. subfield assignations and definitions). The resulting limitations were taken into account in the critical assessment by the reviewers.

The following procedures were utilised regarding the bibliometric data:

- Citation figures were corrected for self-citations.[9]

[8] The “Current Potential” survey was tested in the pilot study Research Rating Sociology.

[9] Exception: the normalized, relative citation figures, because the normalization factors for the international average obtained from ISI are not corrected for self-citations, either.

- Co-publications by authors from several institutions were fully counted for each of the institutions involved (“normal counting“).
- Co-publications whose authors belong to different research units within the same institution were counted in equal shares for the research units involved (“fractional counting“).
- The principle of fractioning was also applied to citations of co-publications within an institution.
- The bibliometric data became part of the institutions’ data reports. In some cases additional information was taken into account for the assessment, e.g. the citation figures for each publication of research units with low numbers of publications, to ensure that the figures were not distorted by “outliers”.

For the 77 participating institutions, a total of 41,948 publications and 320,722 citations were registered, making this bibliometric evaluation the most comprehensive, by far, ever conducted for chemical research in Germany.

Data collection was followed by data inspection and analysis. In consultation with the subject coordinators it was checked that the survey rules stipulated in the questionnaires were adhered to, discrepancies and lack of data concordance (especially between the survey levels institution and research unit) were clarified and, where possible, missing data were acquired at this stage. Wherever feasible, which was only at a very high aggregation level in most cases, the data were reconciled with external statistics. For 66 of the 77 participating institutions (85.7%), amendments or follow-up questioning became necessary. The data collection and analysis stage was concluded by bringing together the data collected through the questionnaires and the external data in data reports, which were presented again to the subject coordinators for final inspection. Based on the final data, derivative indicators and the statistical measures of location and variation of the quantitative data were computed.[10] In their entirety, the data provided a broad basis for the differentiated assessment by the reviewers.

[10] The measures of variation were detailed for the reviewers in an introduction to the data reports. This introduction [“Leitfaden”, only available in German] can be found at: http://www.wissenschaftsrat.de/pilot_start.htm.

I.4. Assessment process

The research performance assessment on the basis of the data reports was the task of the assessment board. The members of the assessment board were assigned to individual institutions and research units, according to their specialist competence, but also taking into account possible biases. This meant, for instance, that non-university institutes could not be assessed by members of the respective scientific organization (FhG, HGF, MPG, WGL). At least two rapporteurs were assigned to each institution or research unit to carry out the initial assessment. For 25 research units, where an assessment only by members of the assessment board was unadvisable due to biases or because of the extreme specialization of the units, nine external, special reviewers were brought into the process. Initially, the rapporteurs proposed their independent ratings of the institutions and research units they were assigned to. After that, each individual rating was explained, discussed and moderated in plenary sessions of the assessment board.[11]

In the “informed peer review” procedure, the reviewers consider from a synoptic perspective the quantitative and qualitative data as well as additional information about each unit assessed. The context-dependent assessment allows taking into account innovative achievements, the specifics of individual areas of research, periods of fundamental change and other unusual situations. This interpretative contribution by the reviewers and the inclusion of qualitative aspects are particularly important for an assessment involving bibliometric data, which in a purely quantitative evaluation could give rise to incentives disfavoring more venturous research.

A.II. Explanation of the assessment criteria

Following the recommendations of the German Council of Science and Humanities, the assessment was carried out in three dimensions, “Research“, “Promotion of young researchers“ and “Knowledge transfer“. The assessment board for chemistry assigned six mutually independent assessment criteria to these dimensions:

[11] Individual reviewers abstained from sessions about cases in which they were biased.

Dimension	Criterion
Research	I. Research quality
	II. Impact/Effectiveness
	III. Efficiency
Promotion of young researchers	IV. Promotion of young researchers
Knowledge transfer	V. Transfer to other areas of society
	VI. Promotion of the public understanding of science

To operationalize these criteria, they were subdivided into assessment aspects, to which, in turn, certain indicators were assigned through an "assessment matrix".[12] "Research quality" was assessed and rated at research unit level, in order to allow internal differentiation by this core criterion within individual institutions. In the opinion of the review board, the data available for the first two criteria, "Research quality" and "Impact/Effectiveness", provided the most differentiated basis for assessment, both quantitative and qualitative.

The grades for the individual criteria are not aggregated to an overall score, and the ratings do not result in rankings or a league table. Rather, the rating procedure produces an individual assessment profile for each institution, which reveals the strengths and weaknesses in the respective performance areas. Hence, the profiles shown in Chapter D.II must always be interpreted with each institution's specific mission in mind.

All ratings were taken from a five-level scale of grades: 5 = "excellent", 4 = "very good", 3 = "good", 2 = "satisfactory" and 1 = "unsatisfactory". For Criterion I, "Research quality", the high quality of the data allowed finer differentiation especially in the higher performance segment, where the intermediate grade "very good to excellent" was introduced. For criterion VI, "Knowledge transfer", on the other hand, the differentiation into 5 grades was abandoned in favor of just three levels ("below

[12] The complete assessment matrix can be viewed at: http://www.wissenschaftsrat.de/texte/Bewertungsmatrix_Chem.pdf. (Excerpts are shown in Section A.II).

average", "average", and "above average"), as the information supplied by the institutions was very heterogeneous.

Some research units and institutions were classed as "unrateable", which in itself must not be misunderstood as a rating. This classification can be due to various reasons, for instance because the respective data basis lacked informative value, or no data were available at all, or the research unit in question was institutionalized or formed near the end of the survey period so that it was to early to expect evidence of its performance. Detailed reasons for any classification as "unrateable" are given in the individual assessment notes (Section D.II).

II.1. Criterion I: Research quality

Criterion I, "Research quality", is for assessing the originality and scientific relevance of the research output, as well as the adequacy of the methods applied. By definition, research quality does not depend on size or volume. Also, the indicators for the research quality rating are not influenced by the particular mission of the assessed institution.[13]

Research quality comprises the assessment aspects "relative success of reception", "output quality" and "peer appreciation". As a data basis for the assessment, the following indicators were surveyed:

quantitative:
– Citations per publication normalized to average citation rate for the subject area (ZP/FCS_m)
– Citations per publication normalized to average citation rate for the journal (ZP/JCS_m)
– Citations per publication (ZP)
– Number of publications (P) – Additional information for assessing the citation indicators
– Ratio subject area-specific over journal-specific citation success (JCS_m/FCS_m)
– Maximum number of citations of a single publication (Z_{max})
– Points score for support by the Chemical Industry Fund
qualitative:
– List of publications
– Research output other than publications, e.g. databases and software, patents, etc.
– List of third party-funded projects
– List of major research awards and prizes

Bibliometric data are very important for the research quality assessment. Mainly with regard to the "relative success of reception", the normalized indicators of citation success, ZP/FCS_m (citations per publication normalized to the average for the subject area) and ZP/JCS_m (citations per publication normalized to the average for the

[13] For instance, the transfer performance of an application-based institution is not assessed and acknowledged under "Research quality", but within the "Knowledge transfer" dimension.

journal), are particularly crucial. The ratio JCS_m/FCS_m, which holds information about what kind of organs a research unit uses for publication, was very important, too. A high ratio indicates a publication strategy targeting very high-value (i.e. frequently cited) periodicals. The normalization of the citation performance to specific subject branches (ZP/FCS_m) is particularly relevant as it can compensate for the diversity of citation cultures and “modes” of research. The association of a publication with a subject branch is based on how the periodical in question is classified in the Thomson-ISI databases. However, especially in minor and/or new branches, this classification can lack selectivity or may be out of date. This is why the reviewers checked the bibliometric indicators by inspection of the lists of publications and, in some cases, the raw citation data, as well. To avoid distortions due to different sizes of research units, the productivity (publications per senior scientist) was taken into account as background information.

The research quality rating not only reflects the bibliometric data, but was supplemented by a substantial assessment of the research outcomes. This involved reading of selected publications. In comparison, an assessment exclusively based on individual bibliometric data would inevitably lead to a loss of validity and differentiation of the rating results. While in many cases there is a high level of agreement between the assessment of the research quality and the bibliometric indicators, there also were a significant number of cases where the consideration of qualitative and quantitative indicators and the existing background information resulted in a rating clearly at variance with the bibliometric data. This occurred, for instance, in branches of research that are pursued by only a few groups in the world with, consequently, very low citation rates. Leading contributions to such areas of chemistry were rated as higher quality than the citation data as such would have suggested.

Generally, the research quality ratings are very robust. This is due primarily to the volume and quality of the data material, and to the differentiation options allowed by an assessment at the level of individual research units. Limitations emerged only where the research units defined were too small and, as a result, the aggregated data lacked informative value; or where the research units were very big and, thus, of uneven quality; or where several posts had been left vacant for long intervals within the survey period.

II.2. Criterion II: Impact/Effectiveness

The criterion “Impact/Effectiveness” serves to assess the contribution of each institution to the development of science within the discipline and beyond. The associated assessment aspects are “research productivity“, “research activity“, “visibility”, “interdisciplinarity“ and “reputation“ of the respective institution.

quantitative: – Number of publications (P) – Number of initial registrations, patents granted – Volume of third-party funding – Proportion of third party-funded staff in total staff (FTE) – Absolute number of citations (Z) (rating taking into account the maximum number of citations for a single publication (Z_{max}) and the number of publications never cited (P_{nz})) – Normalized number of citations: citations per publication normalized to the average number of citations for the journal (ZP/JCS_m) and citations per publication normalized to the average number of citations for the subject area (ZP/FCS_m) – Number of visiting scientists funded by DAAD and AvH – Citations from other subject areas
qualitative: – Self report on interdisciplinarity – Elected/Appointed offices at other scientific institutions (list) – Plenary talks/Named lectures (list)

Regarding the set of indicators, it should be noted that the indicators surveyed for the assessment of interdisciplinarity (self report and citations from other subject areas) proved difficult to interpret. As a result, these aspects were not assessed separately, but were treated as background information for the overall assessment of the criterion.

For the impact/effectiveness rating of an institution it is important that any efficiency aspects are explicitly excluded. As a result, major institutions stand a better chance of doing well by this criterion.

As was the case for research quality, impact/effectiveness was regarded as a very robust criterion. Apart from the limitations concerning the “interdisciplinarity” aspect, the data collected for this criterion were very informative.

II.3. Criterion III: Efficiency

The efficiency criterion measures each institution’s contribution to the development of science within the discipline and beyond (i.e. its impact/effectiveness) in relation to the resources spent on it. The assessment of the efficiency of institutions serves to

compensate for the influence of the size of the institution on some indicators and can thus counterbalance the size-dependent impact/effectiveness criterion. The total, full-time equivalent (FTE) scientific staff count on the survey deadline was chosen as the measure for the employment of resources. Scientific staff comprises professors/directors as well as other staff scientists engaged in research. For the efficiency assessment, the core indicators for the impact/effectivity criterion were divided by the staff count. In one calculation all scientific personnel were taken into account, in another only the mainstream-funded permanent scientific staff were counted for the denominator. The mainstream-funded staff was given a higher weight for the final rating. The alternative approach, using the total budget as an input indicator, was rejected for two reasons: A standardized survey of this indicator would have been near impossible; and branch-dependent variations in the required non-personnel resources would have caused distortions. Therefore the FTE personnel figure is the more robust input indicator.

quantitative: – Ratio number of publications / scient. staff (FTE total and FTE mainstream-funded, weighted) – Ratio number of citations (Z) / scient. staff (FTE total and FTE mainstream-funded, weighted) – Ratio third-party funding vol./ scient. staff (FTE total and FTE mainstream-funded, weighted) – Ratio patent registrations / scient. staff (FTE total and FTE mainstream-funded, weighted)
qualitative: - Impact in proportion to total personnel input (FTE, weighed according to teaching duties, incl. doctoral students and post-docs), to mainstream-funded staff (FTE, incl. doctoral students and post-docs, weighted), to staff excl. doctoral students (FTE, weighted), and to technical staff (FTE number)

When determining the personnel input, the different burden of teaching duties for universities and non-university institutions was taken into account by applying different weightings to the staff numbers:

- professors/directors x 0.5, staff scientists x 0.75 at universities;
- professors/directors x 0.9, staff scientists x 1.0 at non-university institutions.

The reviewers also considered in their assessment that a professor at a smaller institution is usually burdened with more teaching duties than his colleagues at a larger institution. However, for reasons of cost and manageability of the survey, data about teaching duties were not collected in any more detail. Anomalies in the volume of teaching duties at individual universities, as well as other extraordinary workload, could enter the efficiency assessment only as part of the qualitative information about individual institutions.

In some cases the data about the proportion of third party-funded personnel were missing or implausible. Since in such cases the mainstream-funded staff could not be quantified, either, the efficiency criterion was classified as “unrateable”.

More problems with the efficiency assessment can arise if a university cooperates with a non-university institution, so closely that staff cannot be clearly associated to one or the other employer. Finally, service units that also work for disciplines other than chemistry, so that only some share of their resources should enter the calculation for chemistry, are difficult to assess in their efficiency, too. In cases where the comparability of the efficiency data was limited for such reasons, the assessment board desisted from issuing a rating, giving the reasons for this decision in the respective assessment notes.

II.4. Criterion IV: Promotion of young researchers

Measures and achievements in the promotion of young scientists within the subject area (during their doctoral studies and in the promotional phase following the PhD graduation) are assessed by this criterion. As aspects it included the promotion of PhD students and measures to promote the scientific careers of young post-docs.

quantitative:
– Number of postgraduate bursaries and fellowships, plus paid doctoral student posts
– Number of PhD graduations
– Proportion of female PhD graduates
– Number of post-doc fellowships and junior group leader posts
qualitative:
– Structured postgraduate programs (list)
– PhD prizes awarded (list)
– Academic appointments for young scientists (list)
– Prizes awarded to young scientists (list)

Some of the indicators assessing the promotion of young researchers depend on the size of the assessed institution. An institution could be awarded the “excellent” grade for this criterion only if the quantitative and qualitative aspects for the promotion of young researchers showed a consistent balance.

The PhD graduation figures of universities were determined from the numbers of graduation procedures completed. Non-university institutions were asked to provide the number of PhD students whose principal supervisor worked at the respective institution, and who had completed the PhD graduation procedure in the respective year. Since those procedures are conducted at universities, this approach led to

cases of double counting in terms of the overall figure. On the whole, however, the graduations that had been conducted at universities, but supervised at non-university institutions, did hardly cause any shifts. Another issue was that the GDCh data, on which the graduation figures of the universities were based, only included PhD graduations in chemistry, thus excluding graduations e.g. of medical students that had been supervised by scientists of a chemistry institution.

Since there are no data about the fate or whereabouts of PhDs that left academia at some point after their graduation – or such data cannot be provided by most institutions (especially universities) –, the rating by this criterion has to be dominated by the promotion of young scientist within academic institutions.

This limitation is particularly relevant for the Fraunhofer Institutes, where the promotion of young researchers is focused mainly on the non-academic domain. Furthermore, many of the young researchers supervised by senior scientists are only listed under the universities with which they are associated. For these reasons, the Fraunhofer Institutes cannot be assessed adequately with regard to their success in promoting young researchers, and were classified as “unrateable” by this criterion.

II.5. Criterion V: Transfer to other areas of society

The fifth criterion, “Transfer to other areas of society” serves to assess each institution’s performance in the transfer, by application as well as information, of scientific results to areas such as business, politics, administrations, associations, etc.

quantitative:
– Number of patents awarded
– Number of licensed patents
– License income
– Third party-funding from private sector companies
qualitative:
– Spin-offs and shares in businesses (list)
– Consulting functions outside the private sector (list)

As is the case for all other criteria, the assessment of an institution’s success in the knowledge transfer to other areas of society did not depend on whether, or to what extent the respective institution had made such transfer part of its mission. This means that an institution that was less active in this function could not avoid a poor rating by declaring it did not consider knowledge transfer as one of its tasks. Vice

versa, institutions showing excellent achievements in knowledge transfer were rated “excellent” by this criterion even if they “only” fulfilled their mission by doing so.

The assessment of this knowledge transfer criterion was made difficult by the heterogeneous and, in some cases, obviously incomplete data basis. Consequently, the assessment by this criterion is less robust than the assessment of research quality and impact/effectiveness.

II.6. Criterion VI: Promotion of the public understanding of science

This criterion, “Promotion of the public understanding of science”, is defined as measuring the success of conveying scientific, research-based knowledge to non-specialists organizations not engaged in scientific research, and to the general public.

quantitative: – Number of vocational apprenticeships completed
qualitative: – Advanced vocational training courses (list) – Description of exemplary measures to promote the understanding of science beyond the realm of science

The data basis for this criterion is very heterogeneous and consists, mainly, of qualitative data. Consequently, the robustness of the assessment in this respect is inferior to that of the other assessment criteria. For this reason the rating scale for the promotion of the public understanding of science was simplified to three grades, “average“, “above average” and “below average”.

B. Summary of results

The results of the research rating exercise presented here are based on an assessment procedure that meets very high standards. The ratings do not just reflect quantitative indicators, but were determined by reviewers in a complex assessment and moderation procedure. Still, despite these very high standards, it is in the nature of a pilot study that it gives rise to new methodological issues. These, as far as they have not been answered already by the reviewers in the course of the procedure, will be dealt with in the final recommendations of the German Council of Science and Humanities.

The data material available to the assessment board was not of the same informative value for all six assessment criteria (see A, p. 9 ff.). Most notably the criteria of the knowledge transfer dimension – “Transfer to other areas of society” and “Promotion of the public understanding of science” – were more difficult to assess for this reason. The assessment by the research efficiency criterion was also subject to limitations, as a result of the diverse general conditions for different types of institution. And, although they are based on reliable data, the ratings by the criterion “Promotion of young researchers” primarily reflect the quality of processes to promote young academic staff. The highest degree of robustness must be attested to the criteria “Impact/Effectiveness” and “Research quality”, however with one qualification: The variance of the sizes of the research units registered for the pilot study, as well as the variance in their internal heterogeneity was considerable, which made some cases difficult to assess (see p. 12).

The present assessment of chemical research in Germany reflects a high level of agreement between the reviewers. In 75 to 80% of all cases the two rapporteurs responsible for each institution or research unit independently proposed the same ratings (within a margin of half a grade on the rating scale)[14]. The best agreement was achieved for the criteria “Research quality” and “Impact/Effectiveness”. Diverging assessments were discussed and moderated in plenary session. Still, even in cases where there was complete agreement, the rapporteurs explained their ratings in front of the plenum.

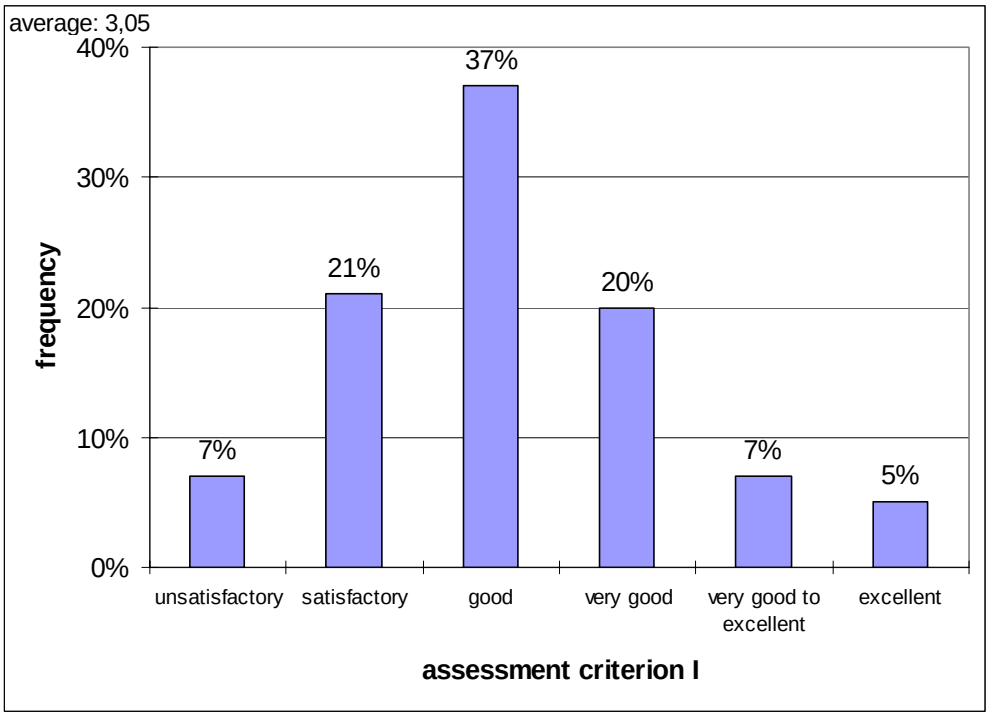
[14] At the stage of individual assessment, the rapporteurs were allowed to use intermediate grades. It was only at the plenary stage that the rating scale was reduced to full grades (except for the grade “very good – excellent” for the research quality criterion).

Four institutions and five research units were classified as “unrateable” by at least one criterion. This classification, which must not be mistaken for a rating as such, was applied for various reasons, which are recorded in the respective assessment notes.

B.I. Results by individual criteria

The average grade in *Research quality* (research unit level, 349 cases) is 3.05 (3 = “good”). The grade “unsatisfactory” applied to 7% of all cases. Another 7% were awarded a “very good to excellent”, while 5% of the research units were rated as “excellent” for the research quality they achieved.

Figure 1: Ratings distribution Criterion I, research quality (research unit level)

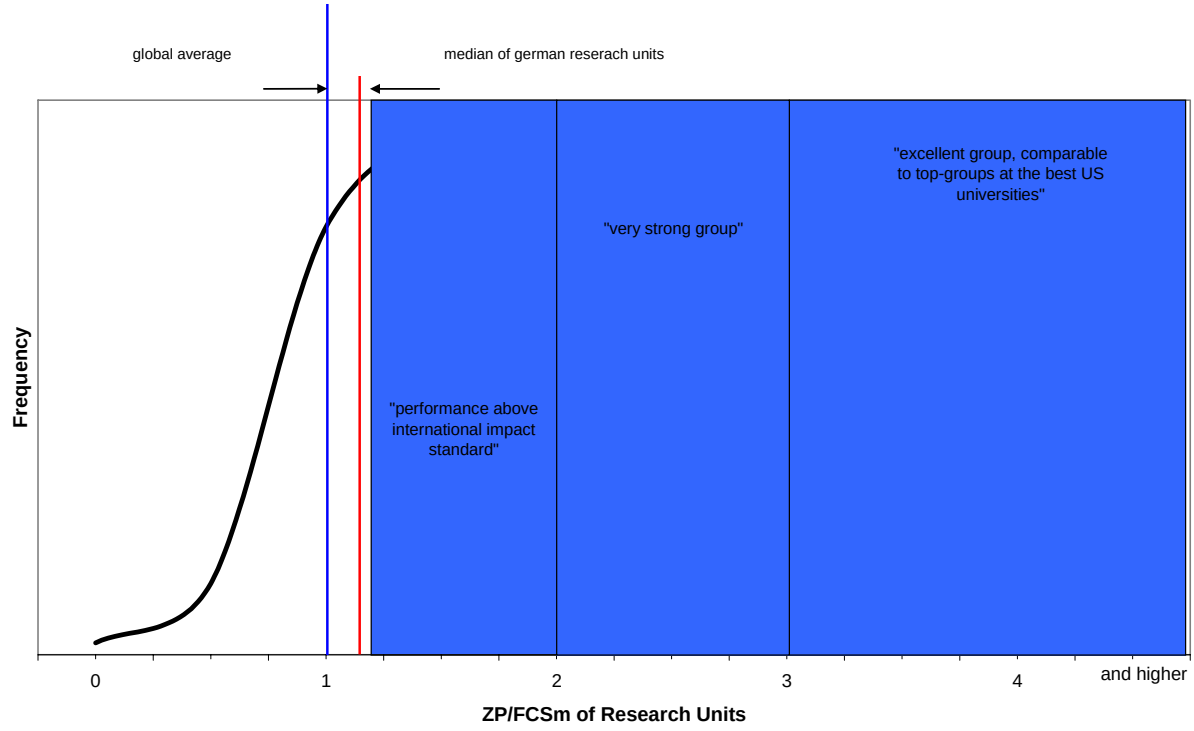


2% of all research units were „not rateable” under the criterion research quality.

According to the definition of the rating scale, only the “excellent” grade is explicitly related to an international scale. Nevertheless, it can be shown that “good” does not equal "average” in international comparisons. This can be achieved by resorting to ZP/FCS_m, the subject-normalized citation indicator, in the following way: ZP/FCS_m (citations per publication divided by the average number of citations for the respective subject area) equals 1 indicates a value close to the international average;

a value of 1.2 or higher indicates that a group of researchers performs above average, internationally; a result between 2 and 3 signals a very strong research performance. Finally, 3 or higher means the group delivers international excellence.[15] The following diagram shows the ZP/FCS$_m$ values achieved by the research units and the threshold values for research groups to achieve international excellence:

Fig 2: ZP/FCS$_m$ scores of *research units* in international comparison



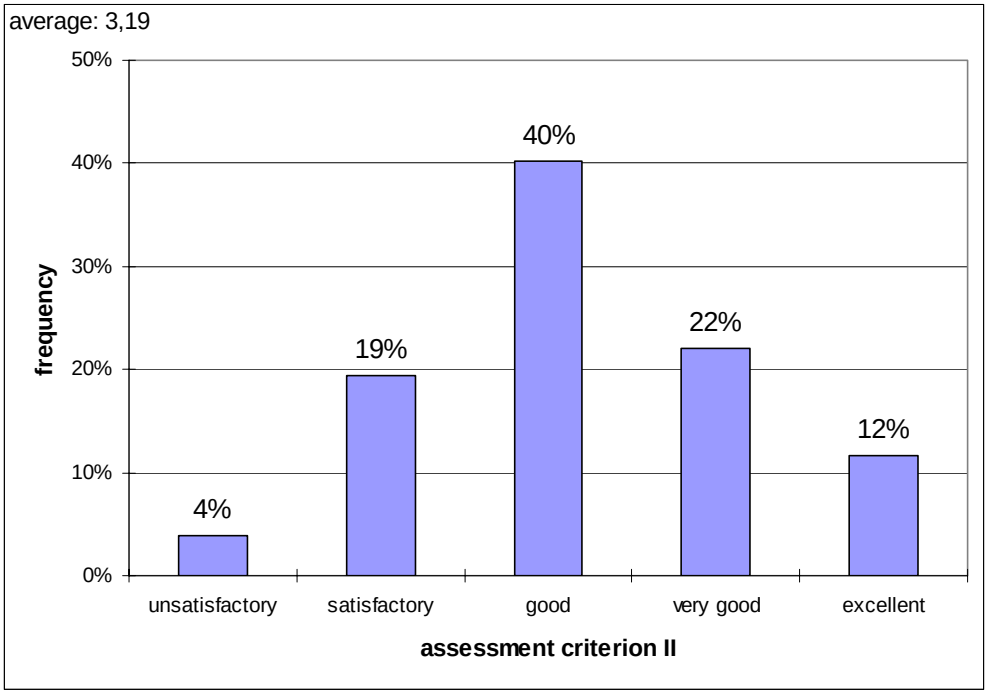
Quantitative thresholds following van Raan, Anthony F.J.: „The use of bibliometric analysis in research performance assessment and monitoring of interdisciplinary scientific developments", in: "Technikfolgenabschätzung 12, 1 (2003), 20-29.

The diagram shows that the median of the German research units (1.17) is above the international average. 31 research units achieved a value of 2 or higher, four research units scored higher than 3, and one research unit reached 7.12. The diagram illustrates that the "average" German research unit, which was rated as "good" in the pilot study, is clearly above average, internationally, in terms of the ZP/FCS$_m$ indicator.

[15] These values were introduced for bibliometry by the "Leiden Group" at the University of Leiden, cf. e.g. van Raan, A.: The use of bibliometric analysis in research performance assessment and monitoring of interdisciplinary scientific developments, in: Technikfolgenabschätzung, 12 (2003) 1, p. 20-29.

The assessment criterion *Impact/Effectiveness*, which reflects the absolute visibility of research achievements and therefore depends on the size of the research unit, produced an average grade of 3.19, meaning “good” with a slight tendency towards “very good”. 4% of the institutions were rated “unsatisfactory” and 12% “excellent” regarding their impact/effectiveness.

Figure 3: Ratings distribution Criterion II, impact/effectiveness

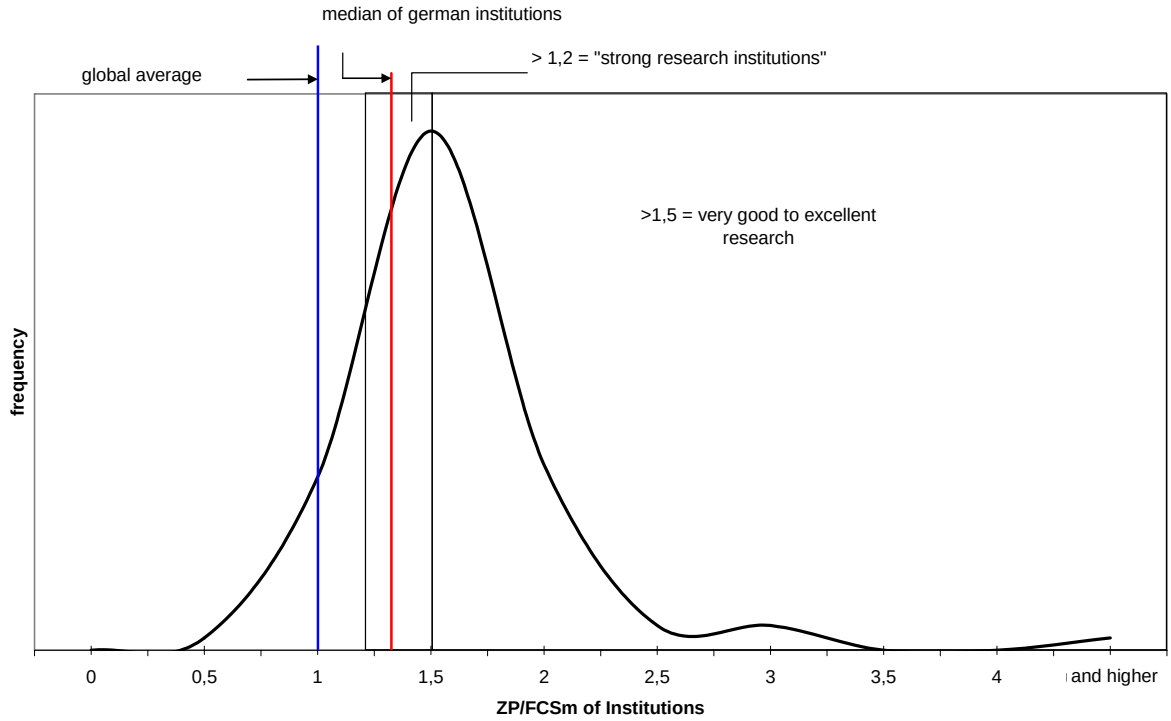


3% of all institutions were „not rateable” under the criterion impact/effectiveness..

An international comparison based on the ZP/FCS_m figure is possible at the level of institutions, as well. Here, due to the higher level of aggregation it is less likely to produce randomly high results than it is at the research unit level, which is why bibliometric literature suggests setting lower threshold values for entire institutions. Actually, the majority of German institutions are set in the region where they can be regarded as “strong research institutions”, with a high probability that they feature very good and excellent research groups (indicator values above 1.2). The median is at 1.28, meaning that 50% of the institutions score up to 1.28 and the rest score higher than this figure. The first quartile is found to be at 1.04. This means that 75% of the institutions score higher than 1.04, i.e. above the international average (1.0). The third quartile is at 1.51, meaning that 25% of all institutions achieve a value

above 1.51. From the threshold of 1.5 one can expect to find “excellent” research at an institution.[16] Four institutions scored higher than 2, one as high as 4.02.

Figure 4: ZP/FCS$_m$ scores of *institutions* in international comparison



The positive assessment of chemical research in Germany in international comparison, based on the distribution of the normalized indicator ZP/FCS$_m$, is confirmed by the numbers for citations, publications and citations per publication generally achieved in Germany:

[16] For the threshold values cited here, cf. van Raan loc. cit.

Table 1: Bibliometric indicators in chemistry in international comparison

Country	Citations	Papers	Citations per Paper
USA	2,939,674	219,333	13,4
Japan	961,876	118,048	8,15
Germany	938,684	96,779	9,7
England	612,975	58,002	10,57
France	580,417	64,420	9,01
Italy	350,278	38,818	9,02
Spain	327,734	39,200	8,36
Canada	325,054	30,764	10,57
Peoples R China	320,700	89,485	3,58
Netherlands	239,730	18,784	12,76
Switzerland	221,086	17,051	12,97
India	199,857	45,945	4,35
Russia	169,824	63,065	2,69
Sweden	158,332	14,162	11,18
Australia	152,888	16,638	9,19
South Korea	138,719	26,056	5,32
Poland	124,653	25,436	4,9
Belgium	111,701	12,062	9,26
Israel	93,943	8,314	11,3
Taiwan	87,319	15,196	5,75

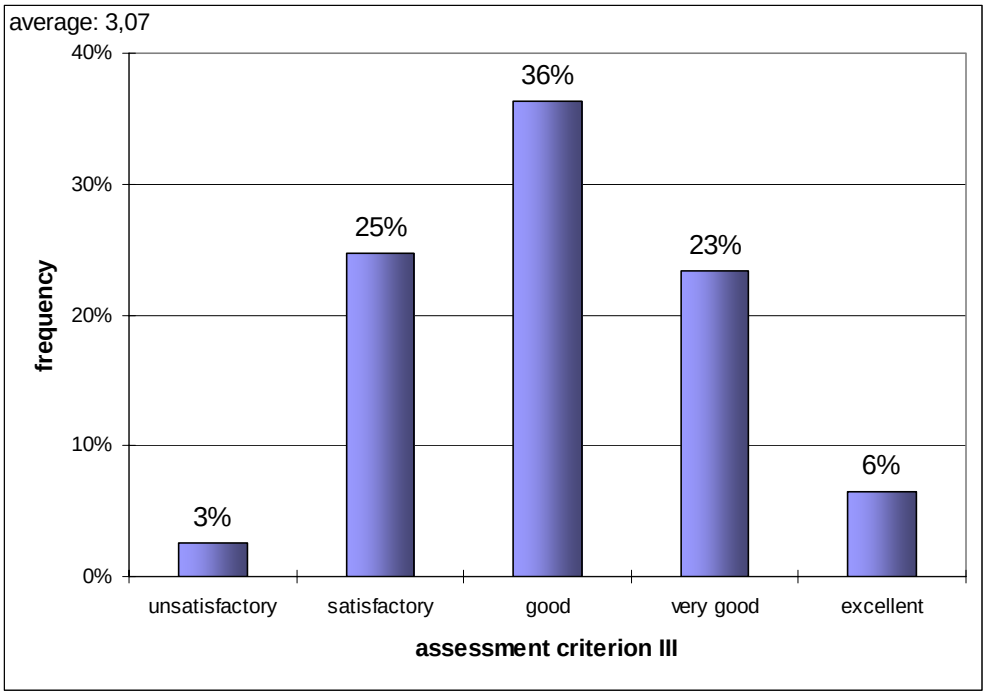
Data refers to top 20 of 89 nations. Period: January 1995 to 2005-31-12. Data refer to publications and citations covered by Thomson-ISI journals in the field „Chemistry“.

Source: Essential Science Indicators 2006-01-01

This table shows that Germany is leading the international field, by some margin, especially regarding the numbers of citations and publications. Concerning the citations-per-publication figures, it should be noted that some smaller countries (Netherlands, Israel, Switzerland, Sweden) or countries with a small research community in chemistry (Canada) score higher by this indicator. This could be attributable to more transparency and more pressure to publish in the leading periodicals. Considering the successful reorganization of the European journals, which are the preferred organs for publication by German researchers, and the strong rise of their impact factors, the citations-per-publication index for Germany will probably show a positive development over coming years.

For the *Efficiency* criterion, 3.07 was the average rating. 3 % of the assessed institutions were rated “unsatisfactory” and 6% scored “excellent”:

Figure 5: Ratings distribution Criterion III, efficiency

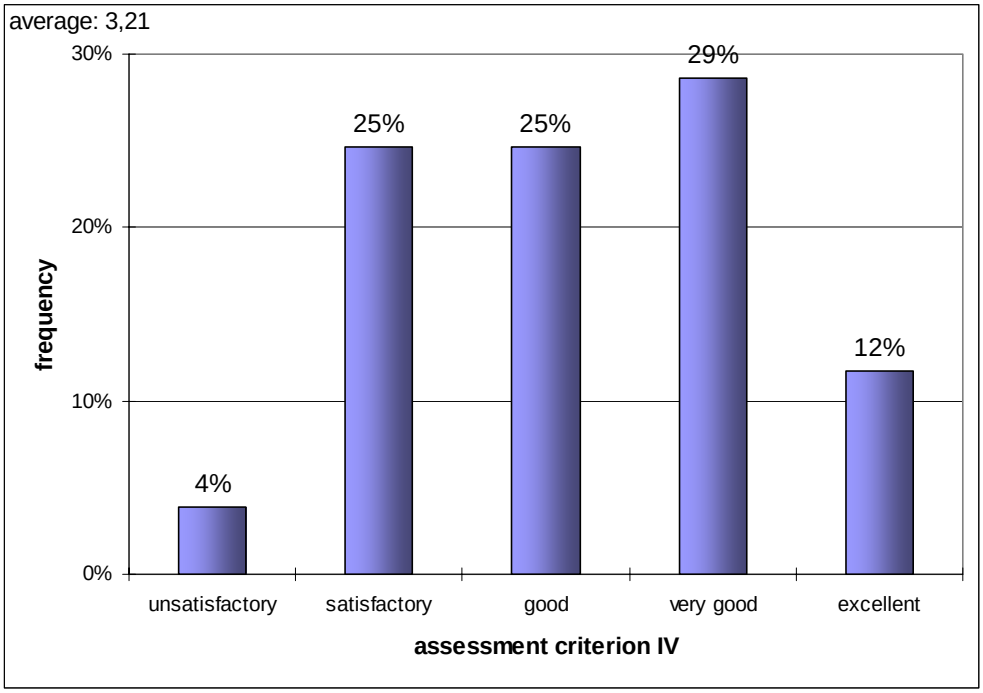


6% of all institutions were „not rateable" under the criterion efficiency.

The relatively high proportion of unrateable institutions for the efficiency criterion (5 out of 77) is due to the fact that the staff input of individual research units assigned to the subject could not be quantified with sufficient certainty in all cases (cf. A.II.3, p. 21f.).

The criterion *Promotion of young researchers* produced an average rating of 3.21, which is relatively high, with 4% of the institutions rated “unsatisfactory”, 12% “excellent” and 29% “very good”:

Figure 6: Ratings distribution Criterion IV, promotion of young researchers

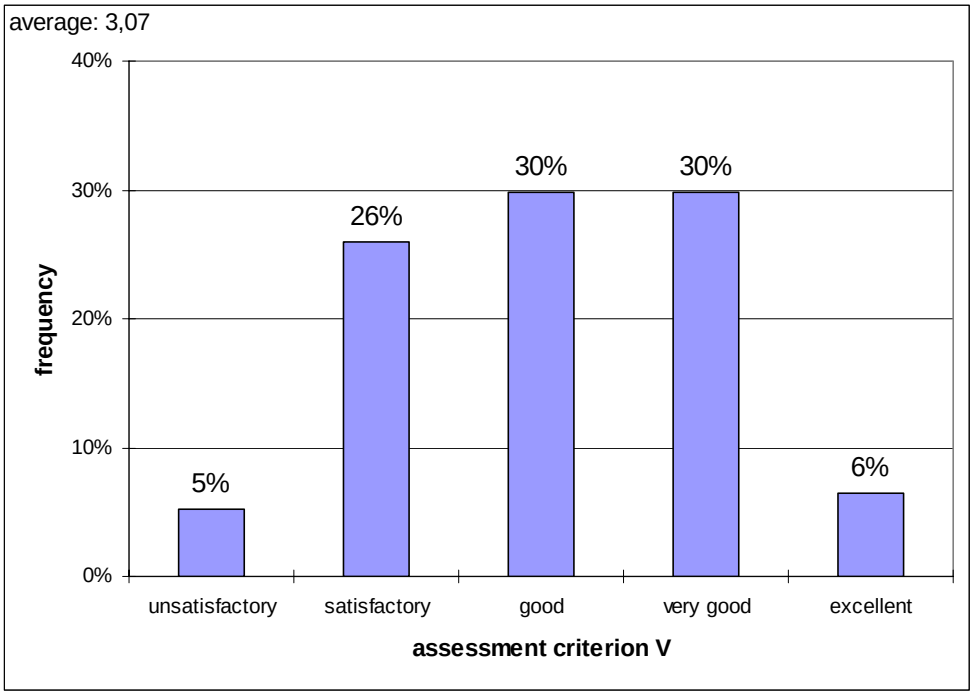


6% of all institutions were „not rateable” under the criterion promotion of young researchers.

For this criterion it is particularly noteworthy that the grade “very good” could be awarded in 29% of all cases. On the other hand, a quarter of the institutions only scored “satisfactory” with their efforts to promote young researchers.

The average rating of the assessment criterion *Transfer to other areas of society* was 3.07, with 5% of the institutions rated “unsatisfactory” and 6% “excellent”:

Figure 7: Ratings distribution Criterion V, transfer to other areas of society

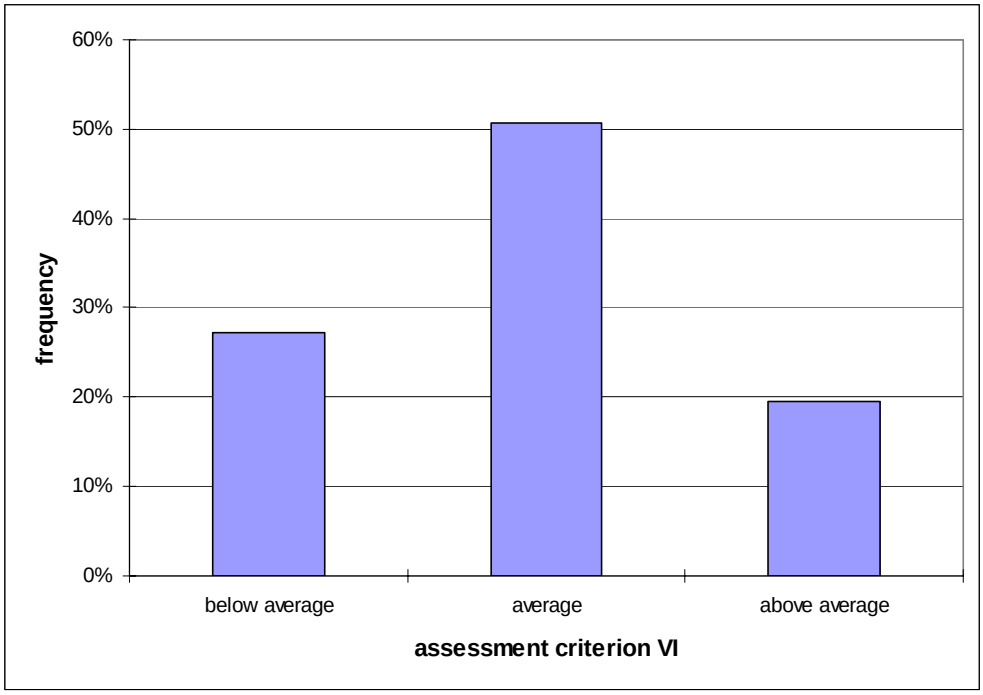


3% of all institutions were „not rateable” under the criterion transfer to other areas of society.

Again, resembling the outcome for Criterion IV, 30% of institutions were awarded the “very good” grade and, in turn, more than a quarter were rated as just “satisfactory“.

For the criterion *Promotion of the public understanding of science*, the rating scale was reduced to only three levels, because the heterogeneous data basis did not allow a reliable differentiation including “extreme grades”. On the simplified scale, 27% of the institutions were assessed as “below average” in their performance according to this criterion and 19% came out as “above average” in their efforts to promote the public understanding of science:

Figure 8: Ratings distribution Criterion VI, promotion of the public understanding of science



3% of all institutions were „not rateable” under the criterion promotion of public understanding of science.

B.II. Correlations between the criteria

Overall, the mean scores in the ratings of the individual criteria settle around 3 (= “good”). 15 of the 77 assessed institutions were rated “excellent” according to at least one assessment criterion. Conversely, there are only nine institutions with an “unsatisfactory” rating in at least one criterion.

The differentiating effect of the assessment by a range of criteria becomes obvious by an examination of correlations between the ratings. Even if some institutions’ ratings across the six criteria are rather homogeneous, most institutions show a more

uneven ratings profile. This impression is confirmed by the correlation matrix of the individual assessment criteria:

Table 2: Correlations in the ratings by individual criteria

		Krit I Research quality	Krit II Impact/Ef-fectiveness	Krit III Efficiency	Krit IV Promotion of young R.	Krit V Transfer	Krit VI Public Understand.
Krit I Research Quality	Spearman-Rho	1	,769(**)	,498(**)	,665(**)	,345(**)	,331(**)
Krit II Impact/Ef-fectiveness	Spearman-Rho		1	,496(**)	,774(**)	,534(**)	,386(**)
Krit III Efficiency	Spearman-Rho			1	,525(**)	,375(**)	,318(**)
Krit IV Promotion of young R.	Spearman-Rho				1	,454(**)	,395(**)
Krit V Transfer	Spearman-Rho					1	,352(**)
Krit VI Public Understand.	Spearman-Rho						1

** correlation is significant on the level of 0,01 (2-sided).

There is a strong correlation between the impact/effectiveness rating and the average research quality rating (mean rating of the research units within the respective institution, weighted by the number of senior scientists in the research units on the survey deadline). This means: Generally strong, high-impact research institutions also produce higher research quality at the research unit level in most cases. Still, the pilot study also identified some weak units at generally strong institutions. On the other hand, four institutions of only average impact (“good”) feature some research units rated “excellent” or “very good to excellent” in terms of research quality.

The rating for the criterion “Promotion of young scientists”, too, strongly correlates with the impact rating. In contrast, the correlation between the efficiency rating and the impact/effectiveness rating is much less pronounced. This confirms that the separate assessment of absolute and relative performance criteria does make sense.

The ratings for the criterion “Promotion of the public understanding of science” show the weakest correlation, overall, with the other criteria, including the first criterion in the same dimension, “Transfer to other areas of society”. This means that any

institution with poor ratings in this criterion can still be very strong when assessed by the other criteria, and vice versa.

One of the advantages of the research rating is that the differentiated rating by a range of criteria reflects different profiles. It is difficult to identify, for instance by a cluster analysis, dominant “types” of ratings distribution for the individual criteria across the institutions. There are many institutions that perform more or less well according to different criteria, although the variation often spans no more than one grade level. Still, for other institutions the ratings are relatively homogeneous. Unfortunately this also means that there are institutions whose ratings are homogeneously clustered near the bottom end of the scale. There is a type of institution that shows particular strength in the transfer dimension while performing much worse in the other dimensions. Such ratings profile usually indicates that the respective institution is largely practice-based and its research geared towards application. The pilot study also found many cases where the assessments produced inhomogeneous results even within the three dimensions: Strength in “Promotion of the public understanding of science” does not necessarily imply strength in “Transfer to other areas of society”, and vice versa. Equally, the ratings for the three criteria within the research dimension are often mixed. The relative efficiency rating of many institutions rated as high-impact was found to be lower by more than one grade level than their impact/effectiveness rating. Therefore the different assessment criteria should be considered as such, too. The institutions can draw various conclusions from the ratings profiles. Good results in the transfer dimension are more important for an application-based institution than for one focusing on basic research; and the “Promotion of young researchers” rating of a non-university institution must be seen in its proper context for any meaningful comparison with universities.

These findings suggest that the individual results should certainly not be aggregated into an overall score. Rather, the multidimensionality of the assessment, which had been purposefully chosen for the research rating procedure, was shown to be appropriate. The present ratings are evidence that there is no such thing as *the best* institution. One-dimensional rankings cannot adequately reflect the differentiated performance found through the multidimensional assessment by six criteria.

C. Strengths and weaknesses of chemical research in Germany

The results of the research rating exercise show that, overall, chemical research in Germany is in a very good position. A large number of institutions were rated “very good” or “excellent” by at least one criterion. Chemical research in Germany offers breadth as well as many peaks. Very good research is found in all branches of chemistry, and excellent research in most of them.

The fact that the average rating for each of the assessment criteria ranges around the “good” grade does not imply by any means that chemical research in Germany is just average in international comparison (this was shown by putting the results into the context of the internationally normalized ZP/FCS_m value in Section B, p. 17ff). Research rated “good” actually means that the subject assessed is, literally, “good research”.

Provided some special, national features are taken into account, the research rating results for chemistry are relevant for international users as well. This is the case especially because existing international ranking/rating systems exclude the very strong field of non-university research institutions and thus fail to reflect adequately the quality of chemical research in Germany. Even if the non-university institutions also bolster the performance of neighboring universities, the present ratings show that a considerable share of excellent chemical research is actually achieved in the non-university sector.

Another remarkable point regarding international competitors is that many German universities deliver strong research achievements despite their significant disadvantage in terms of student-tutor ratios compared to leading universities in the US, and the much greater teaching obligations of professors in Germany. The heavy workload from teaching in Germany is not easily compensated, especially by smaller institutions, where it more likely disadvantages research than at large institutions. This too was taken into account when the ratings were settled.

The *Research* dimension also offers insights into the performance of individual sub-disciplines of chemistry. As the research quality was assessed at the level of research units, which can usually be associated to certain branches, an analysis in

this respect allows some tentative statements. Some sub-disciplines stand out by conspicuous results:

- Analytical chemistry and food chemistry, which both are usually small and highly specialized areas of research, sometimes with a high degree of interdisciplinarity, produced the lowest ratings, on average, compared to other sub-disciplines of chemistry. None of the research units engaged in these sub-disciplines was rated “excellent”. Better research performance and, consequently, higher ratings in the future should be achieved primarily by topical and administrative concentration on shared chemical-analytical research interests and by integration into multidisciplinary units. The firm link between analytical chemistry and inorganic chemistry, which still exists at many research locations, has become an anachronism. Analytical chemistry can develop a higher profile and gain more independence by further opening up towards organic analytics and life sciences.
- Theoretical chemistry as a whole performs above average. This result, however, only applies to those research units that were uniquely associated with theoretical chemistry. Some professorial chairs that were engaged in theoretical chemistry, but registered as research units in another branch of chemistry, are not covered by this assessment. Nevertheless, the above-average ratings reflect the extraordinary strength of theoretical chemistry at German institutions.

The ratings in the dimension *Promotion of young researchers* show that chemistry in Germany produces very good results in this respect. This high quality, which provides the foundation for the future performance of chemical research, must be sustained by continued support. The strong basis of young researchers is the pool from which chemical research institutions can recruit their senior scientists and thus generate excellent research in the future. The chemical industry also depends on a steady supply of outstanding young scientists. Enhanced efforts to provide further evidence for this connection, e.g. through alumni surveys conducted by universities, would be desirable.

In the third performance dimension, *Knowledge transfer*, another special feature of chemical research in Germany affects international comparisons: the close contacts between chemical research – both at universities and at non-university research institutions – and the chemical industry. Generally, the chemical research institutions

in Germany produce few spin-off businesses and little license revenue. The reason for this could be that universities and non-university research institutions often work in close cooperation with large corporations, anyway, which usually take care of the application of research results and, in turn, financially support research projects.[17] This means that knowledge transfer is often realized through long-term consulting contracts, which are difficult to quantify and, in many cases, subject to commercial confidentiality.

The research rating procedure produced some general recommendations for further strengthening the chemical research sector in Germany.

Universities have been granted increased autonomy in recent years, which is a very welcome development. However, universities that have the freedom and obligation to take strategic steering decisions need a verifiable basis for assessing the consequences of those decisions. The data collection stage of the research rating exercise showed that, in many cases, a solid, comprehensive basis for decision-making is not in place. To be successful in applying their new autonomy to strengthen their competitive position, universities require reliable strategic data. Improved internal controlling would enable institutions to detect weaknesses and identify strengths. It would support the institutions in generating their individual profiles. In the course of the research rating procedure, some institutions showed that they could improve their overall research quality by strategic profile development. Such strategy would make sense especially for smaller institutions. Nevertheless, even at smaller universities chemistry teaching must be maintained in its full breadth. So, in their research these smaller universities must concentrate on focus areas without becoming specialized in their teaching.

By making more difficult any superordinated planning, the increasing autonomy of the universities also entails the risk that small sub-disciplines of chemistry are critically weakened if a number of universities make decisions without prior consultation. Therefore it should be ensured that strategic decisions of universities and research

[17] Evidence for the strong connections of the chemical research sector to chemical industry is legion, cf. e.g. Weingart, P.: Die Stunde der Wahrheit? Zum Verhältnis der Wissenschaft zu Politik, Wirtschaft und Medien in der Wissensgesellschaft, Weilerswist, 2001, p. 189; also see: Wissenschaftsrat: Empfehlungen zur Interaktion von Wissenschaft und Wirtschaft, Drs. 7865-07, Berlin, May 2007, p. 20f., p. 52, p. 68, were chemistry is quoted as an example of particularly close interaction between science and industry.

institutions are based on the best possible information about the general development of their field.

The recommendation to develop a more distinct profile thus applies not just to individual institutions, but to chemical research in Germany, as a whole. The breadth of research must be maintained while the existing elite research is further strengthened. For top-ranking research is rooted inseparably in a broad basis of good quality research. A “critical mass” of good scientists at individual or collaborating institutions is absolutely essential for strengthening top-end research in Germany, because excellence can only be built on a broad foundation. Where excellence is the aim, it appears important that the underfunding of institutions, especially in comparison to the top universities in the US is remedied. It is often said that Germany’s research performance compared to other nations must be seen in proper perspective, pointing to the rather uncompetitive budgets of German institutions. From the efficiency angle, this can be seen as a sign of strength, but it can be taken as evidence for the enormous scientific potential that could be exploited much better under more generous funding conditions.

Overall, chemical research in Germany presents itself in very good health. The research ratings help identifying the strengths, but also the weaknesses, of which there are some, of German chemical research. The transparency created this way provides importance guidance and assists the decision-making of stakeholders and organizations in the science system. Still, the allocation of public funds should not be directly linked to a selective, one-off assessment. In the opinion of the assessment board, the informative value of research rating would increase considerably again by repeating the exercise after an interval of some years. This would provide clear evidence for any trends and deliver a proper basis even for far-reaching decisions. Also, such reassessment could confirm the general finding of the pilot study: that chemical research in Germany, considering both universities and non-university institutions, operates on high quality level, from which it is still developing. A repeated rating exercise could show if the right strategic decisions were taken to tackle the weaknesses identified during the pilot study and guide the assessed institutions to new strength.

D. Individual results

D.I. Explanation of the results' presentation

The ratings of the universities are listed in alphabetical order according to the universities' locations. That list is followed by the ratings of the non-university institutions, in groups according to the organizations operating the respective institutions and, within these groups, in alphabetical order according to the institute's names. Additionally, the results for each institution are presented in two diagrams:

1. Overview of ratings for the institution as a whole, according to criteria I-VI. For the "Research quality" criterion, the diagram shows the average of the ratings for the research units, weighted by the number of senior scientists engaged in scientific research in each unit on the survey deadline date (2005-12-31).[18] Apart from the individual rating of the respective institution, each diagram also shows the average ratings for the entire population. In this way the diagram reveals the fields in which the institution is above or below average, respectively.
2. Again for the "Research quality" assessment, a diagram showing the rating distribution across the research units within the institution. This shows what percentage of the institution's research units was rated at each grade on the rating scale. To each research unit a weighting factor is applied according to the number of senior scientists engaged in research in it on the survey deadline (2005-12-31). At 100 missing percent: "unrateable".

Apart from the diagrams, the report offers case-to-case notes by the assessment board on the ratings of individual institutions. These inform about any anomalies affecting the assessment and thus can serve the user to arrive at a proper interpretation of the results.

The research quality ratings of the research units remained unpublished because for some units it could not be ruled out that the ratings constitute personal data. A differentiated overview of the research unit ratings was made available to the institutions for internal use. The institutions were strongly encouraged to make this very informative overview accessible for the public, too. Should an institution choose

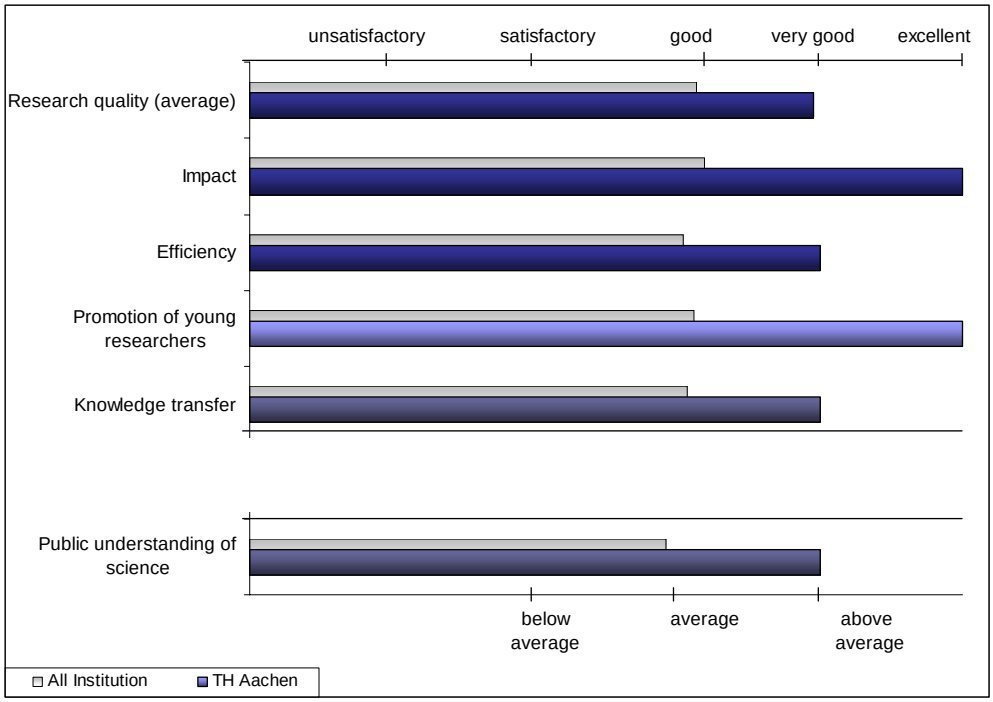
[18] "Unrateable" research units were not included in the calculation of the average rating.

the route of internet publication for this purpose, there is the option, in co-ordination with Council Head Office, to place a link to these detailed results on the Council website, www.wissenschaftsrat.de/pilot_start.htm.

D.II. Ratings of universities and non-university institutions

RWTH Aachen University

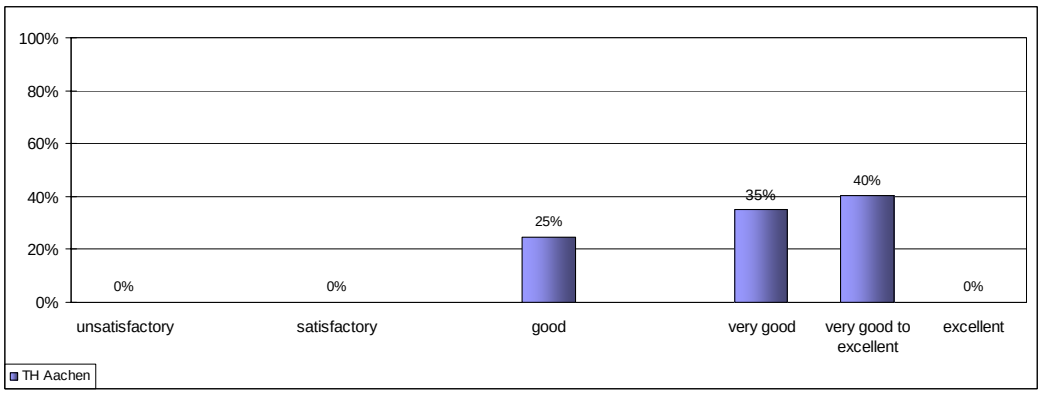
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

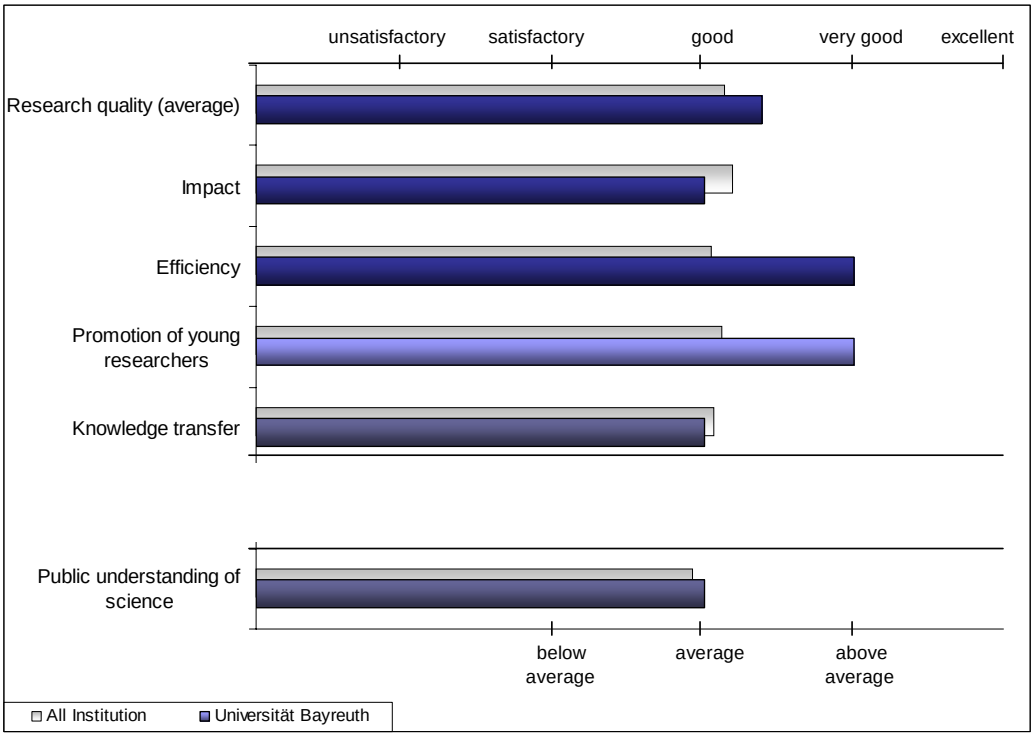


Assessment notes

The assessment of chemistry at RWTH Aachen includes the Deutsches Institut für Wollforschung. This is an affiliated institute, which, by its mission and character, is an entity very different from the classic university institutes.

Bayreuth University

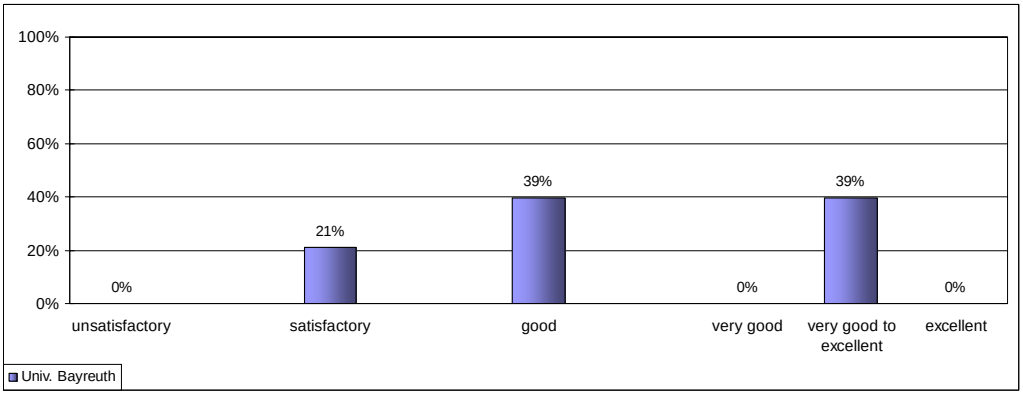
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

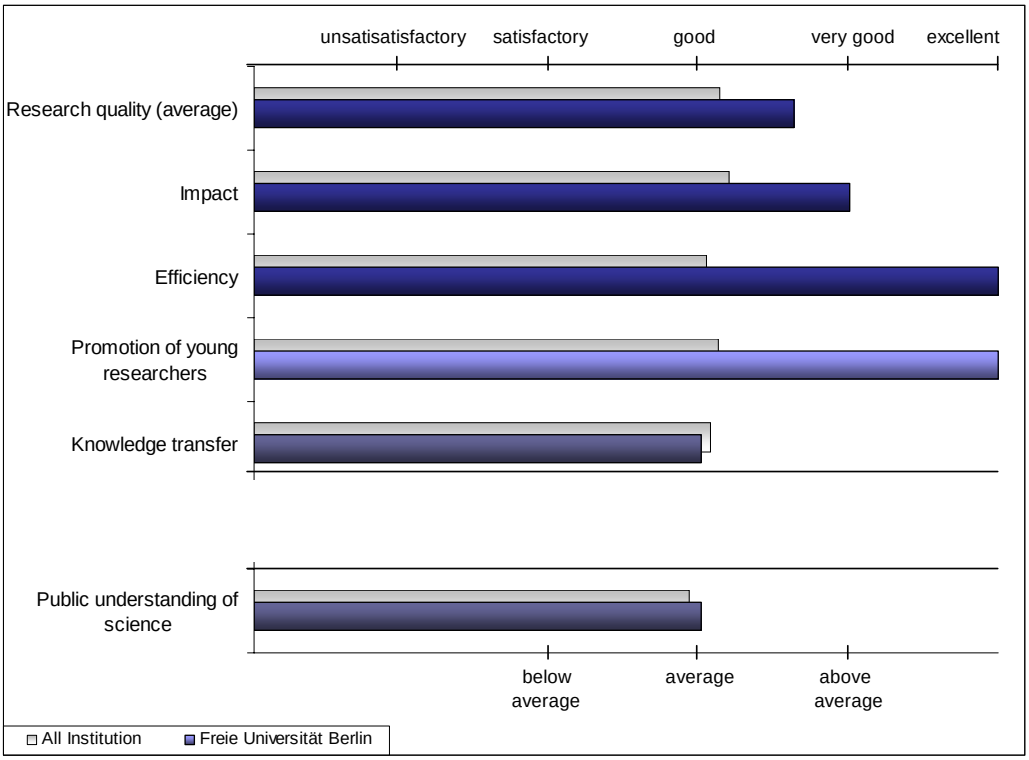
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Free University of Berlin

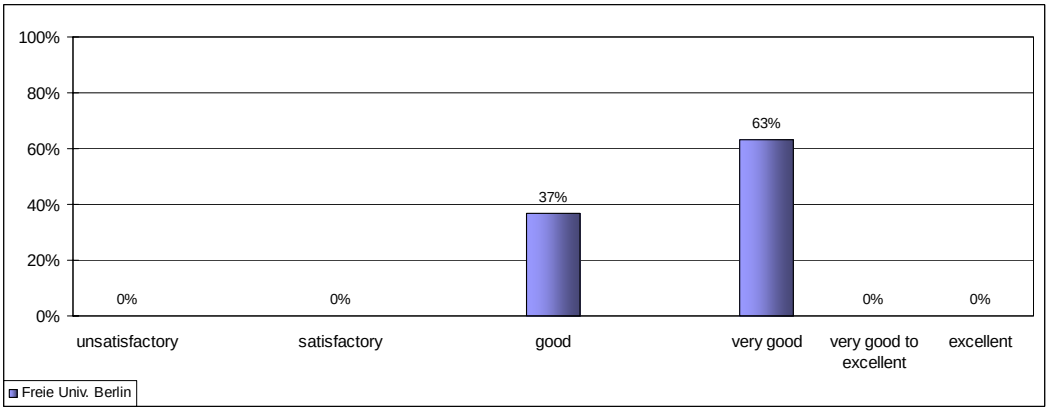
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

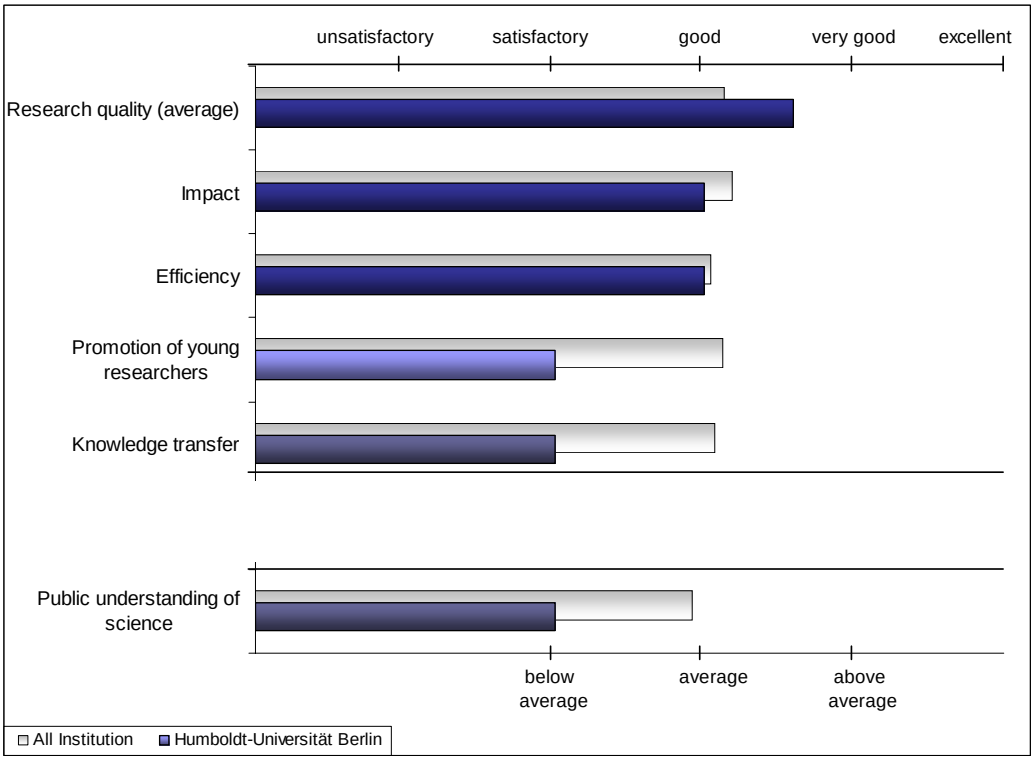


Assessment notes

The assessment of chemistry at Freie Universität Berlin includes two special professors working at the Max Delbrück Center and at the Leibniz Institute for Molecular Pharmacology, respectively. There was no clear separation of data in this respect.

Humboldt-University of Berlin

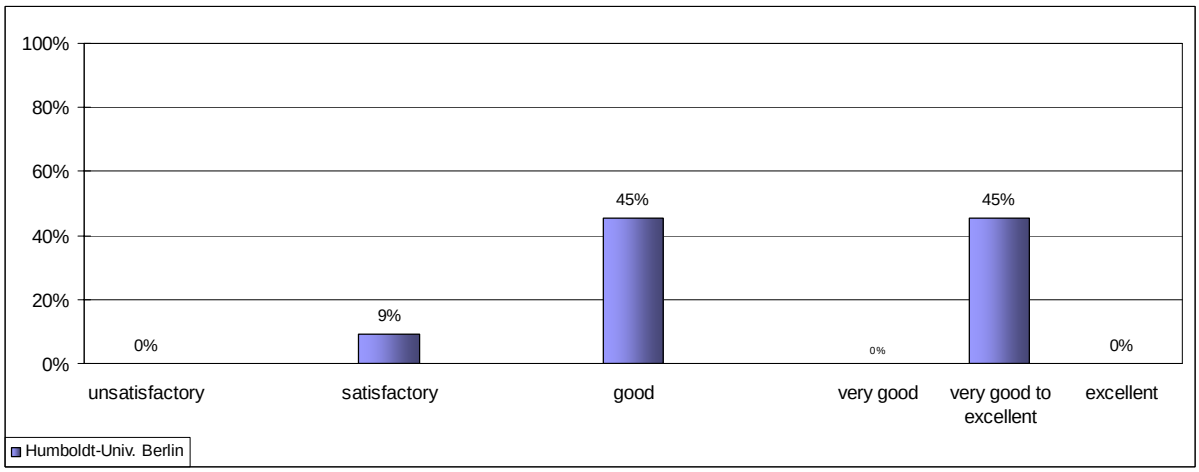
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

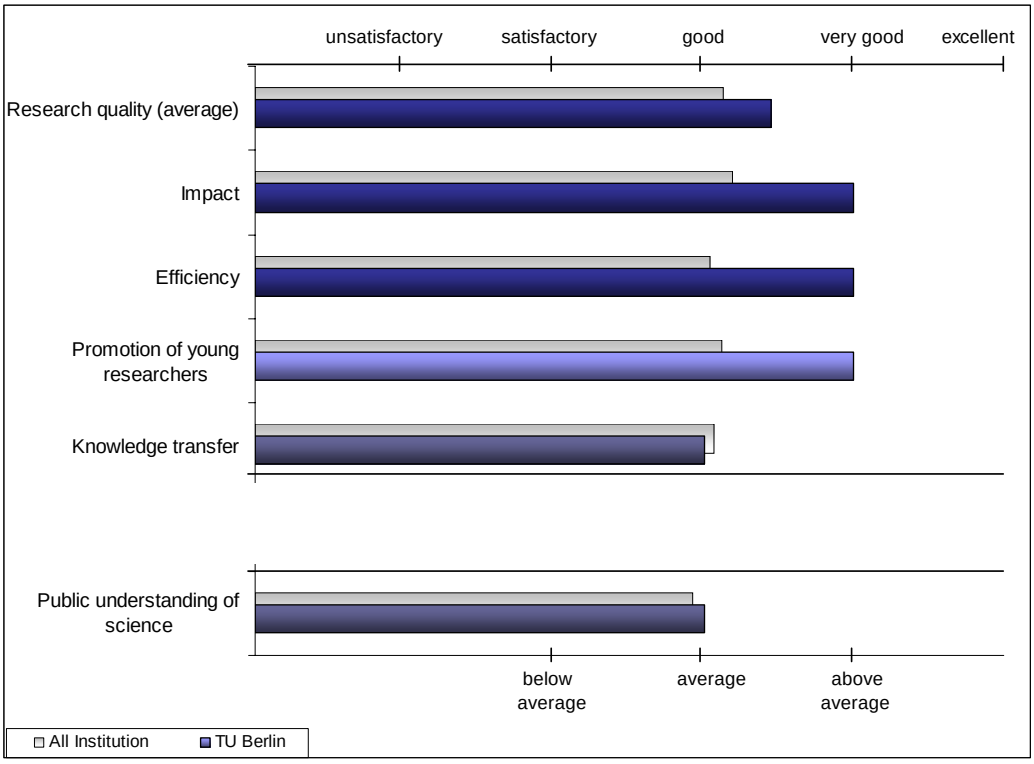


Assessment notes

Chemical research at the Humboldt-Universität Berlin was affected by cost cuttings and restructuring measures during the survey period. With the restructuring completed, the outlook is positive.

Technical University of Berlin

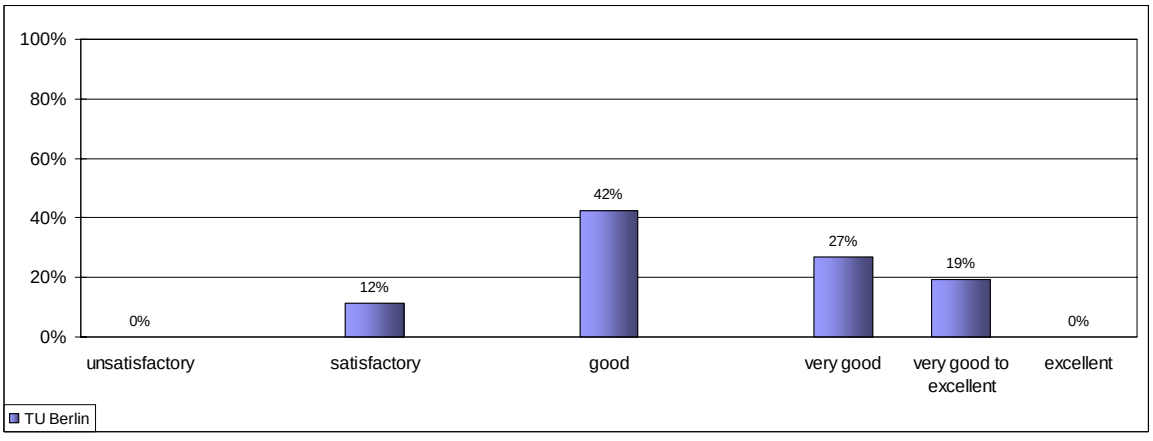
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

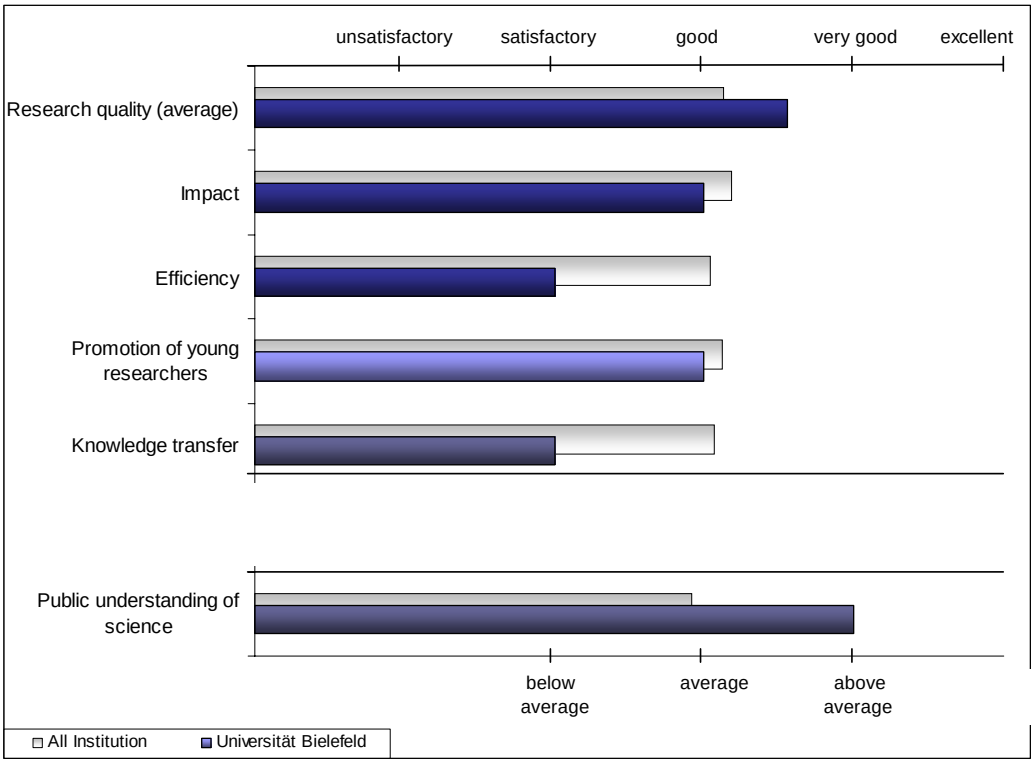
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Bielefeld University

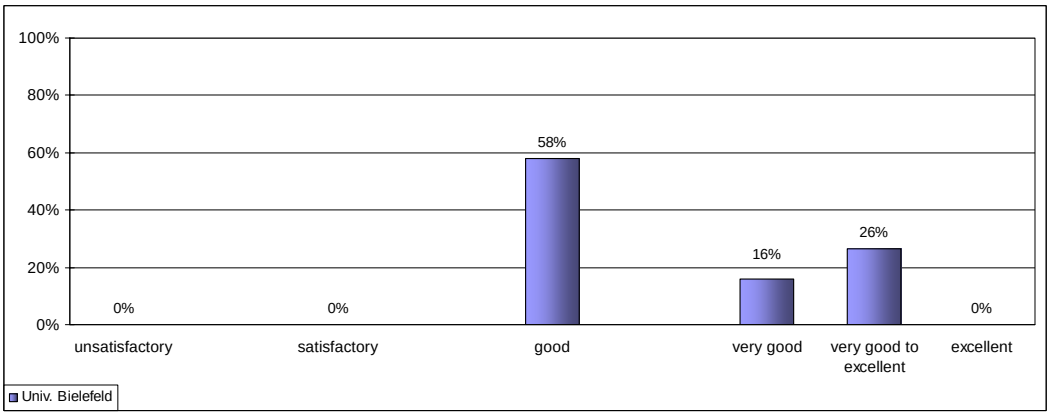
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

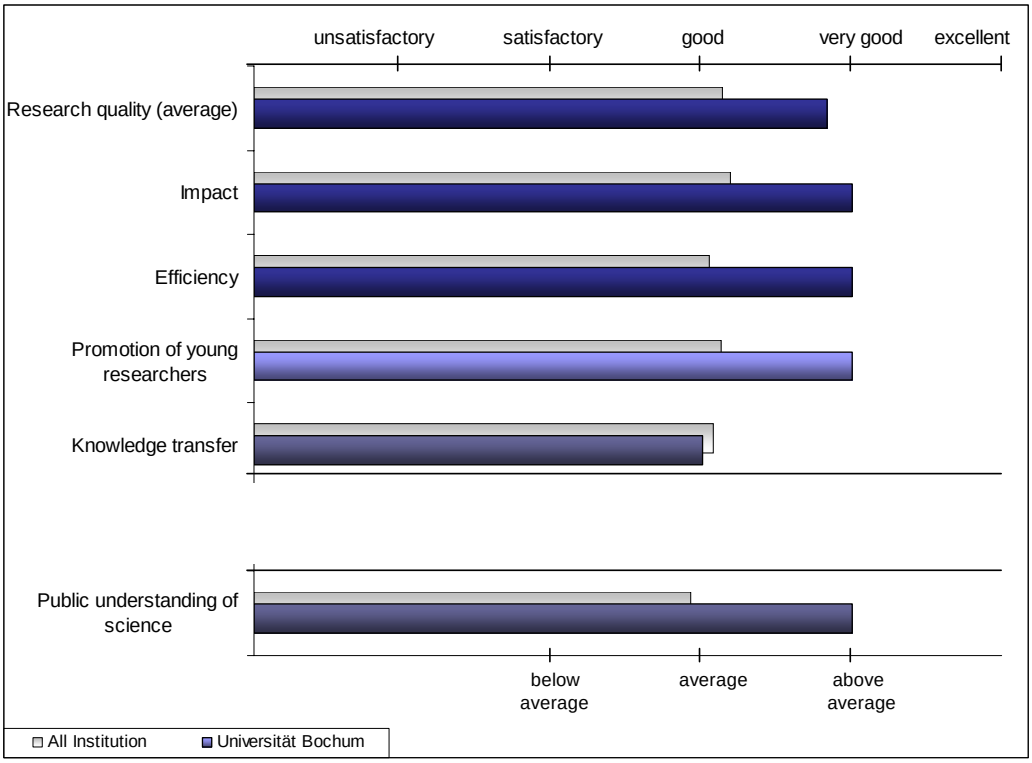


Assessment notes

The University of Bielefeld is a leading promoter of the public understanding of science, with outstanding achievements in this area.

Ruhr-University Bochum

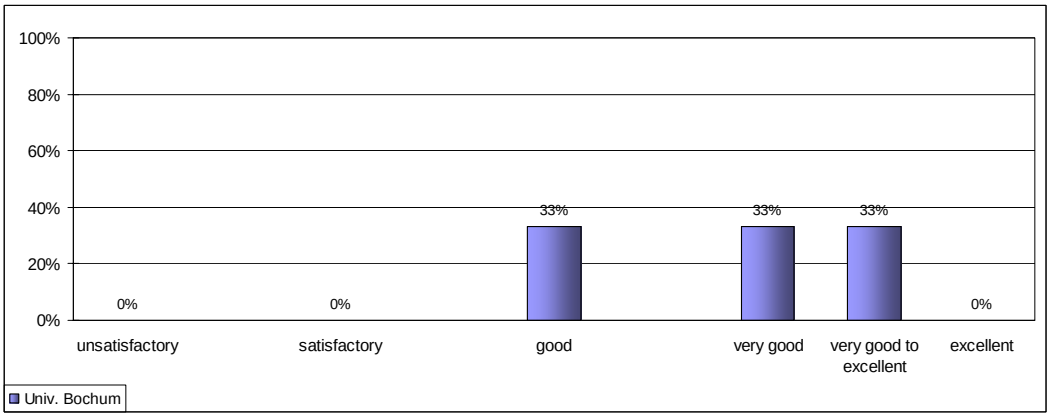
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

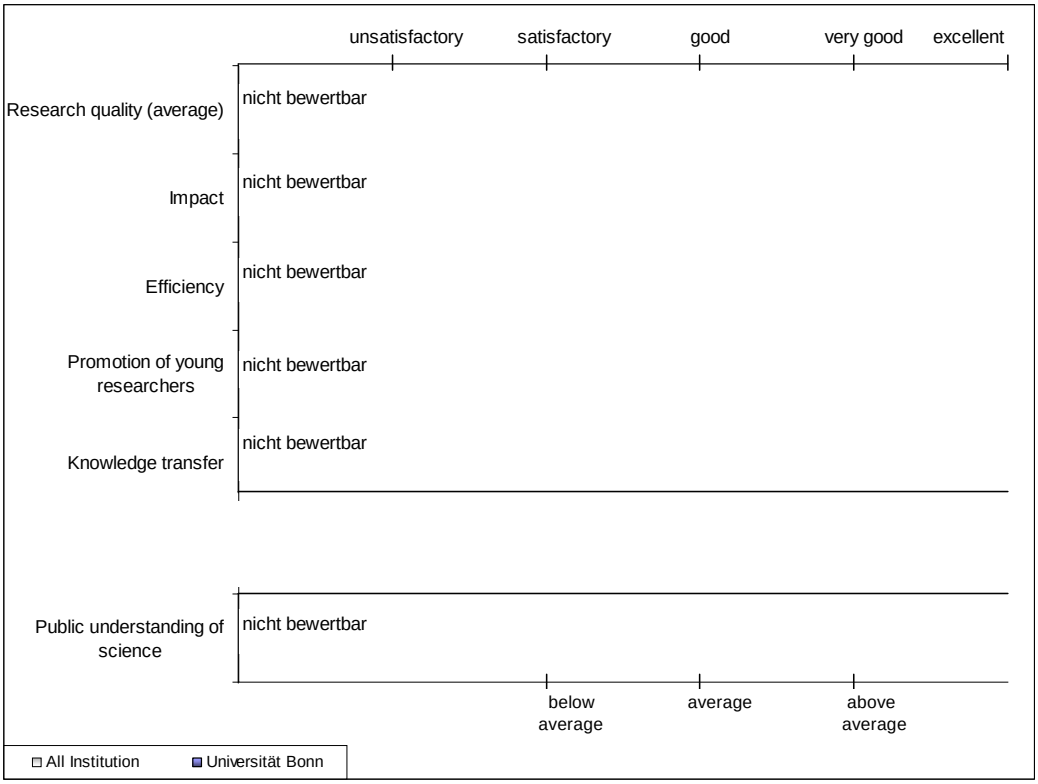


Assessment notes

Chemistry at the University of Bochum was restructured at the beginning of the survey period. The new structure has already proven itself and promises much for the future.

University of Bonn

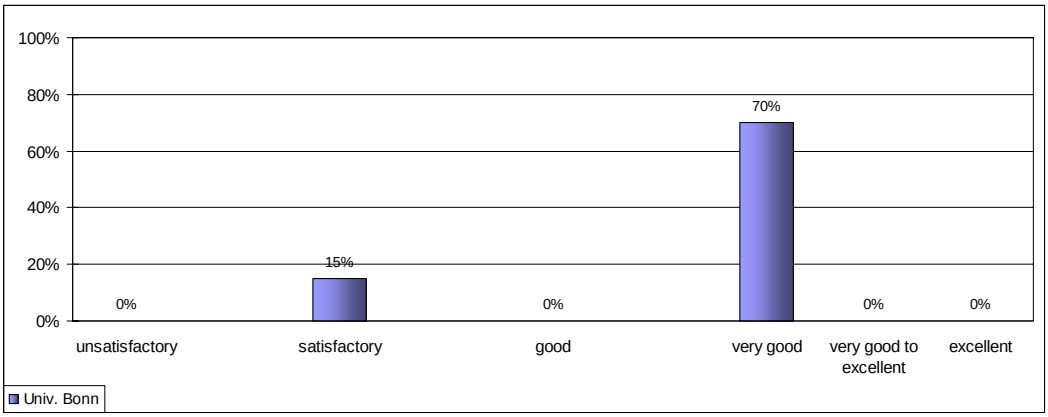
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

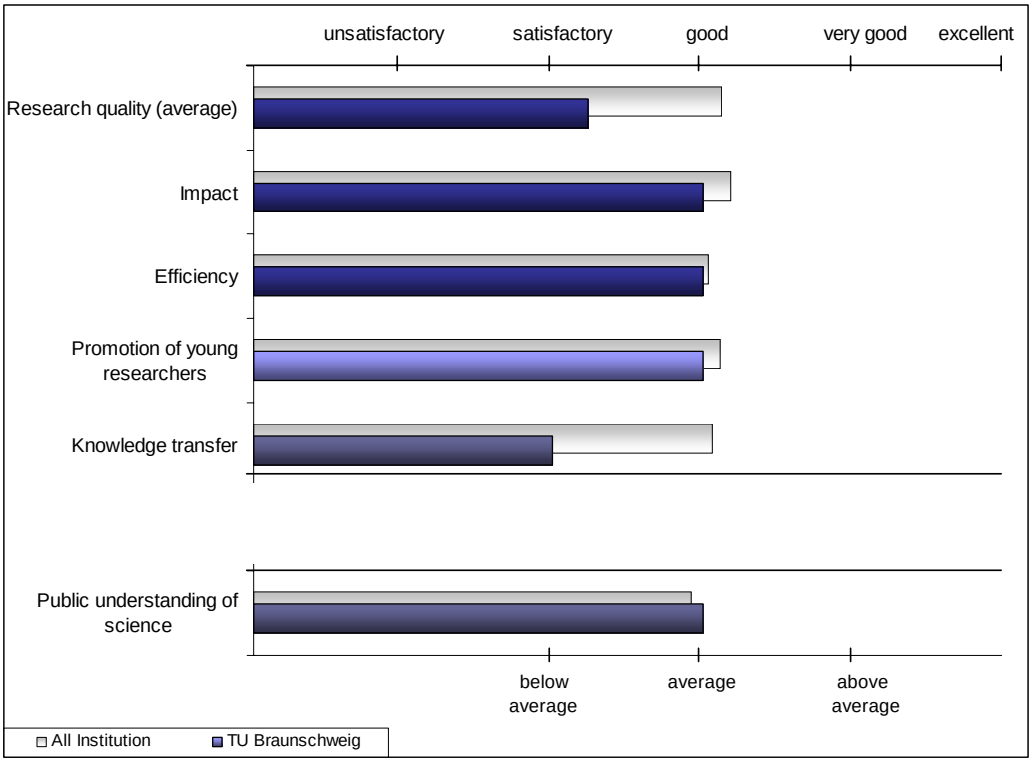


Assessment notes

The University of Bonn did not submit any inorganic-chemistry data. The Institute for Physical and Theoretical Chemistry was unrateable, because no data were submitted for physical chemistry, and theoretical chemistry was vacant for more than 50% of the survey period. Due to these gaps in the data basis, an overall assessment of chemistry at the University of Bonn could not be conducted.

Braunschweig University of Technology

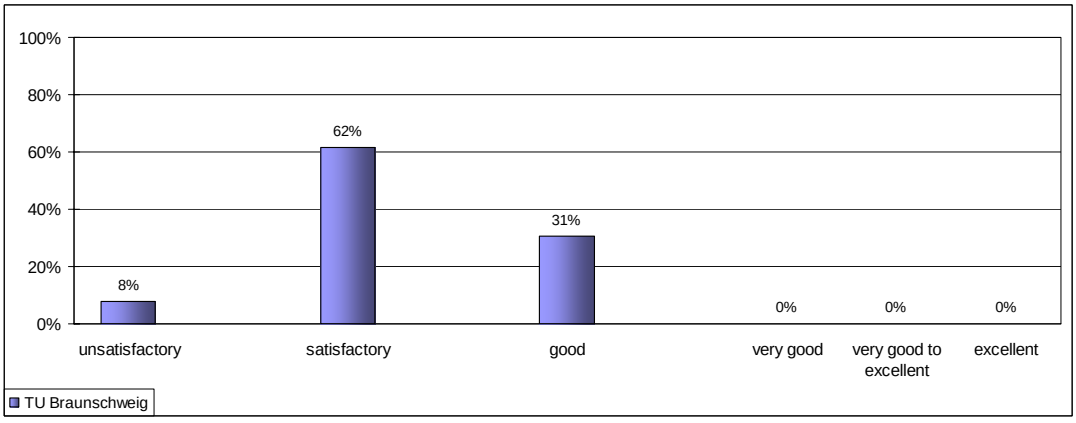
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

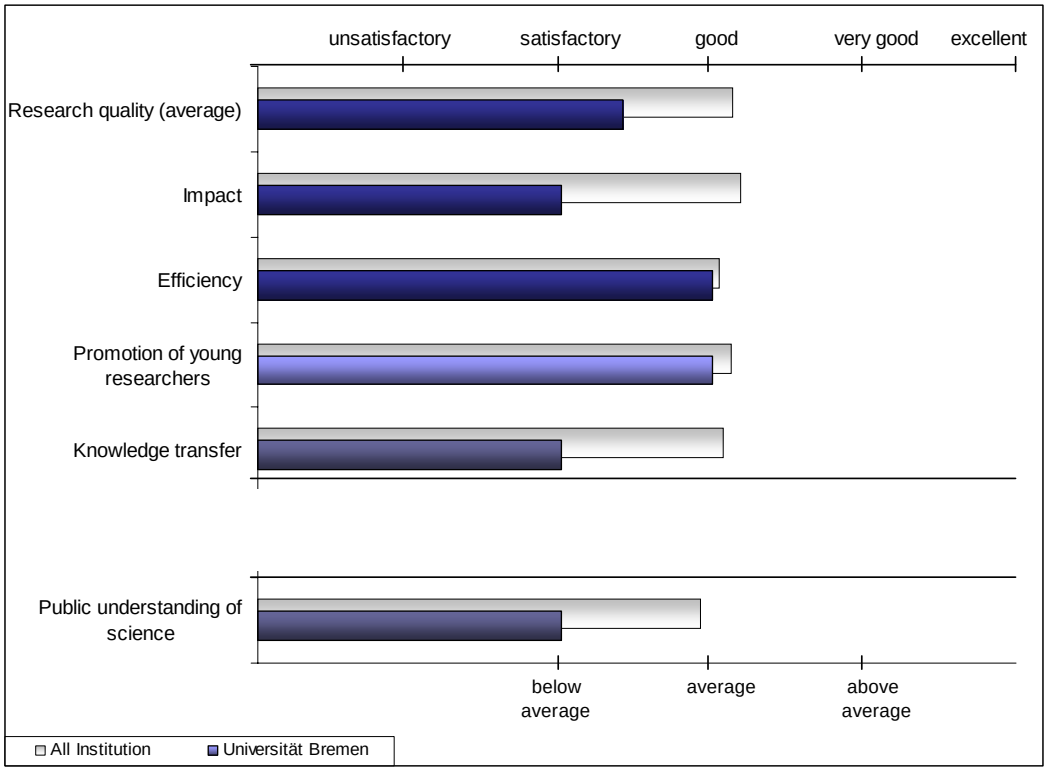
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Bremen

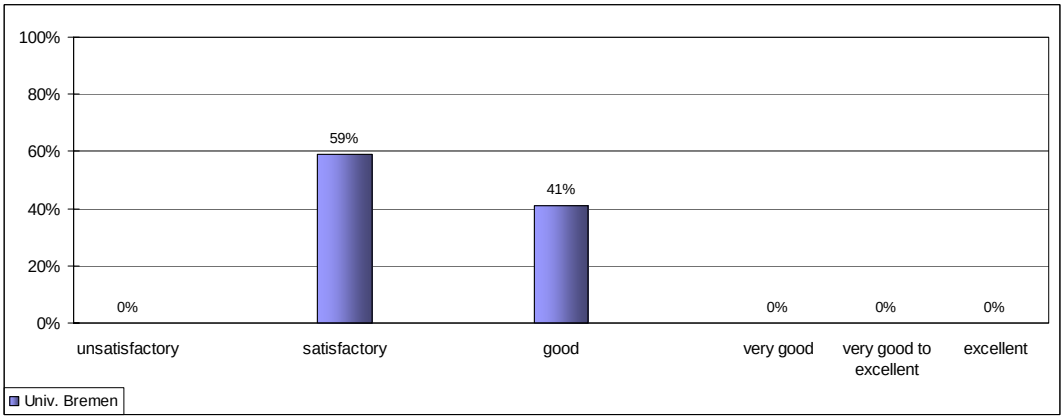
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

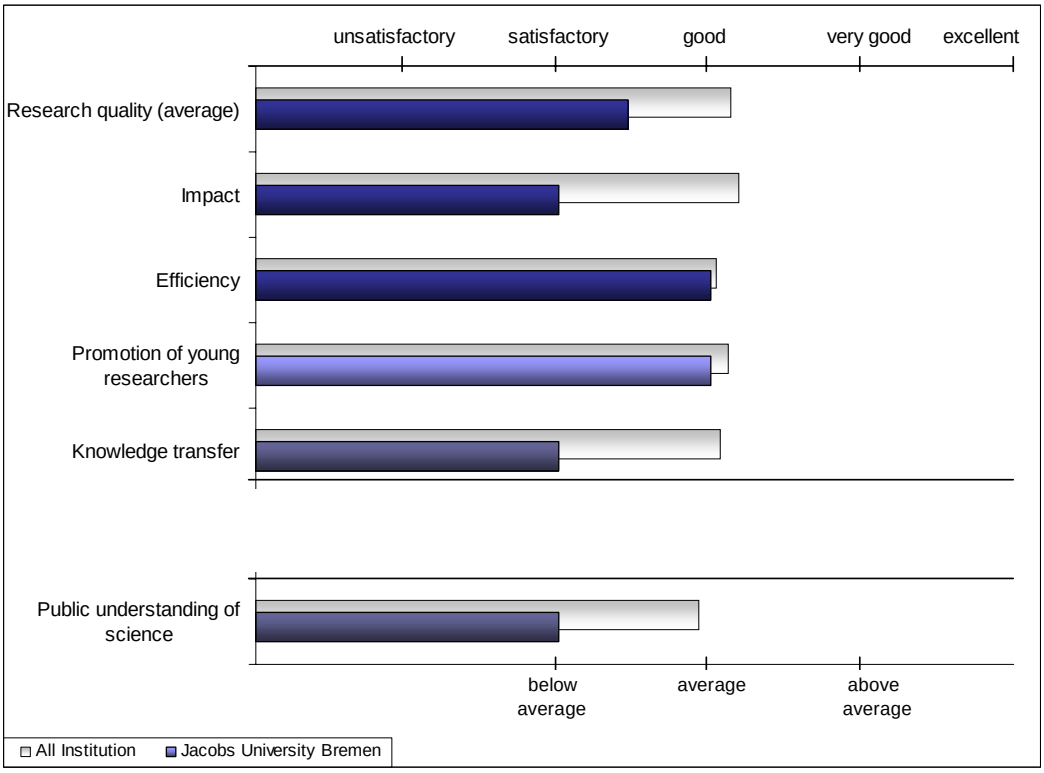
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



International University Bremen

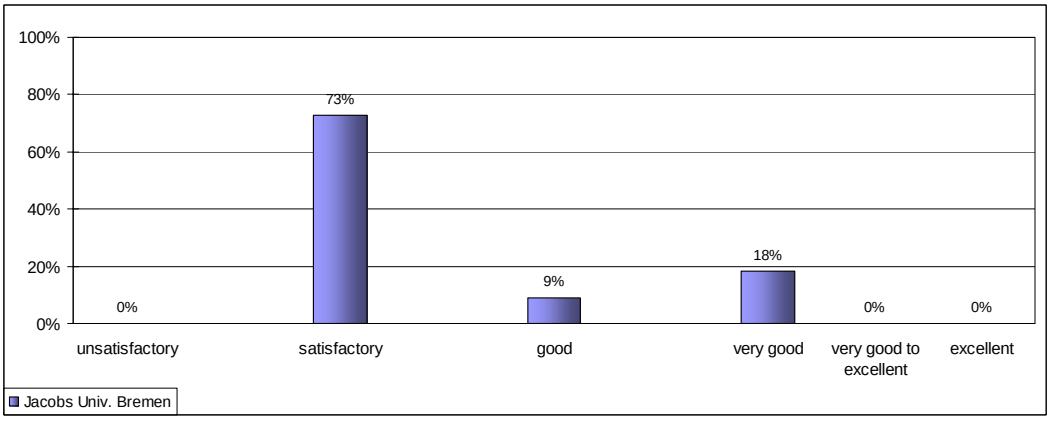
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

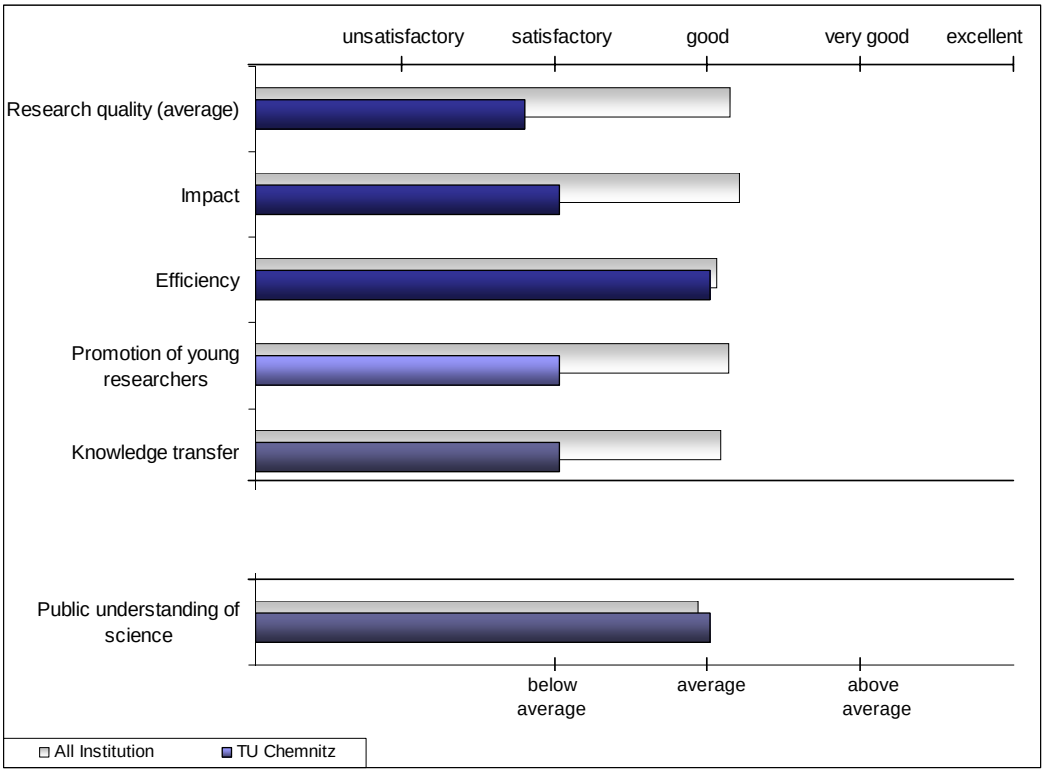


Assessment notes

Chemistry at Jacobs University Bremen was still in its beginnings in the survey period, during which all the chemistry professors at Jacobs were newly appointed. Under these circumstances, the achievements so far must be regarded as positive, and the route taken as promising.

Chemnitz University of Technology

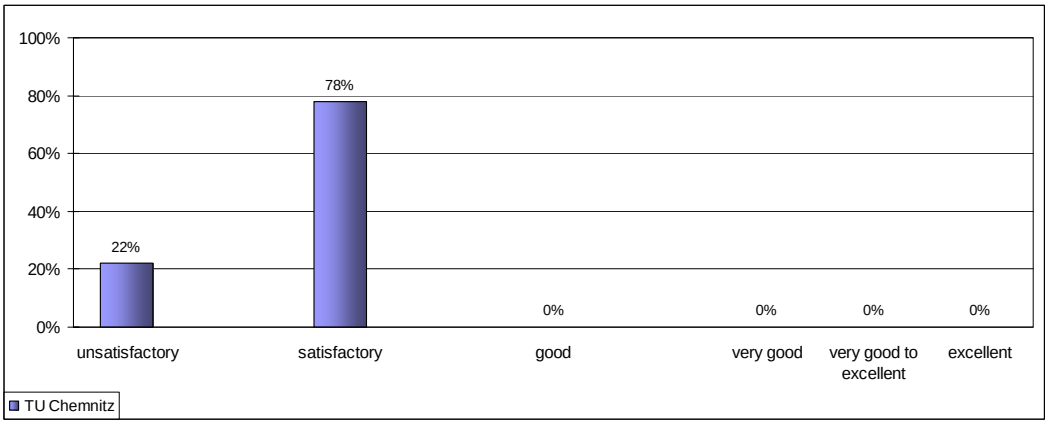
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

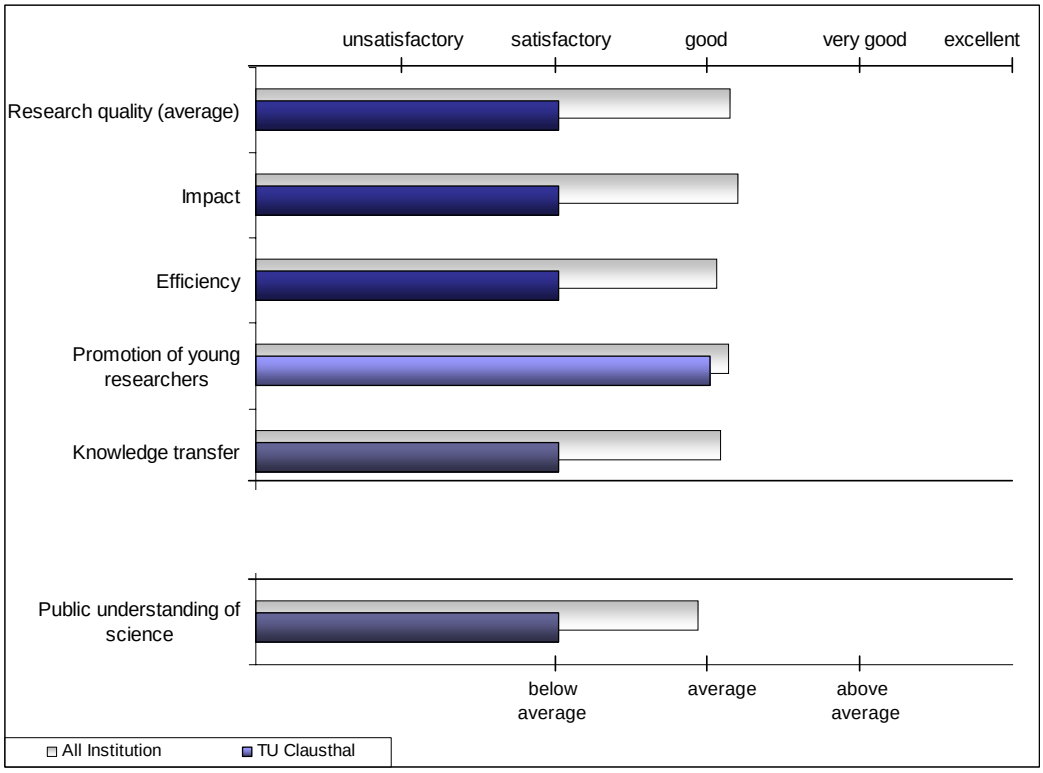
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Clausthal University of Technolgy

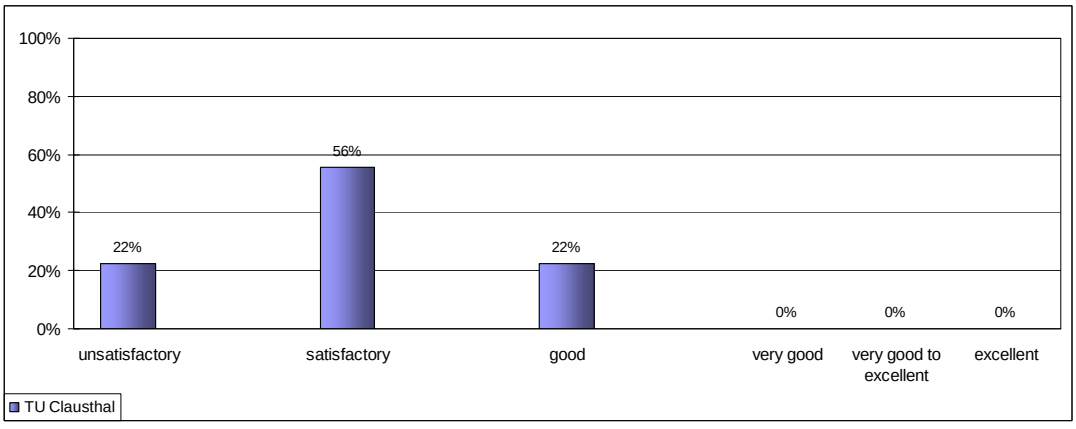
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

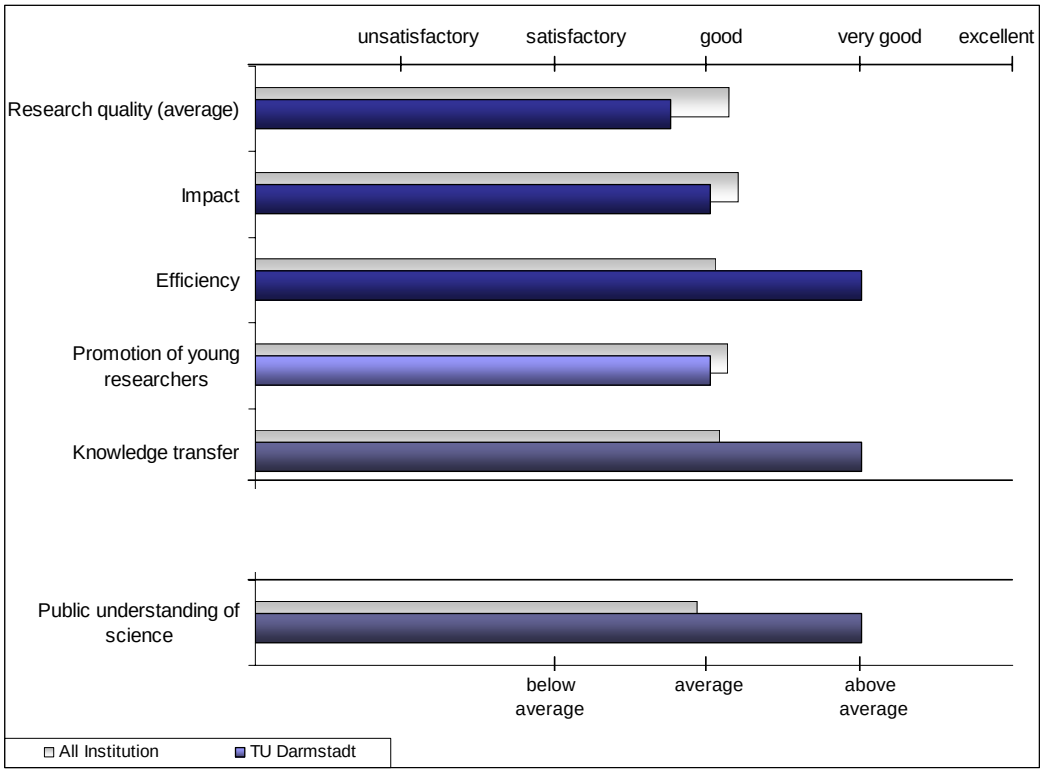
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Technical University of Darmstadt

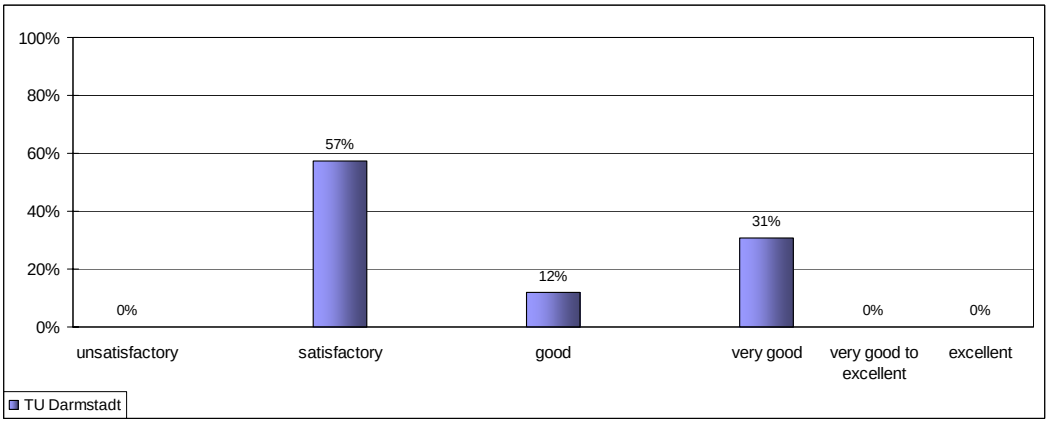
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

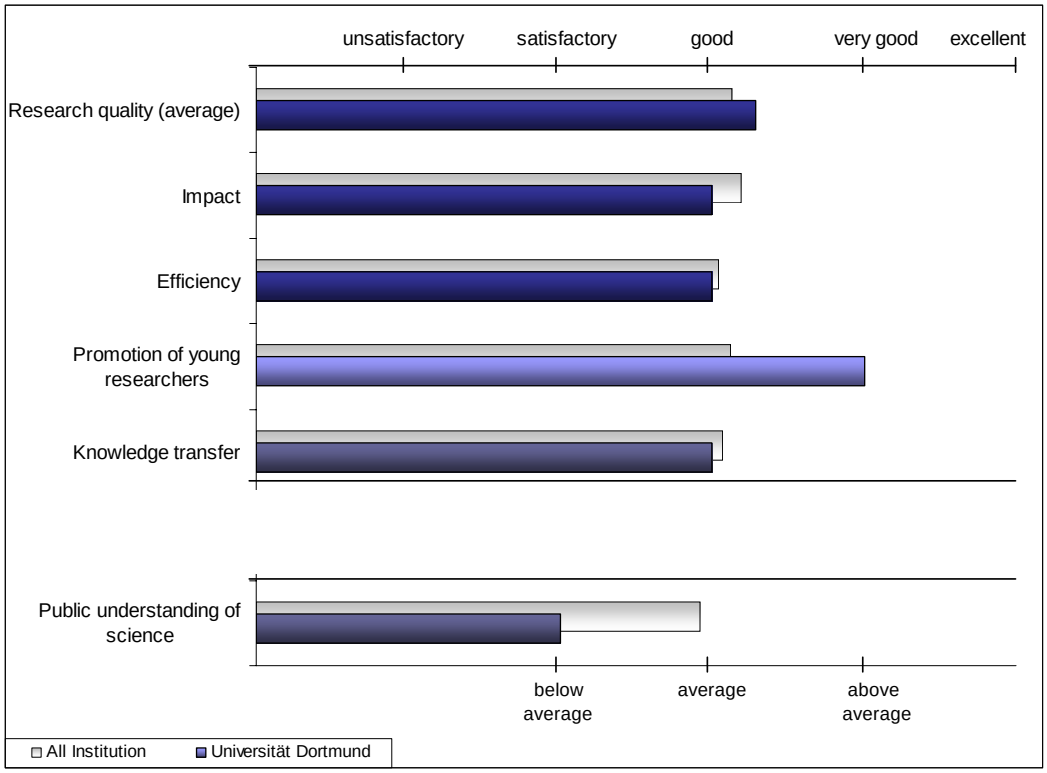


Assessment notes

The assessment of chemistry at TU Darmstadt includes the Deutsches Kunststoffinstitut (DKI), which is an affiliated institute and, therefore, clearly different by its mission and character from the classic university institutes.

Technical University of Dortmund

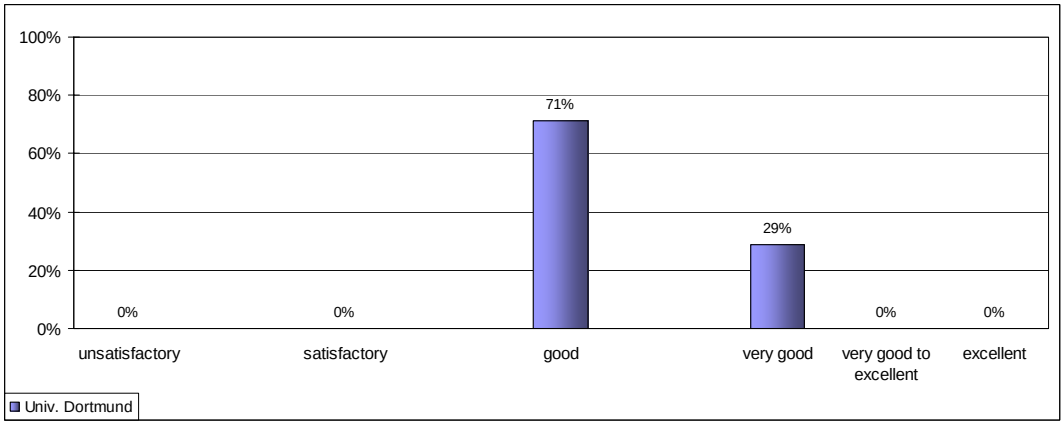
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

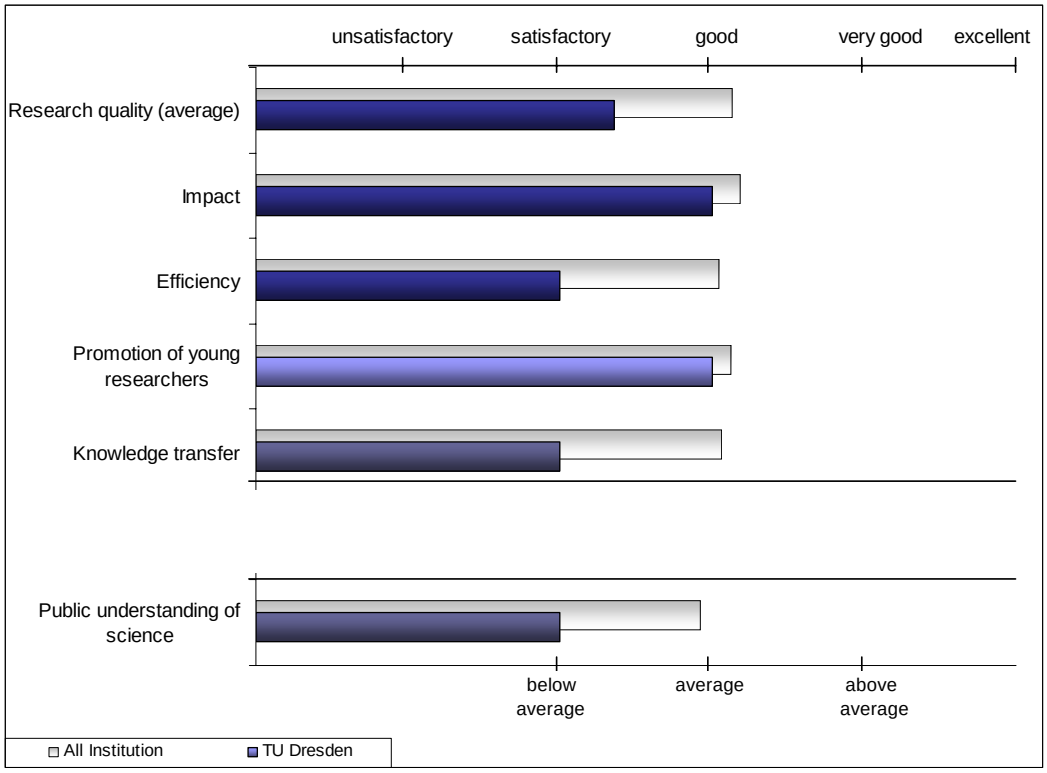


Assessment notes

The assessment of chemistry at the University of Dortmund includes, through personal union, a department of the MPI of Molecular Physiology. Complete separation of university and non-university achievements was not possible.

Technical University Dresden

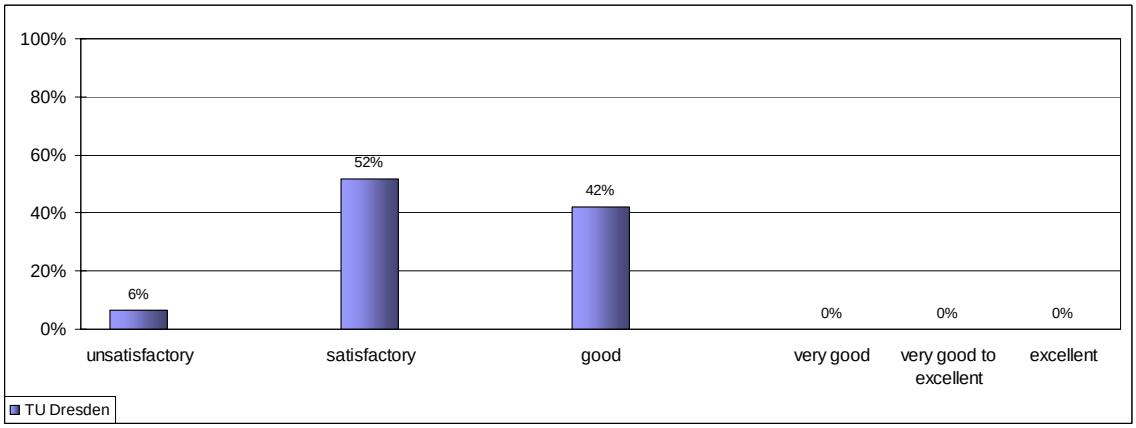
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

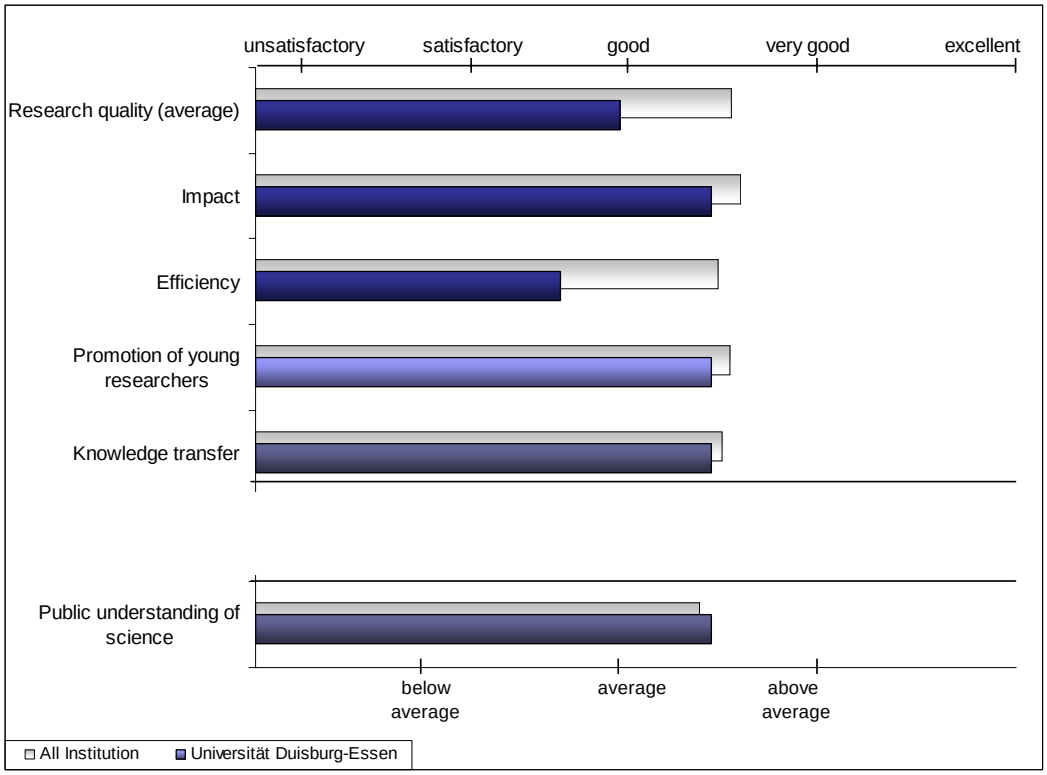
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Duisburg-Essen

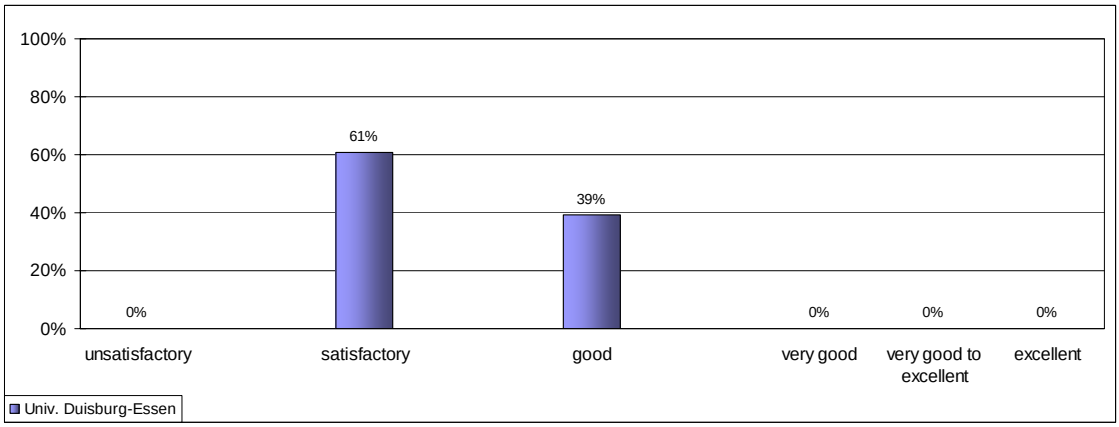
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

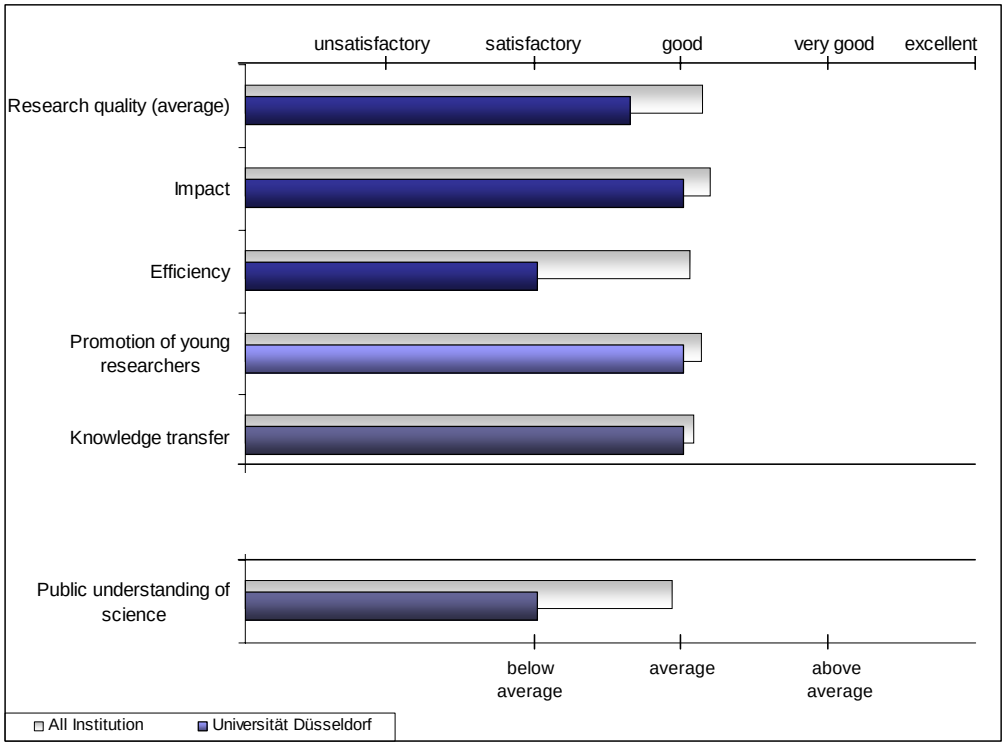


Assessment notes

Due to the fusion of the universities of Duisburg and Essen, chemistry was subject to considerable restructuring measures in the survey period.

Heinrich-Heine-University Düsseldorf

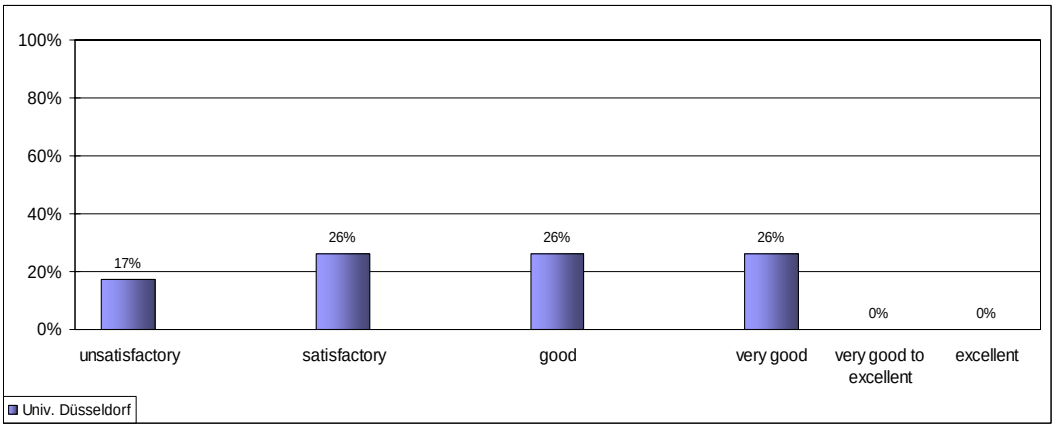
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

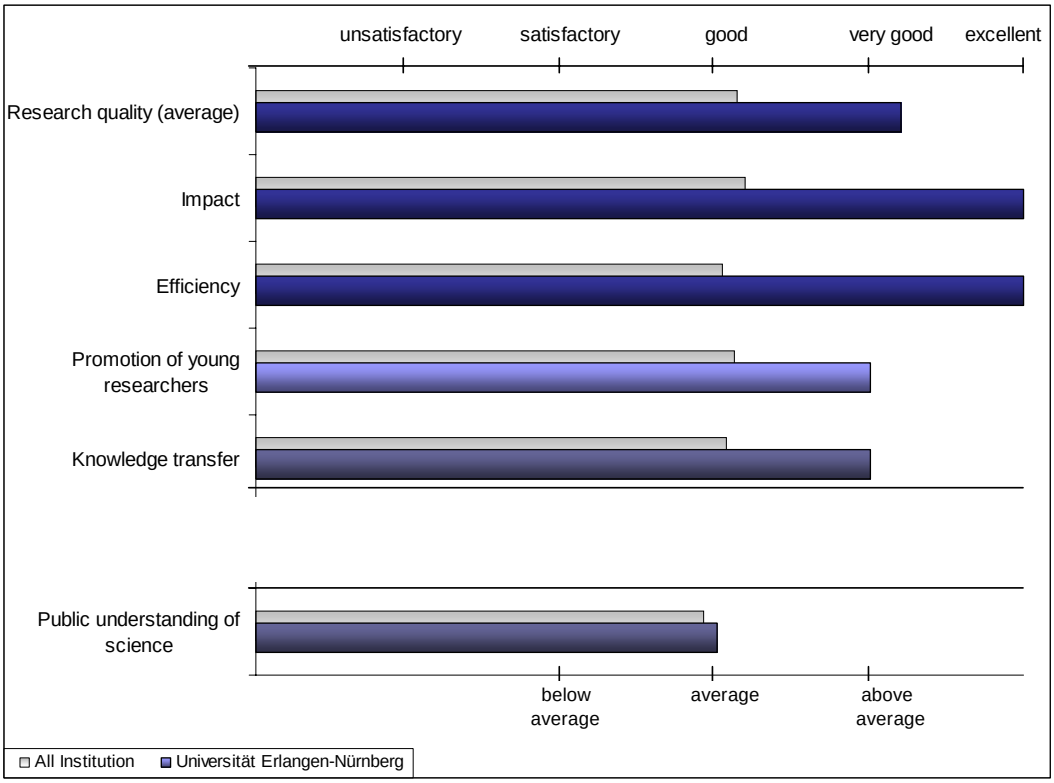


Assessment notes

The chemistry research ratings for the University of Düsseldorf are affected by the very detailed definition of the research units, with some units at an “undercritical” size. Also, there were strong fluctuations among the senior scientific staff during the survey period. The performances of the individual research units diverged considerably within the survey period.

University of Erlangen-Nürnberg

I. Rating of the institution according to single criteria



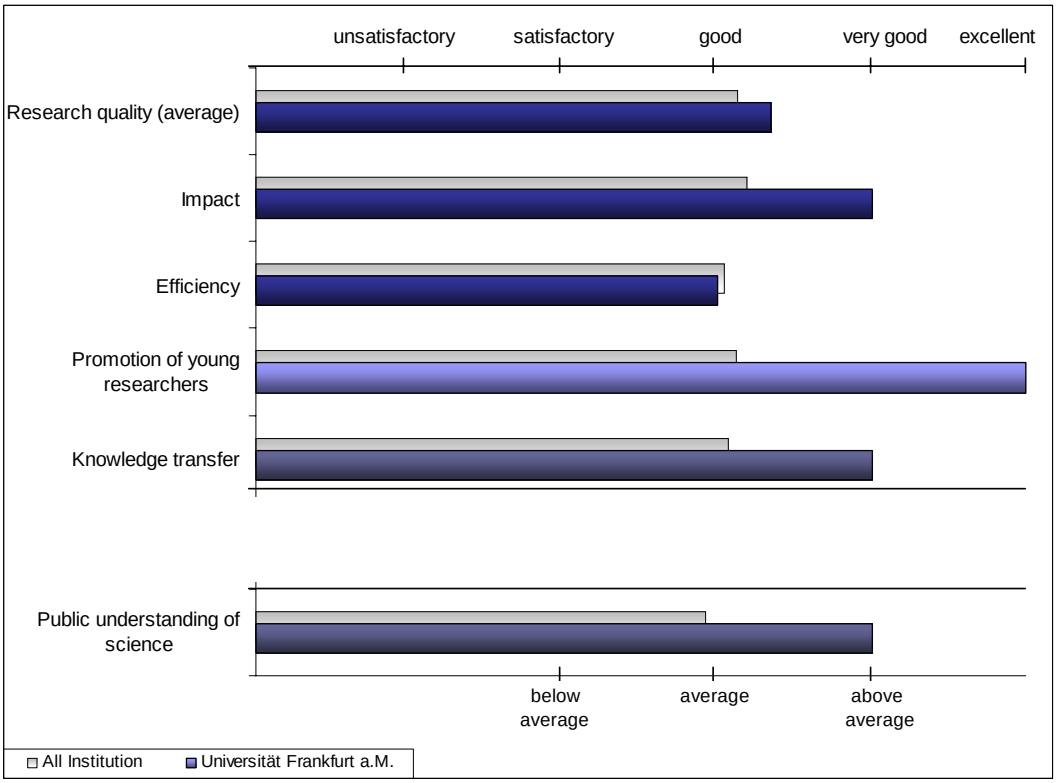
Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

Johann Wolfgang Goethe University Frankfurt a. M.

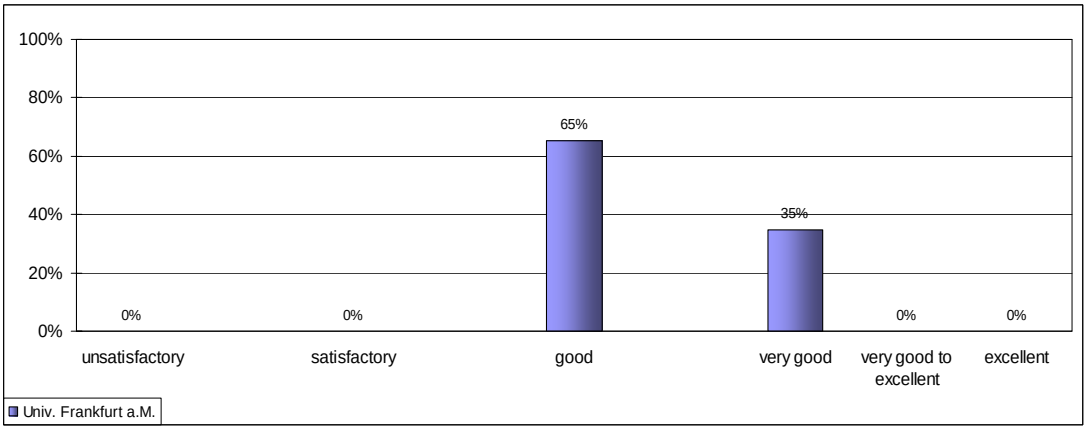
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

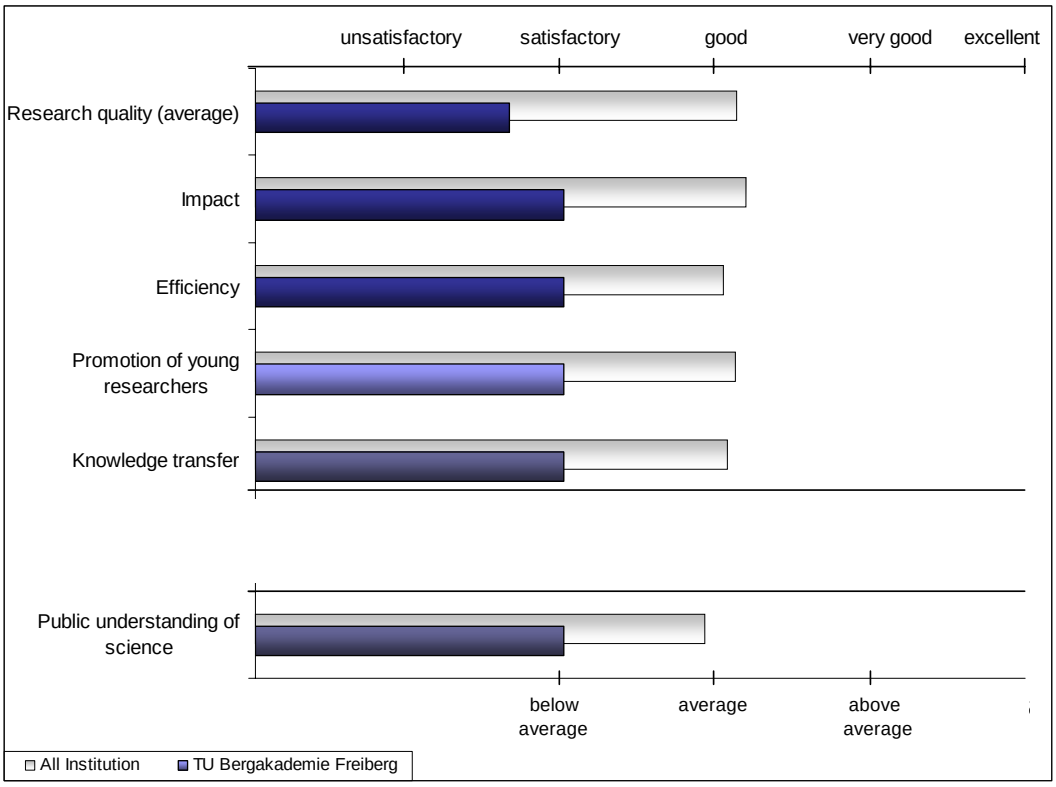
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Technical University of Freiberg

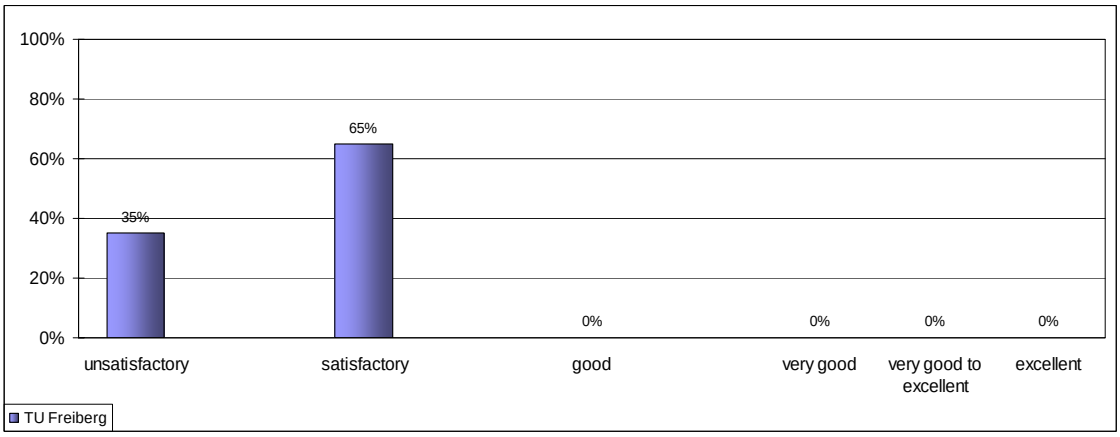
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

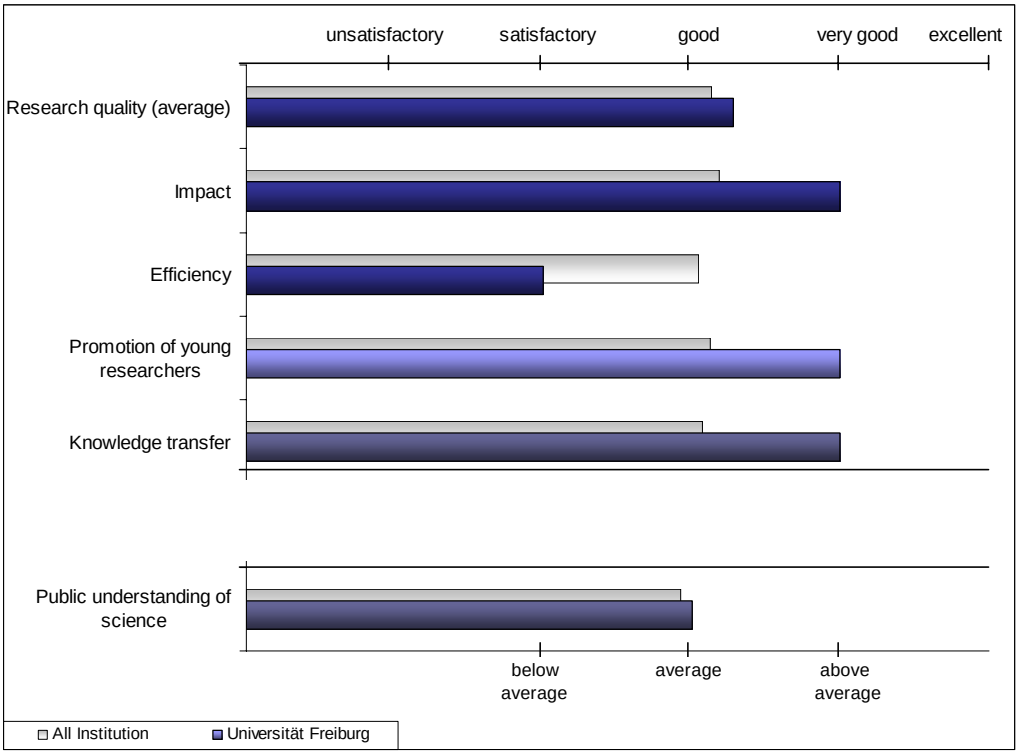
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Freiburg

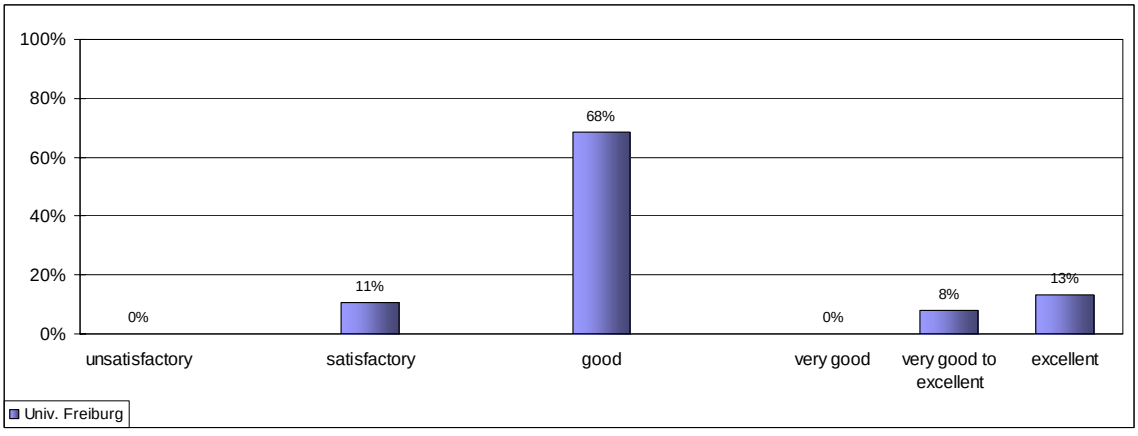
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

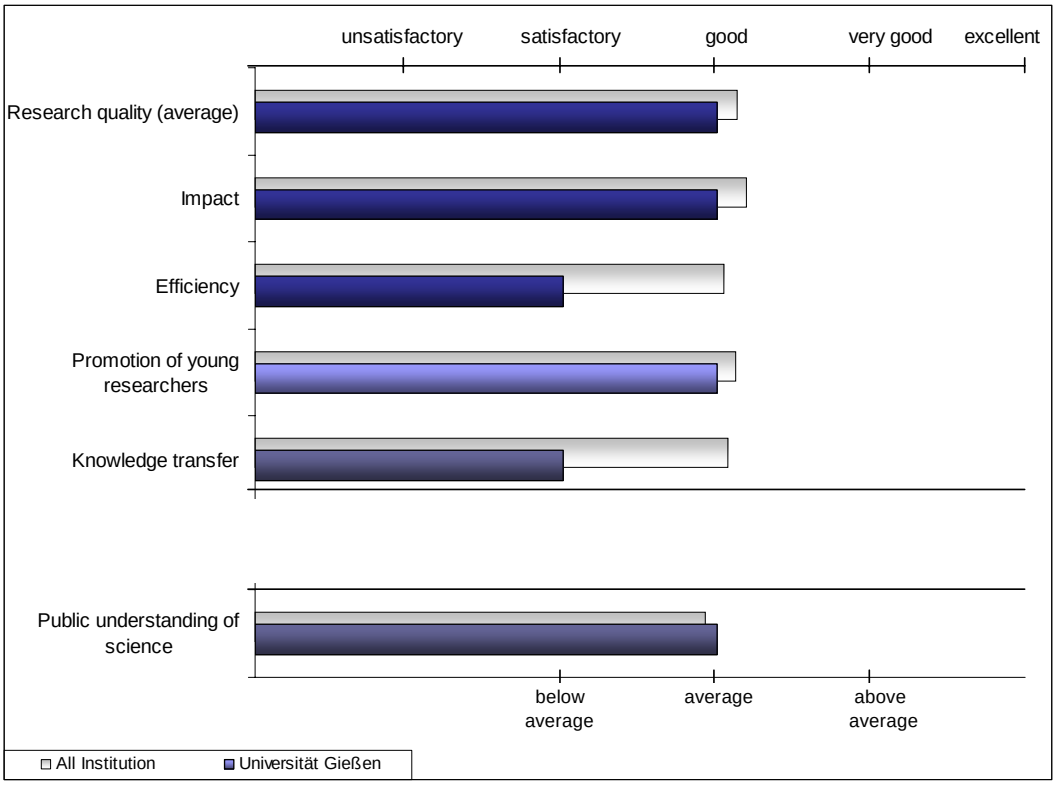


Assessment notes

The assessment results for chemistry at the University of Freiburg are affected by the very detailed definition of the research units, leaving some units at an “undercritical” size. The performances of the individual research units diverged considerably within the survey period.
In contrast to most other universities, Freiburg registered two research units from biology (biochemistry, microbiology) for research rating in chemistry.

Justus-Liebig-University Gießen

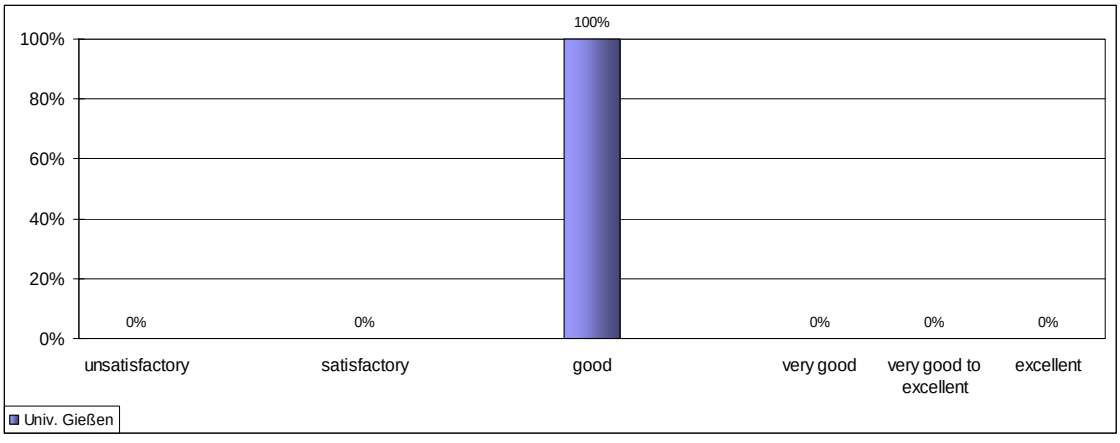
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

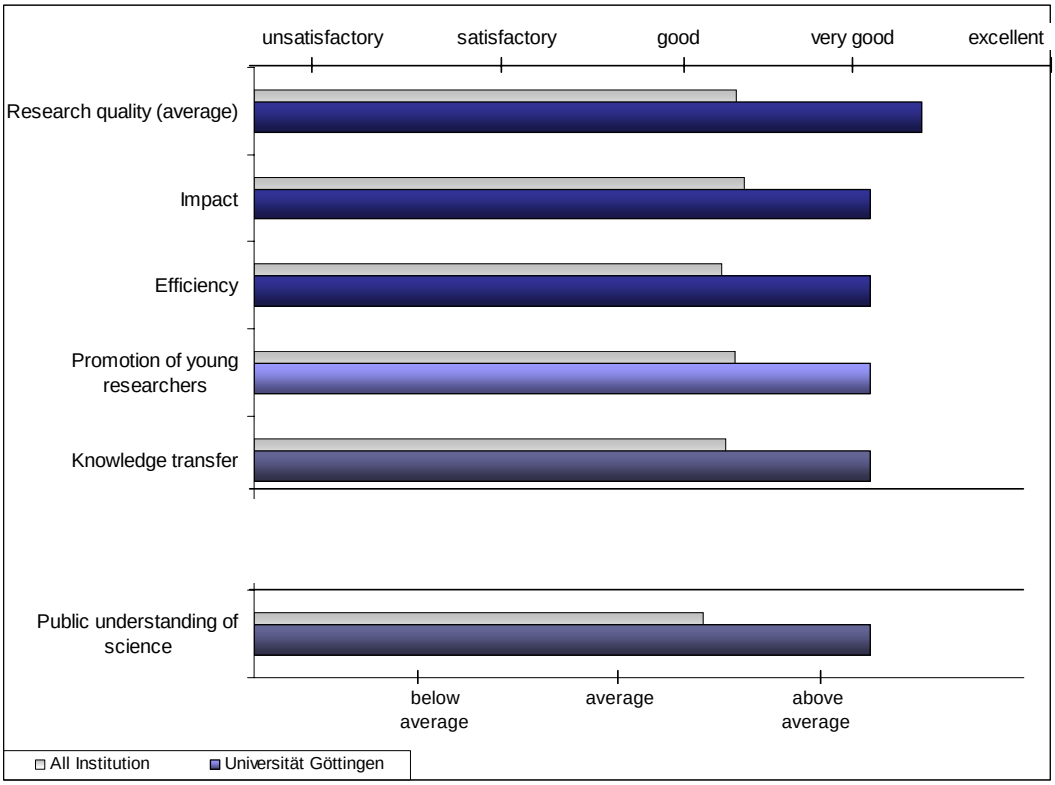


Assessment notes

The University of Gießen was subject to strong fluctuations of staff over the survey period.

Georg-August-University Göttingen

I. Rating of the institution according to single criteria



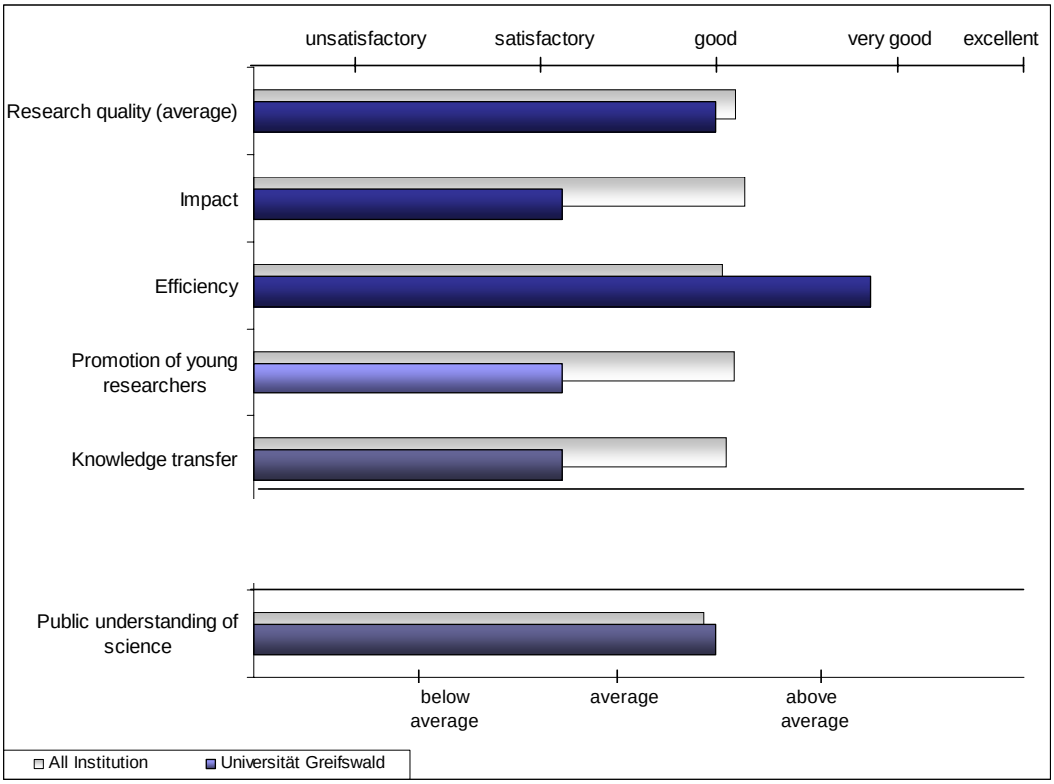
Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

Ernst-Moritz-Arndt University Greifswald

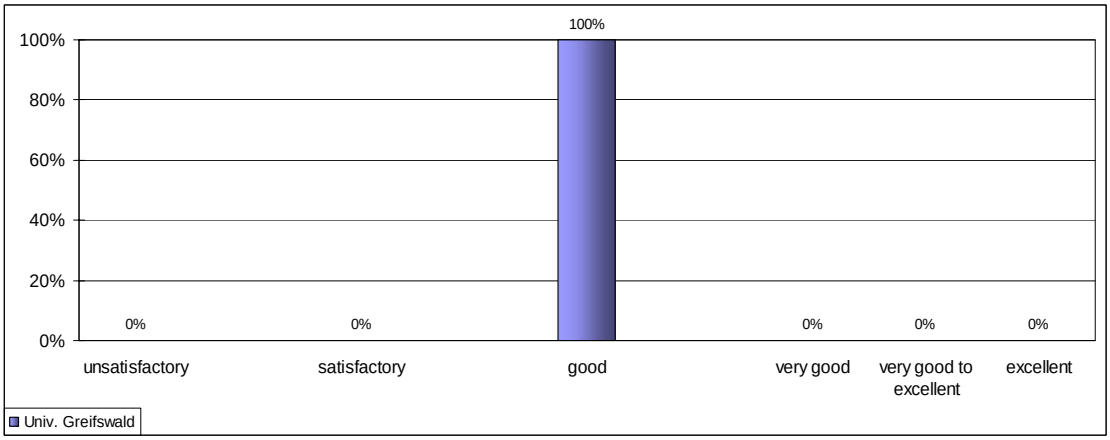
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

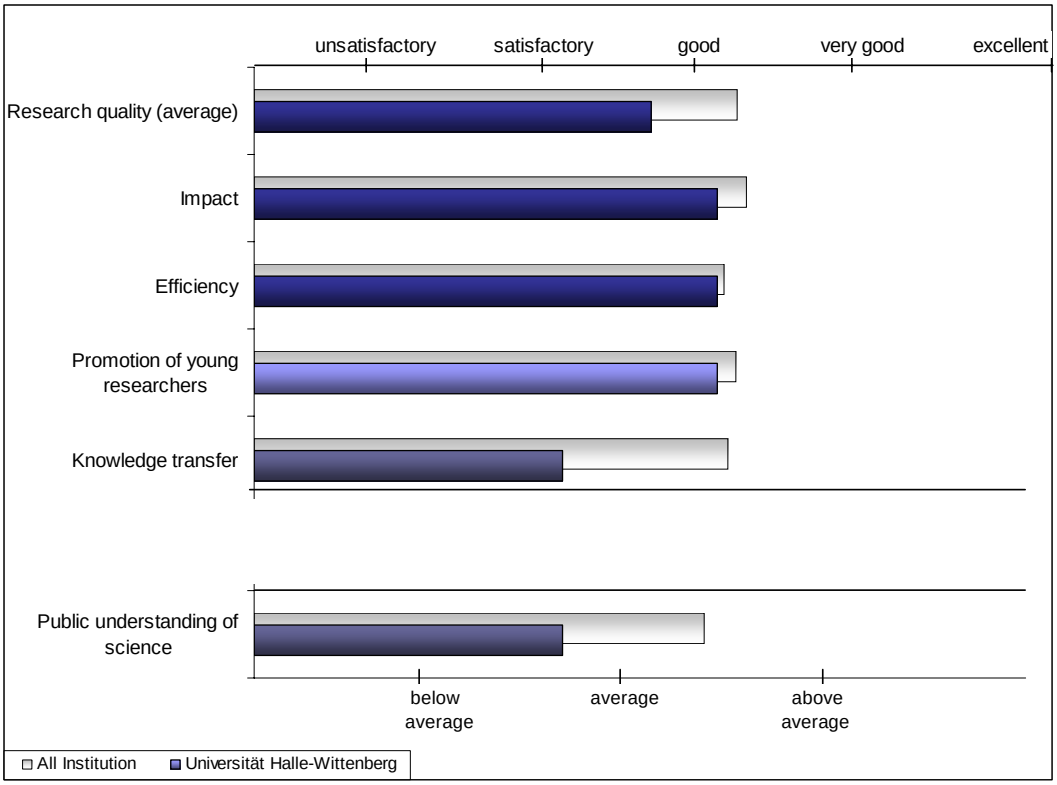
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Martin-Luther-University Halle-Wittenberg

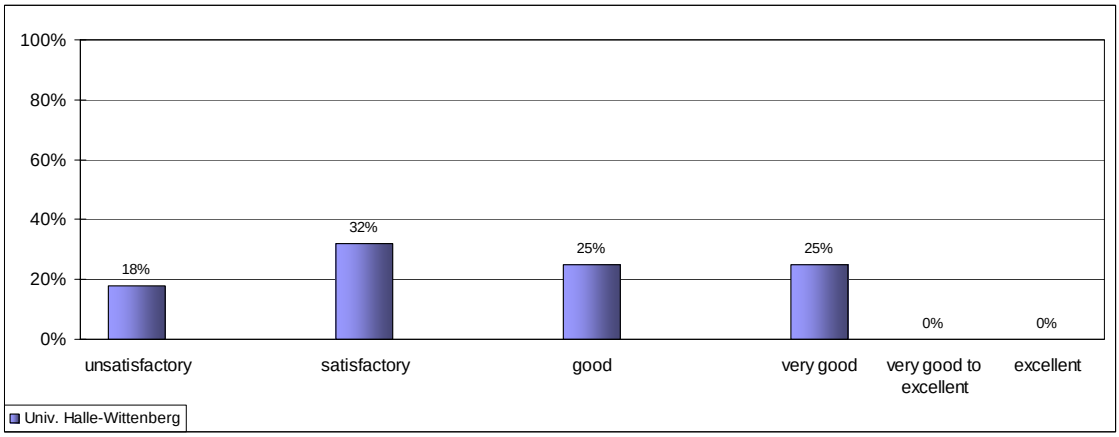
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

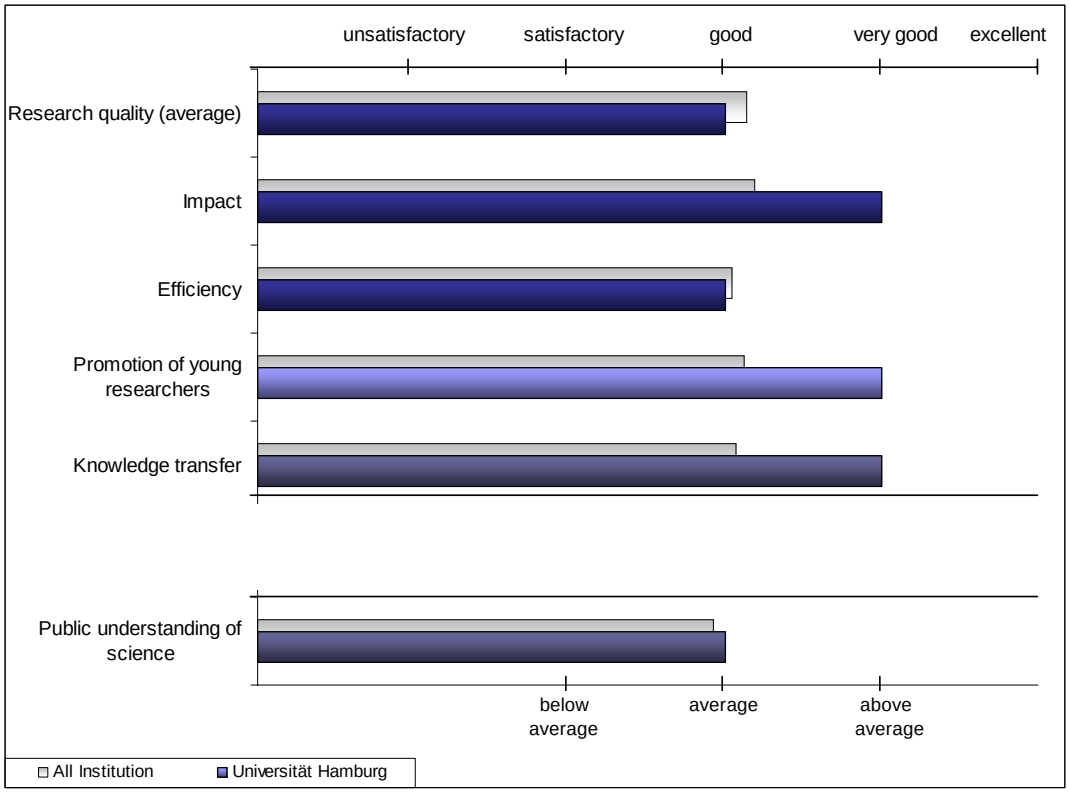
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Hamburg

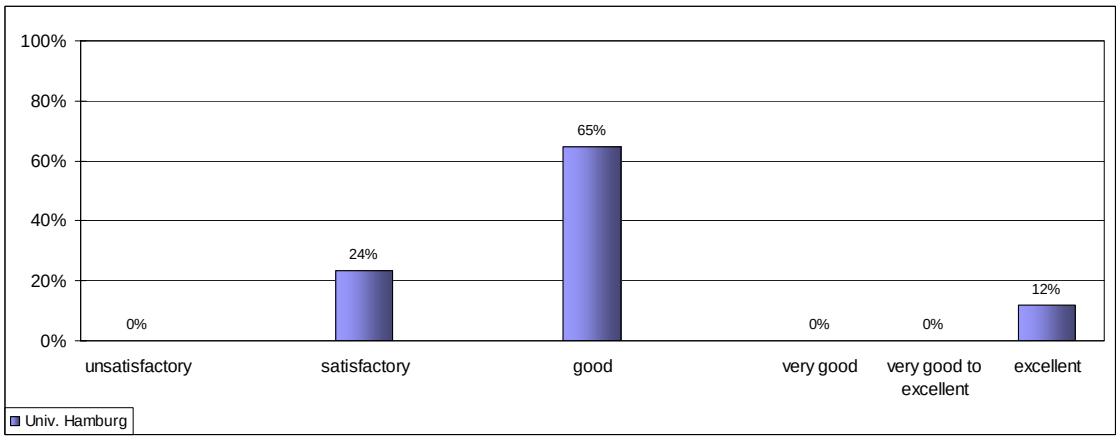
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

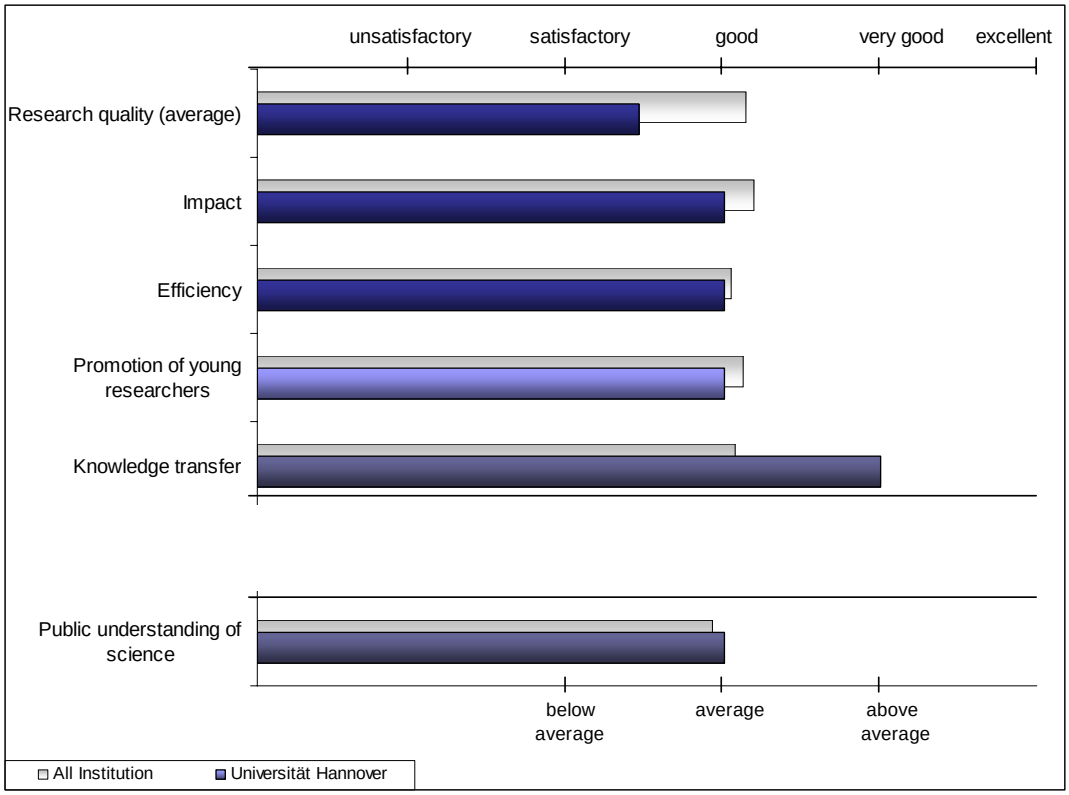
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Hannover

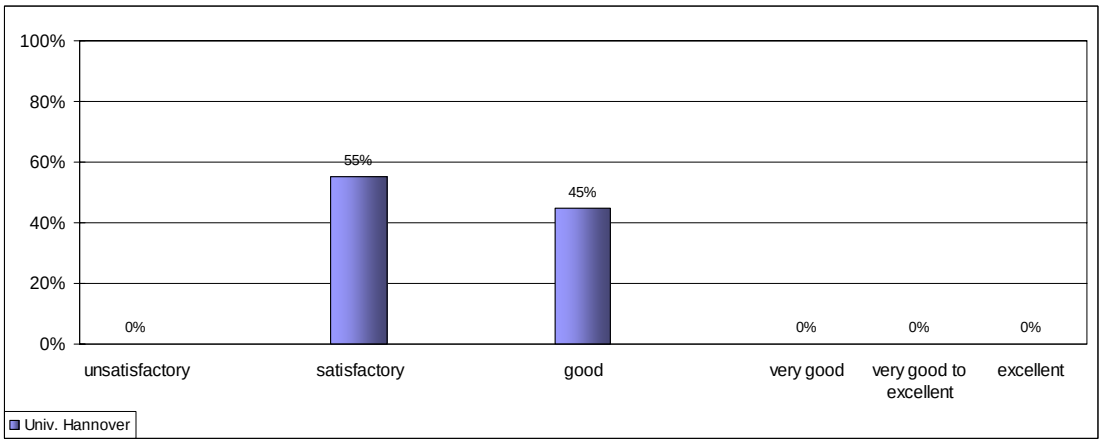
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

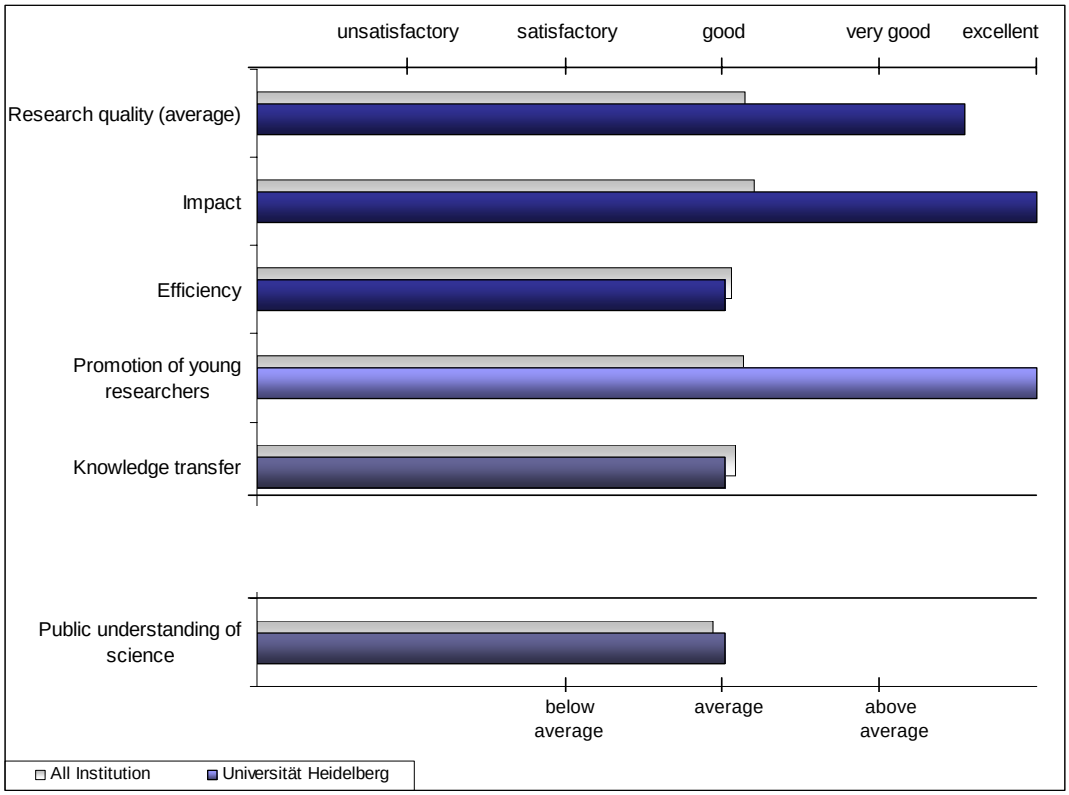


Assessment notes

The University of Hannover did not submit any data for theoretical chemistry. Consequently, that branch of chemistry was excluded from the assessment.

University of Heidelberg

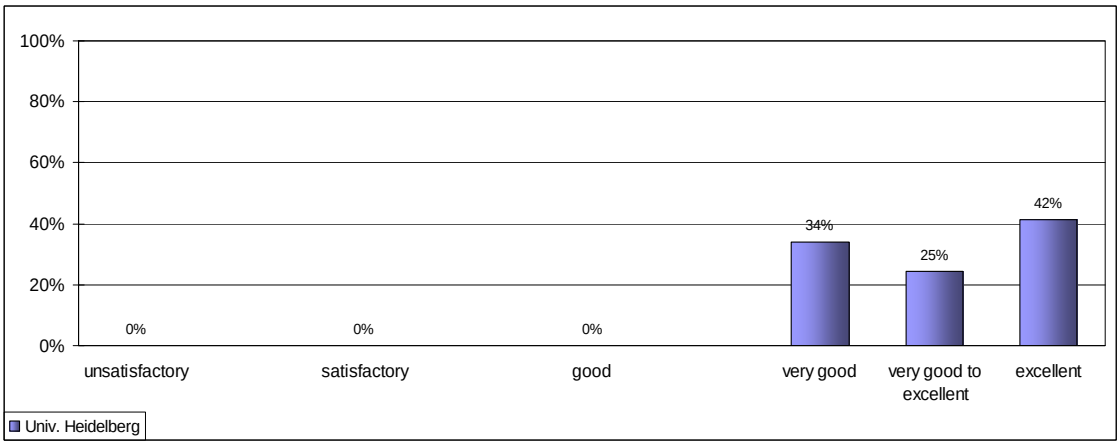
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

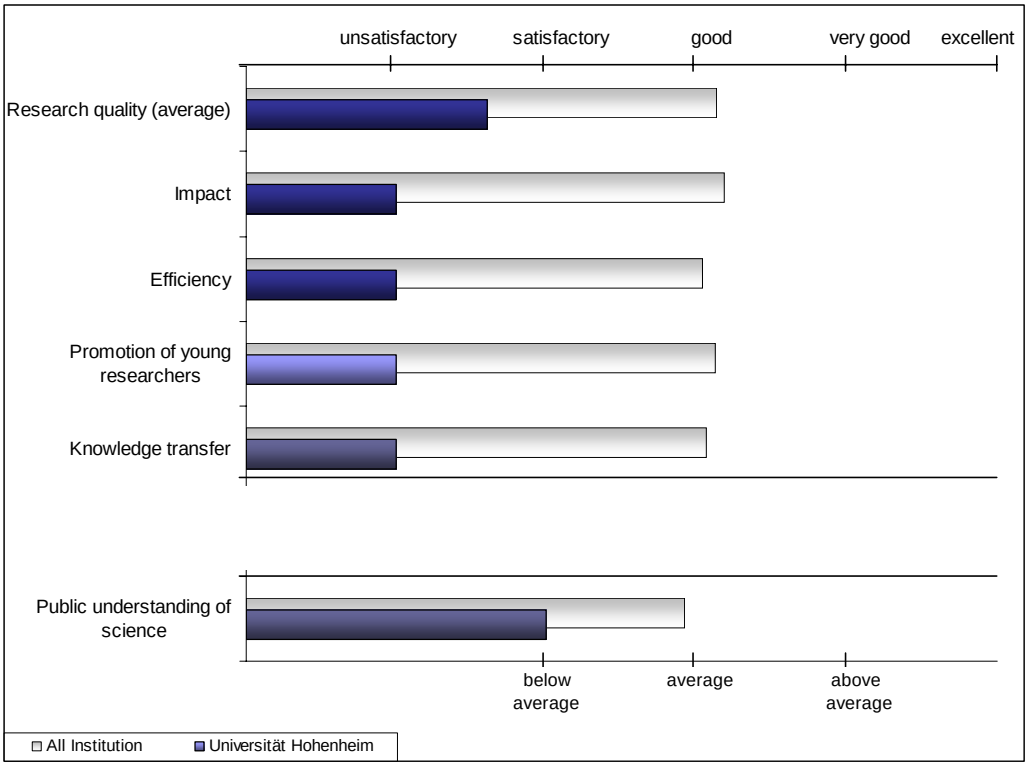
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Hohenheim

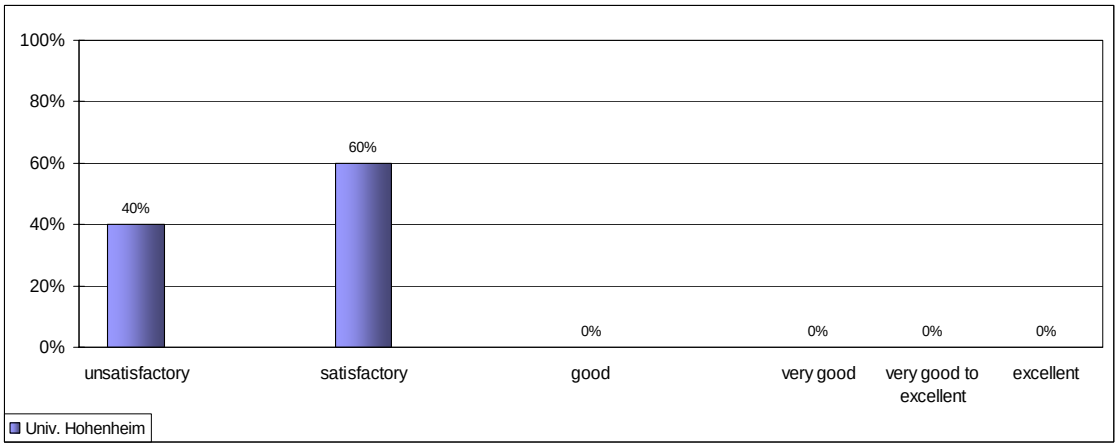
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

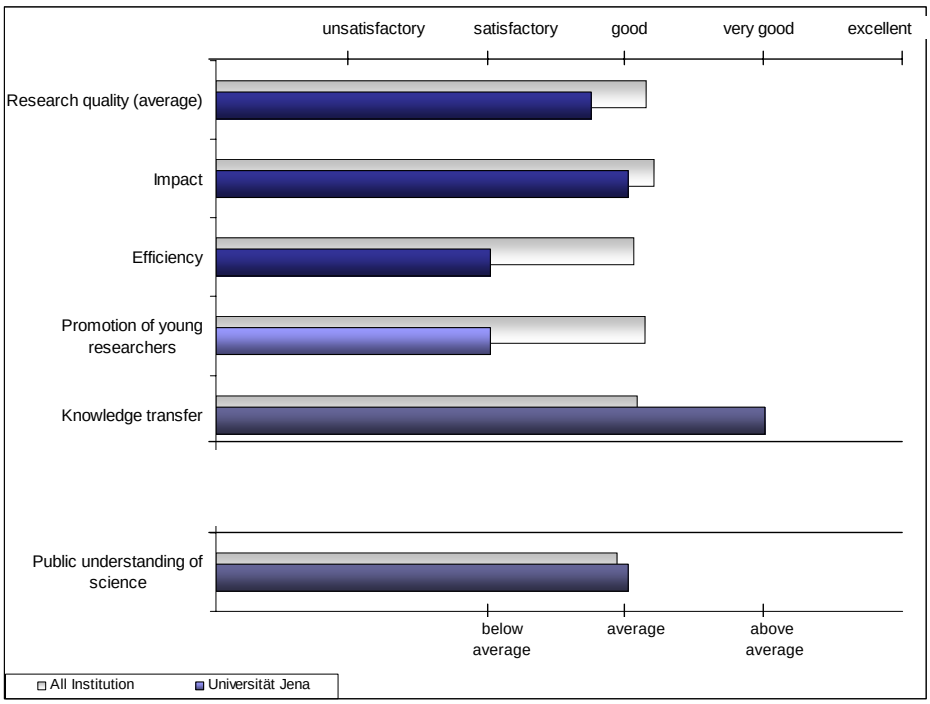


Assessment notes

The research units registered by the University of Hohenheim are very heterogeneous and “undercritical” in terms of their ability to function as independent chemical research units. No synergy effects and no clear research profile could be identified.

Friedrich-Schiller-University Jena

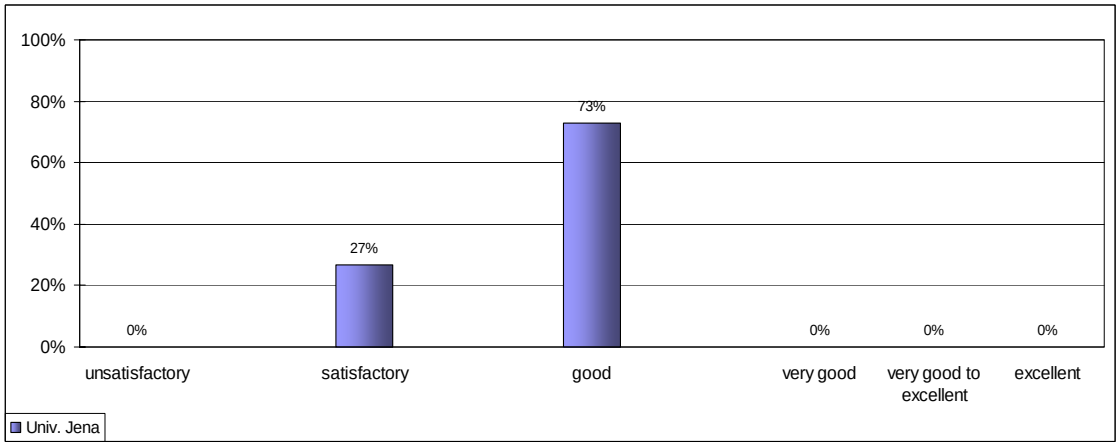
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

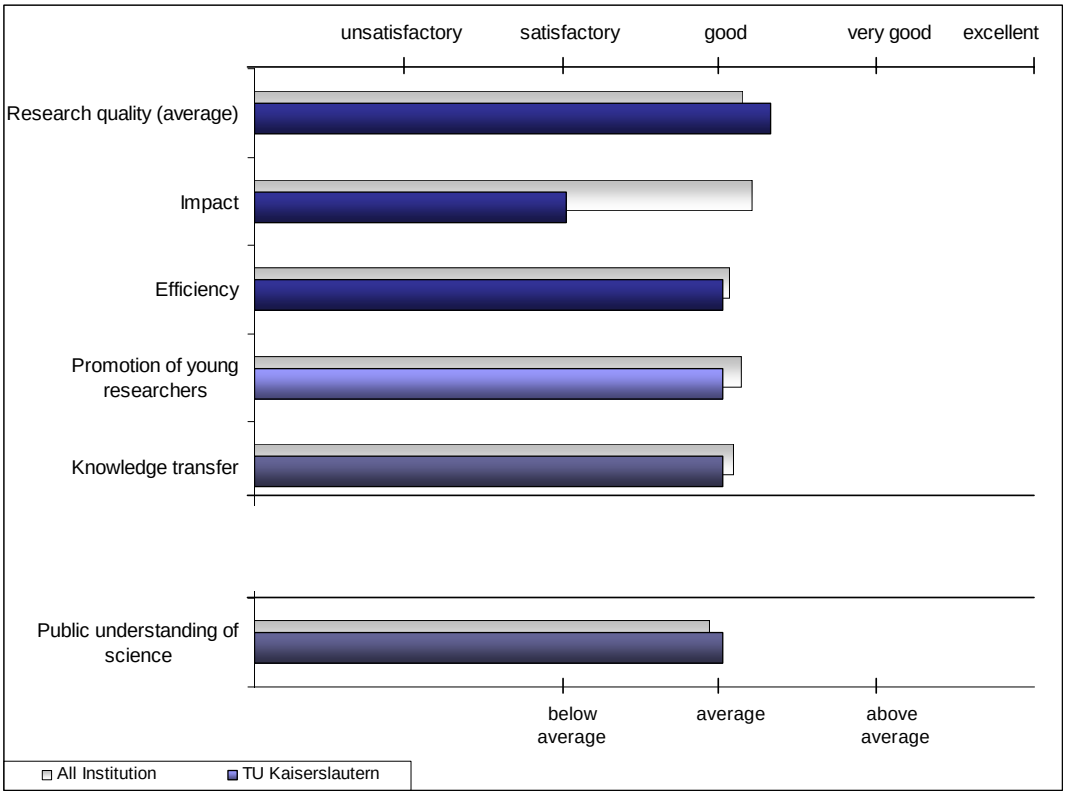


Assessment notes

Chemistry at the University of Jena underwent a change of generations in the survey period. Due to successful appointments and the development of a focus area in material science, Jena is now showing a positive tendency.

Technical University of Kaiserslautern

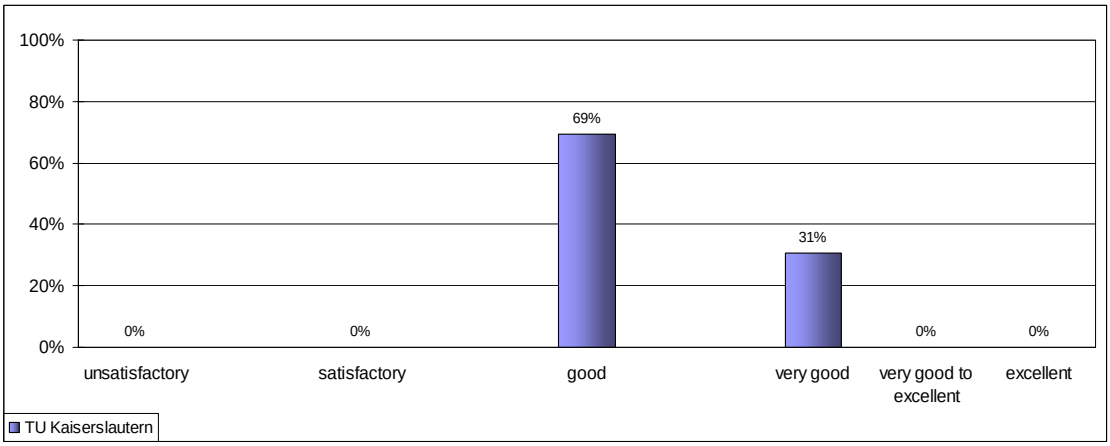
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

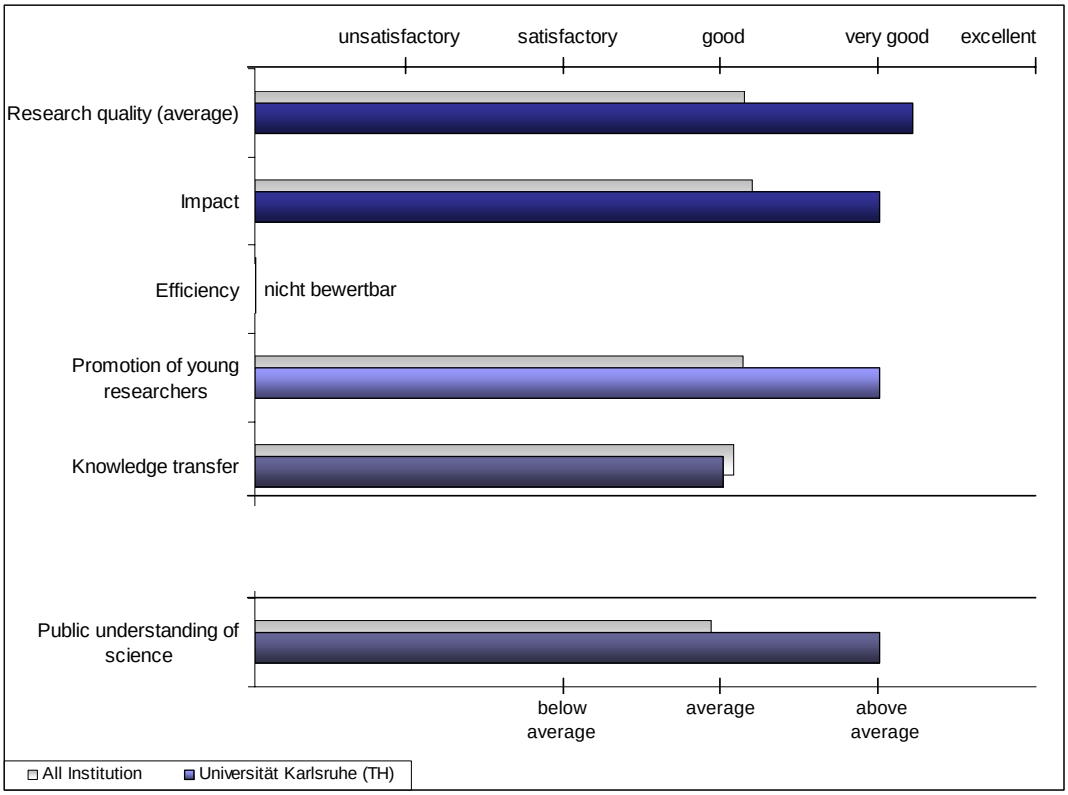
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Karlsruhe

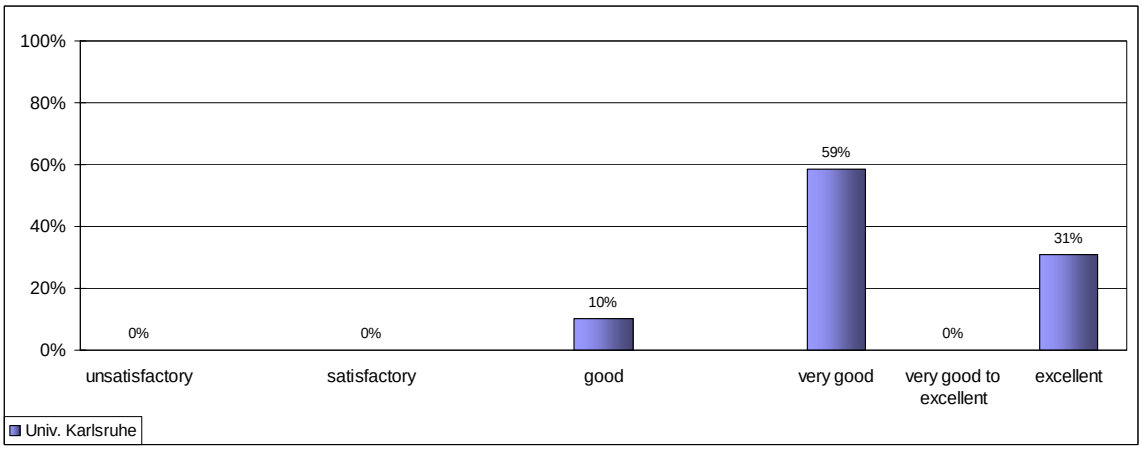
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

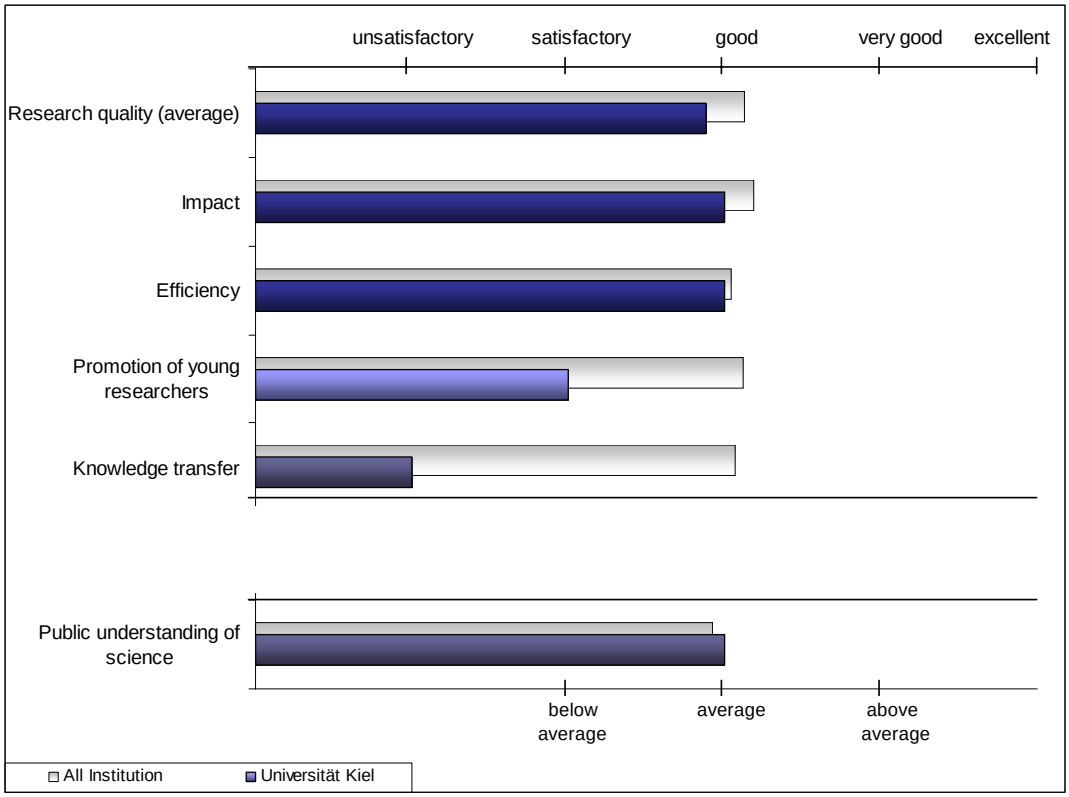


Assessment notes

On the basis of figures presented, Karlsruhe University appears to be excellent in its efficiency. However, as it could not be clarified to what extent resources of Forschungszentrum Karlsruhe were used, the efficiency criterion was classed as “unrateable”.

Christian-Albrechts-University of Kiel

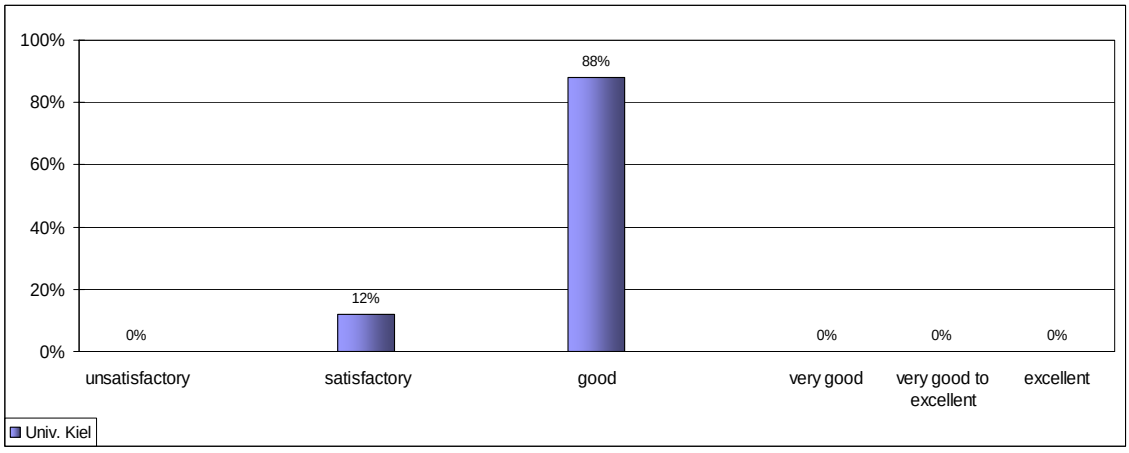
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

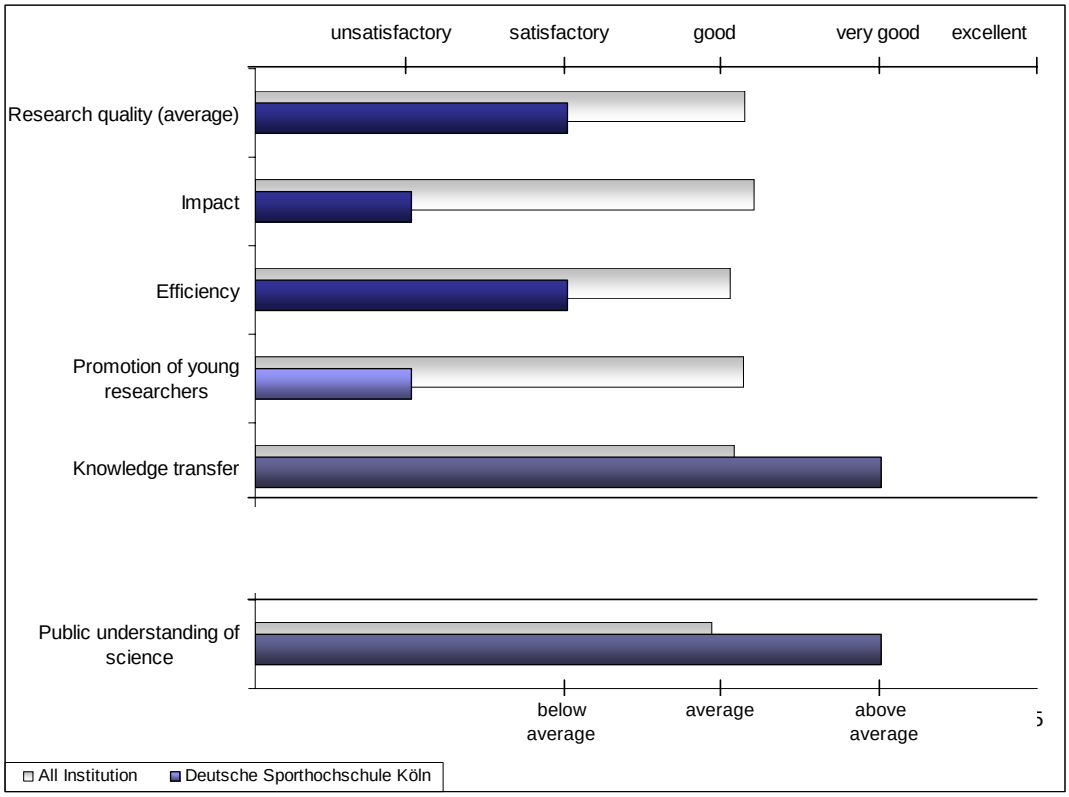


Assessment notes

The University of Kiel supplied only incomplete data for the assessment of its chemical research.

German Sport University Cologne

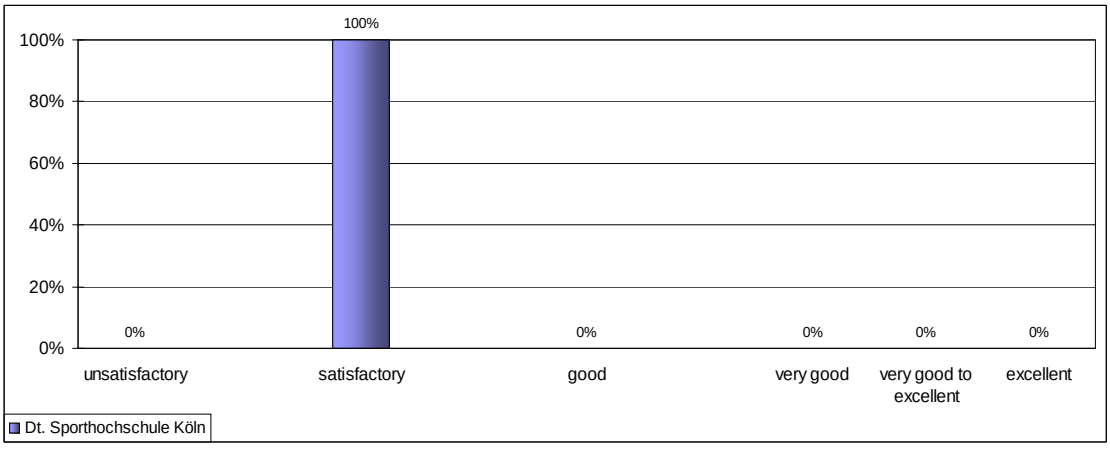
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

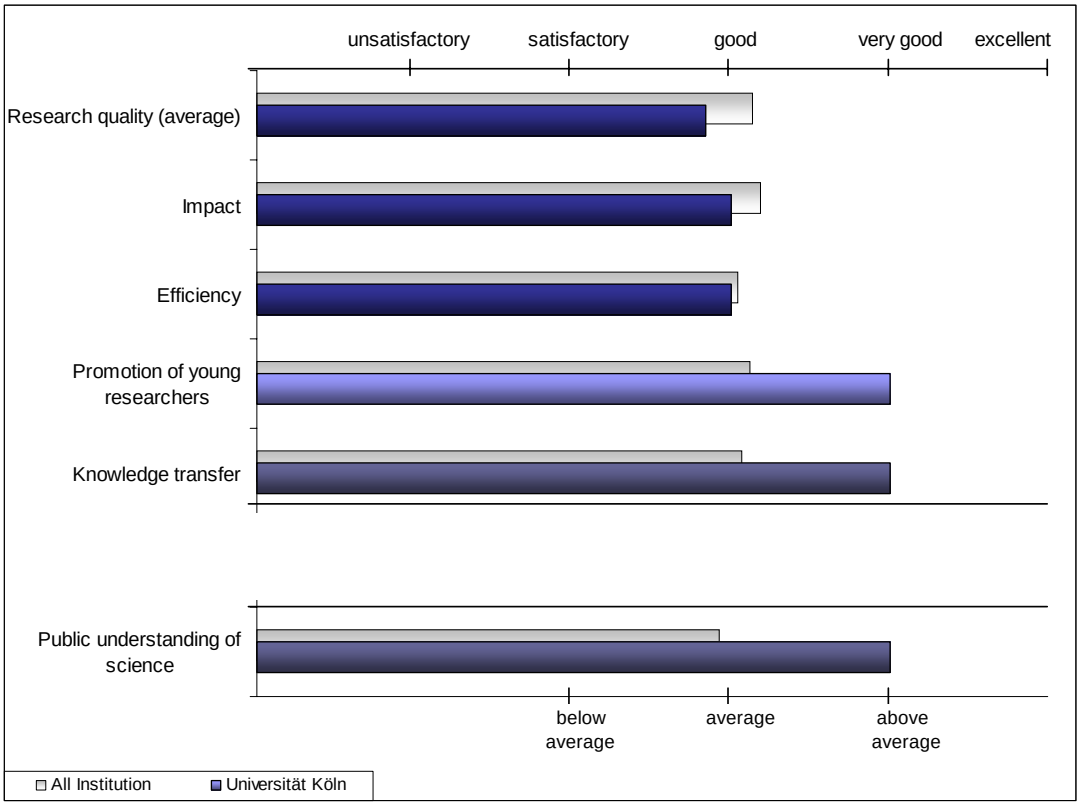


Assessment notes

Due to the particular mission of this institution, comparisons between chemistry activities at the German Sport University Cologne and those of typical chemistry institutes at universities are difficult. The main achievements of the Sporthochschule lie in the service area and the knowledge transfer dimension.

University of Cologne

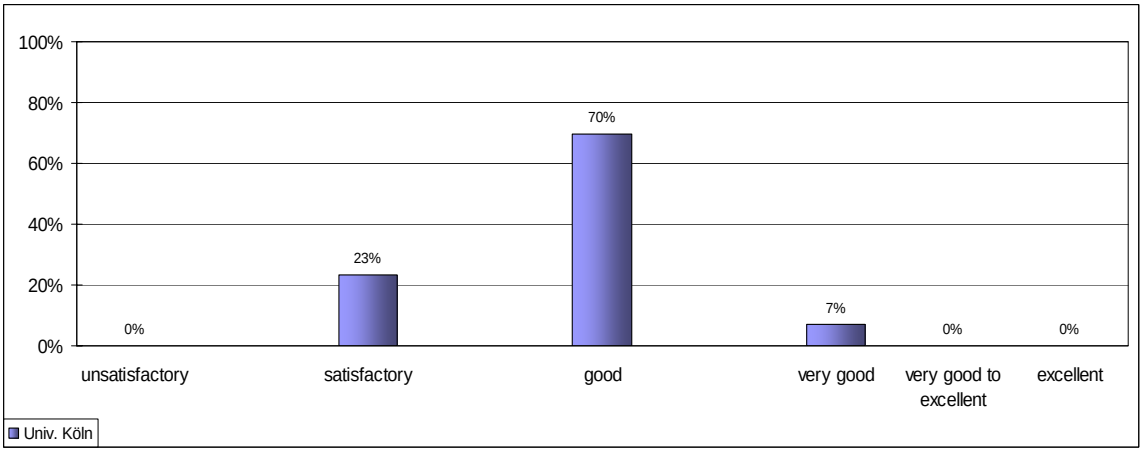
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

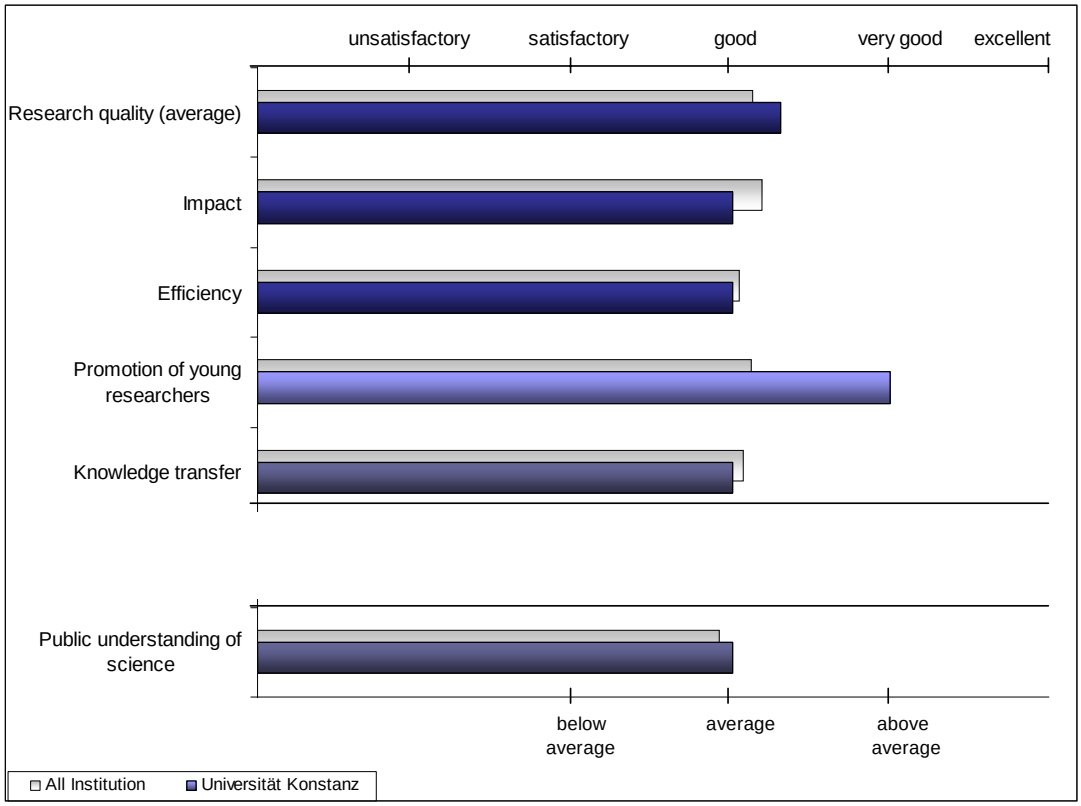
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Konstanz

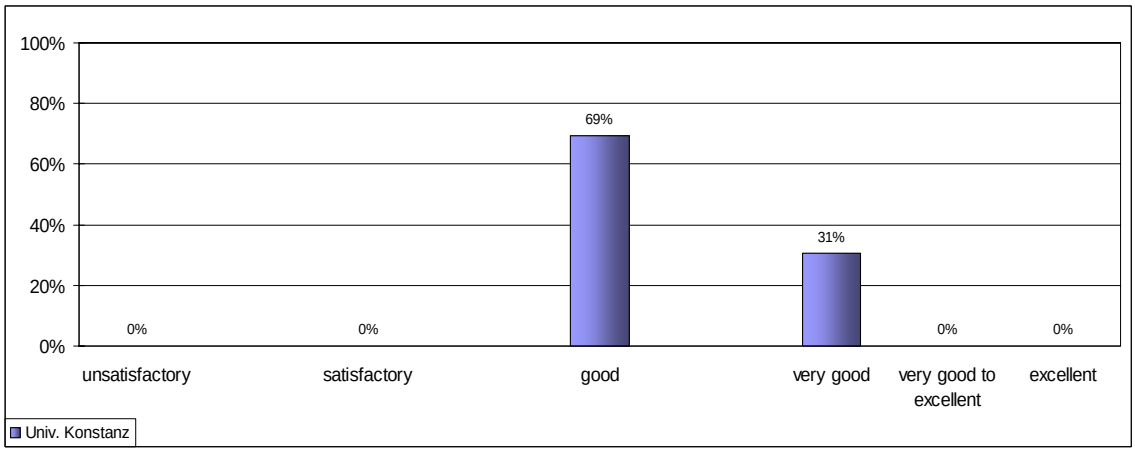
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

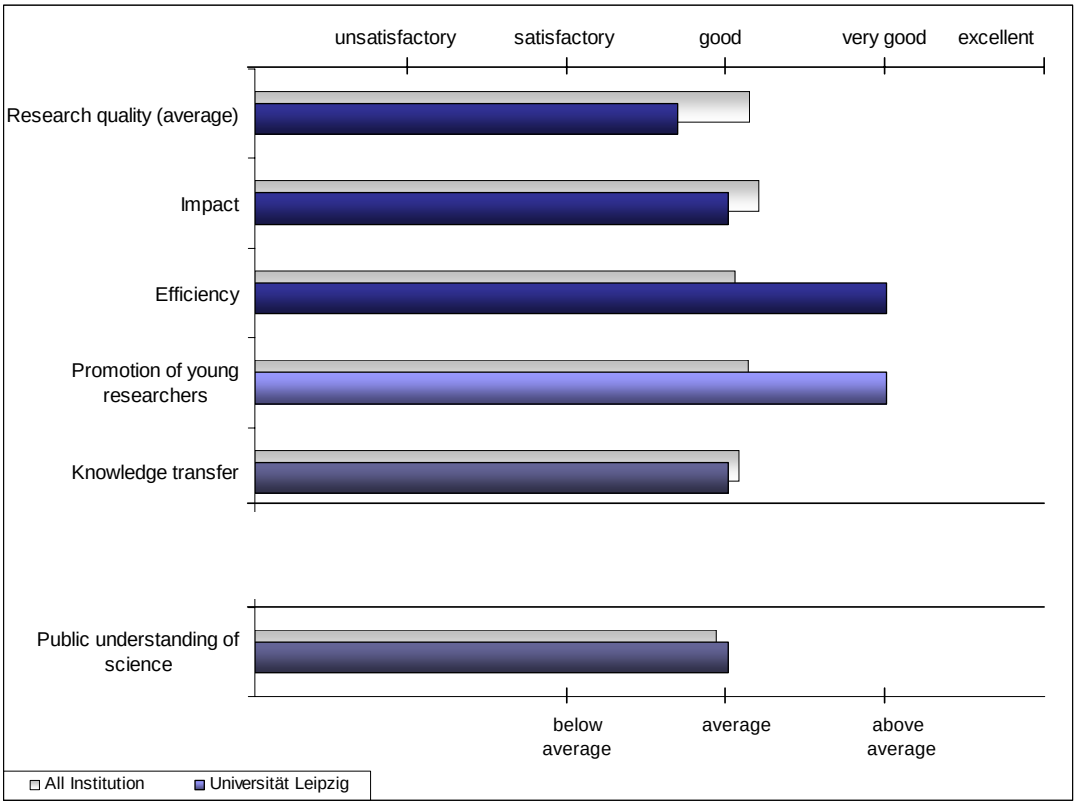


Assessment notes

The decision taken by the University of Konstanz to define two large, internally heterogeneous and interdisciplinary research units made it impossible to carry out a differentiated assessment.

University of Leipzig

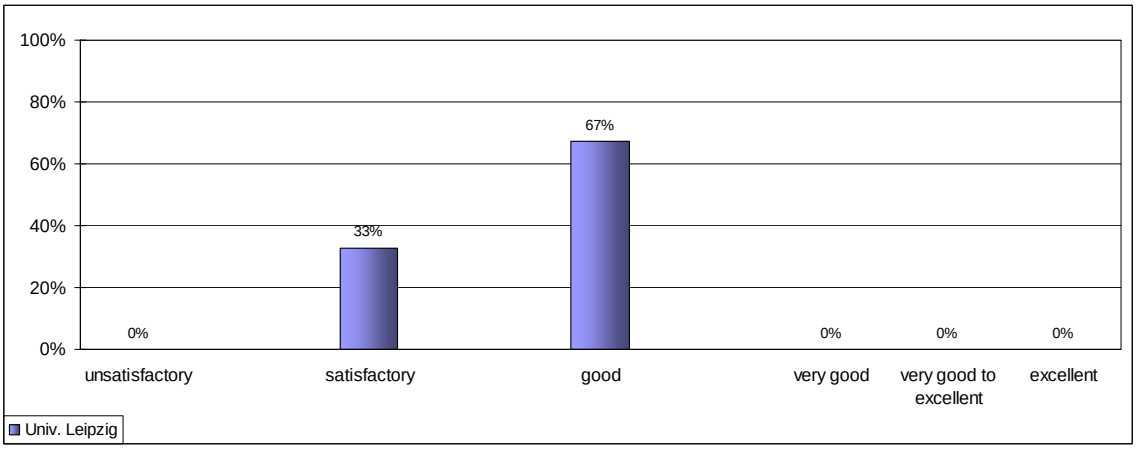
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

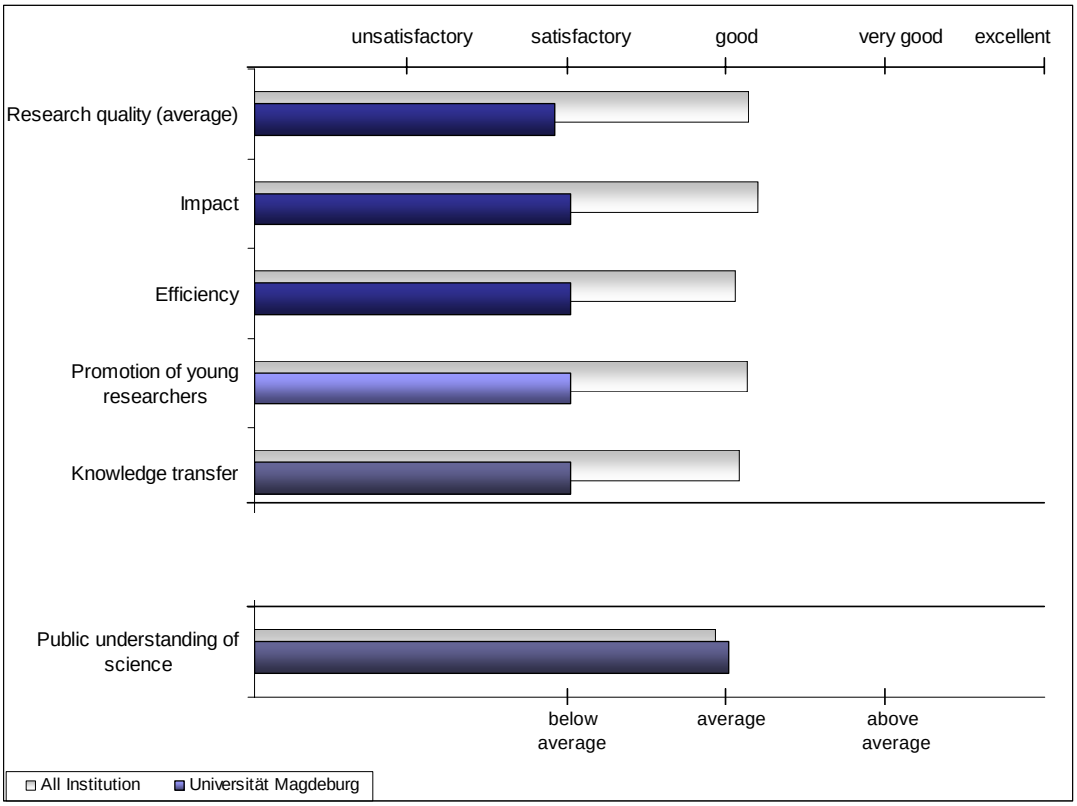
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Otto von Guericke University Magdeburg

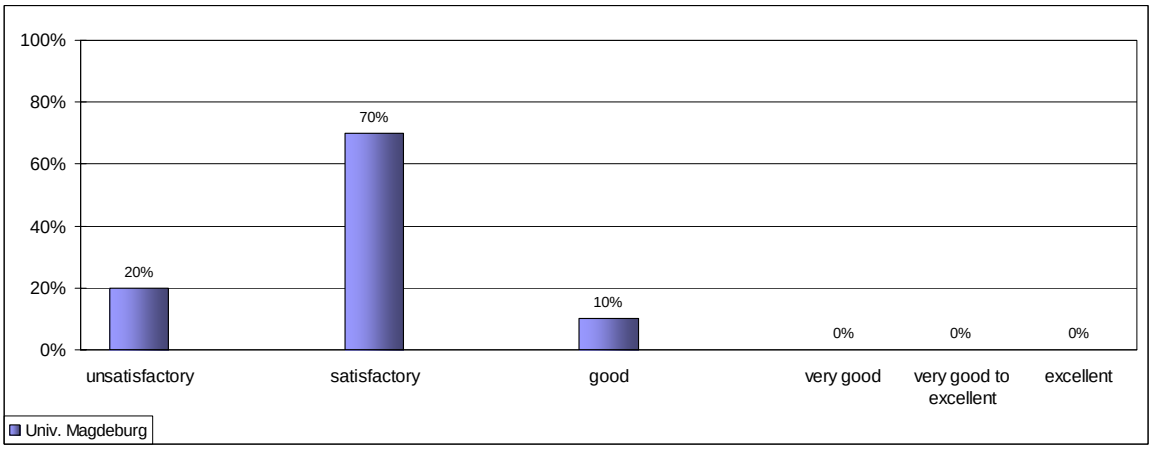
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

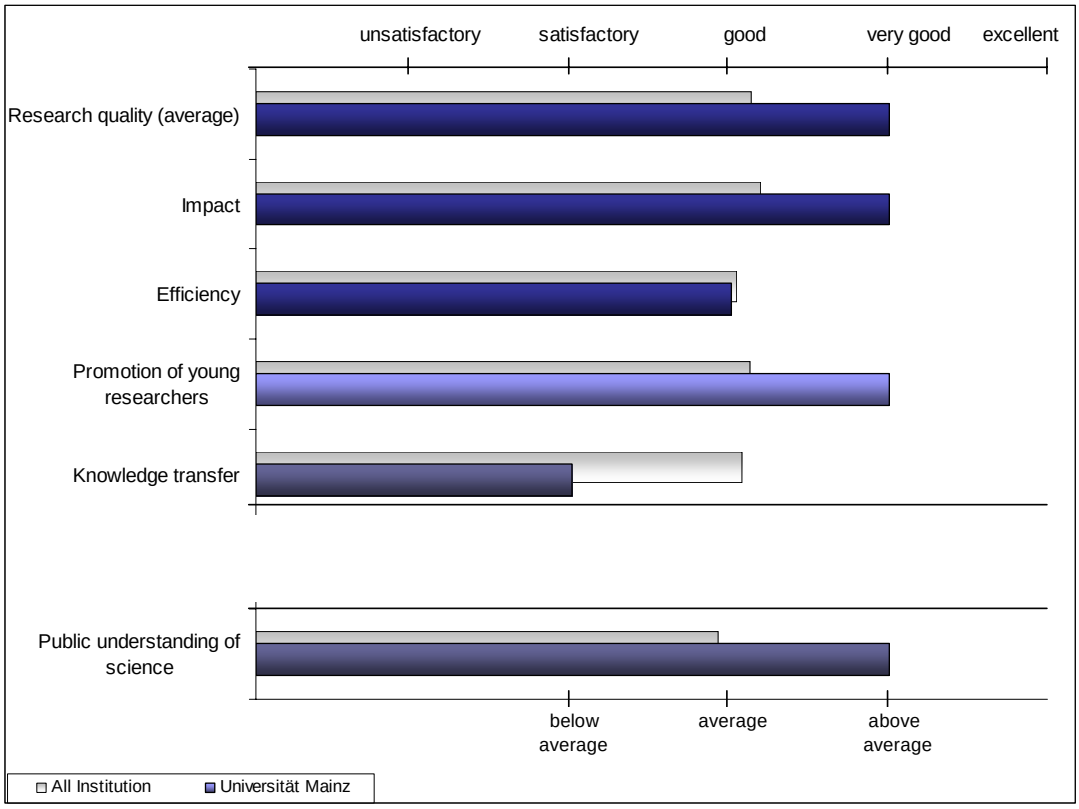
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Johannes Gutenberg University Mainz

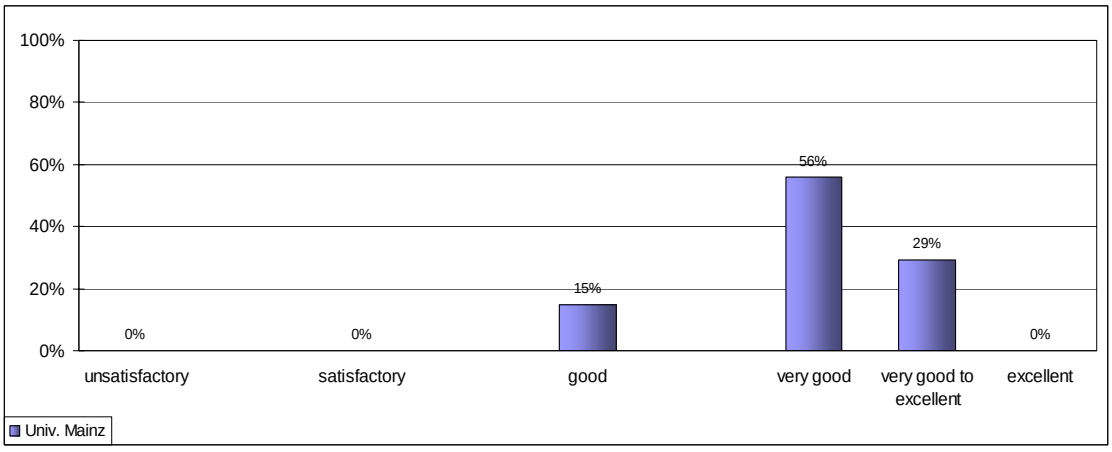
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

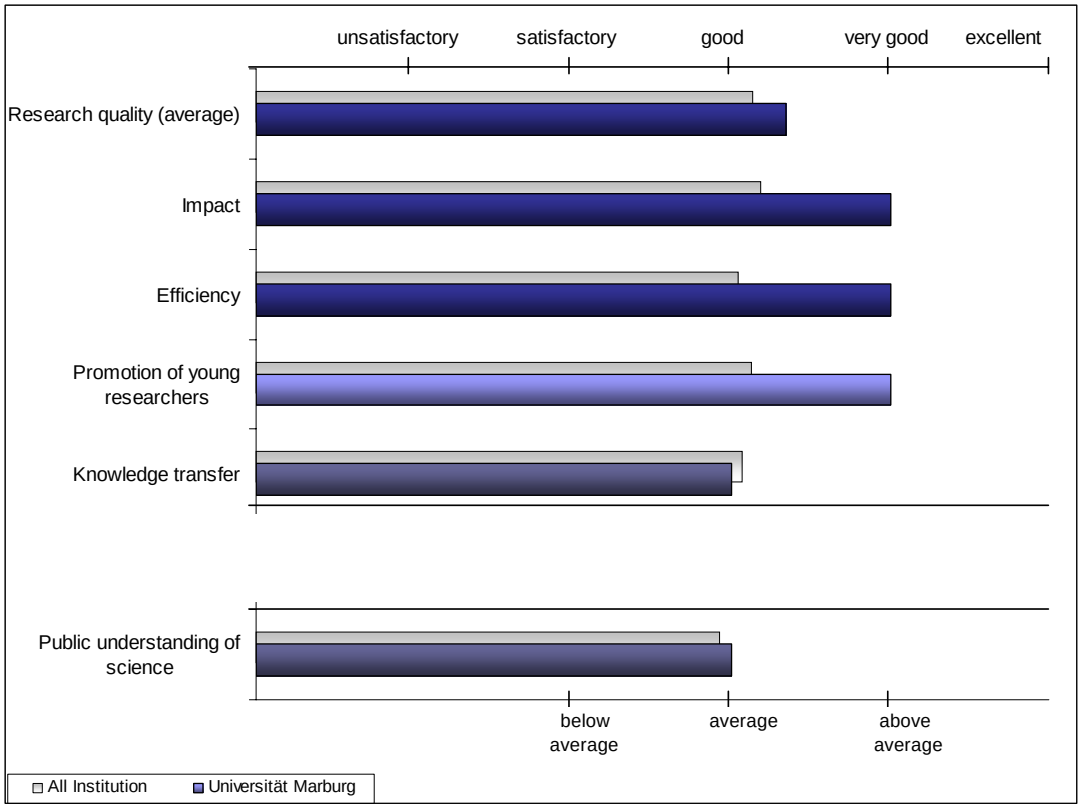
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Philipps University Marburg

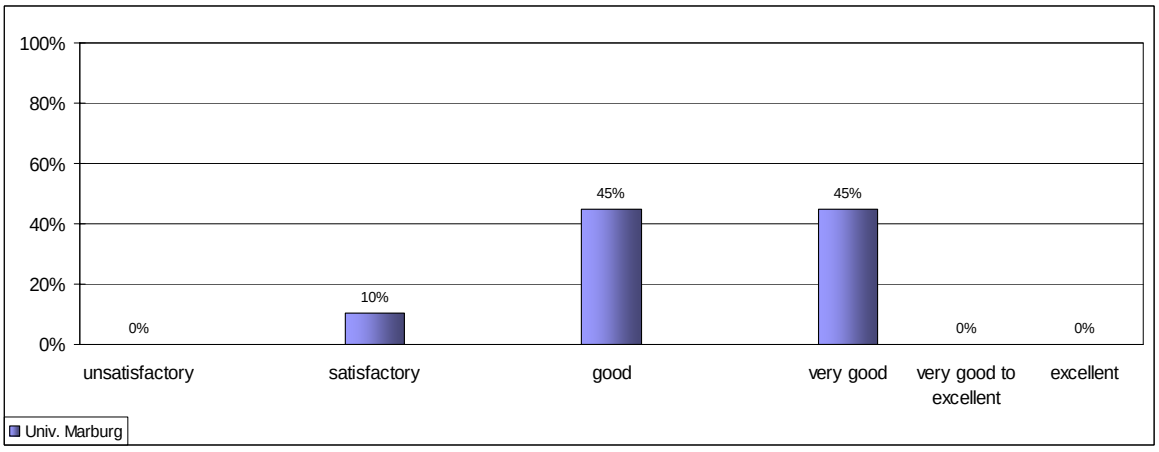
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

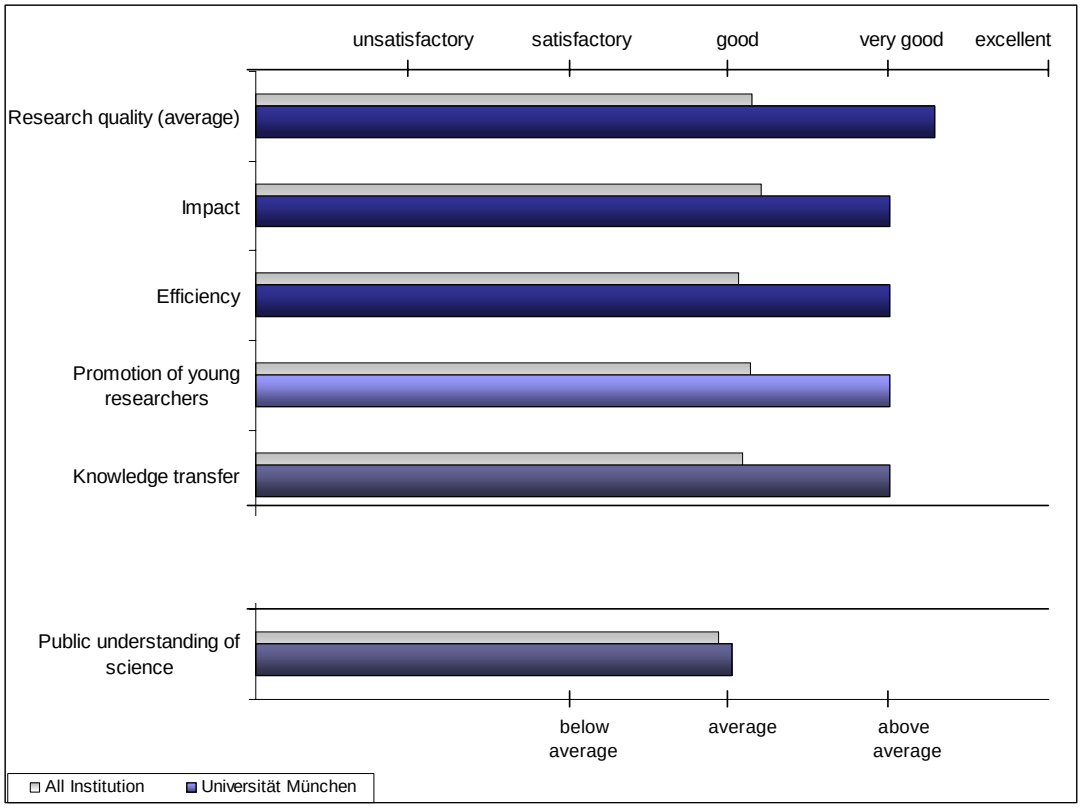
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Ludwig-Maximilian University Munich

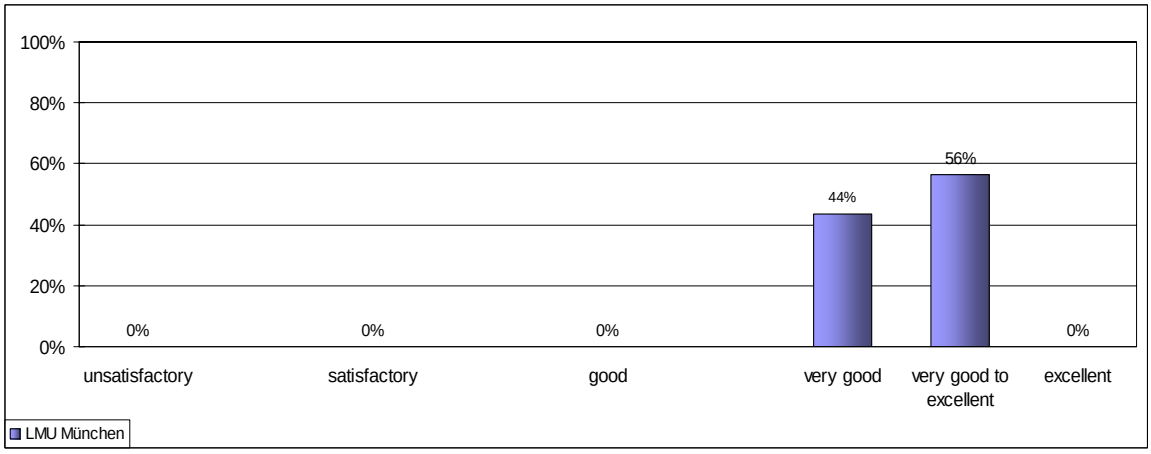
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

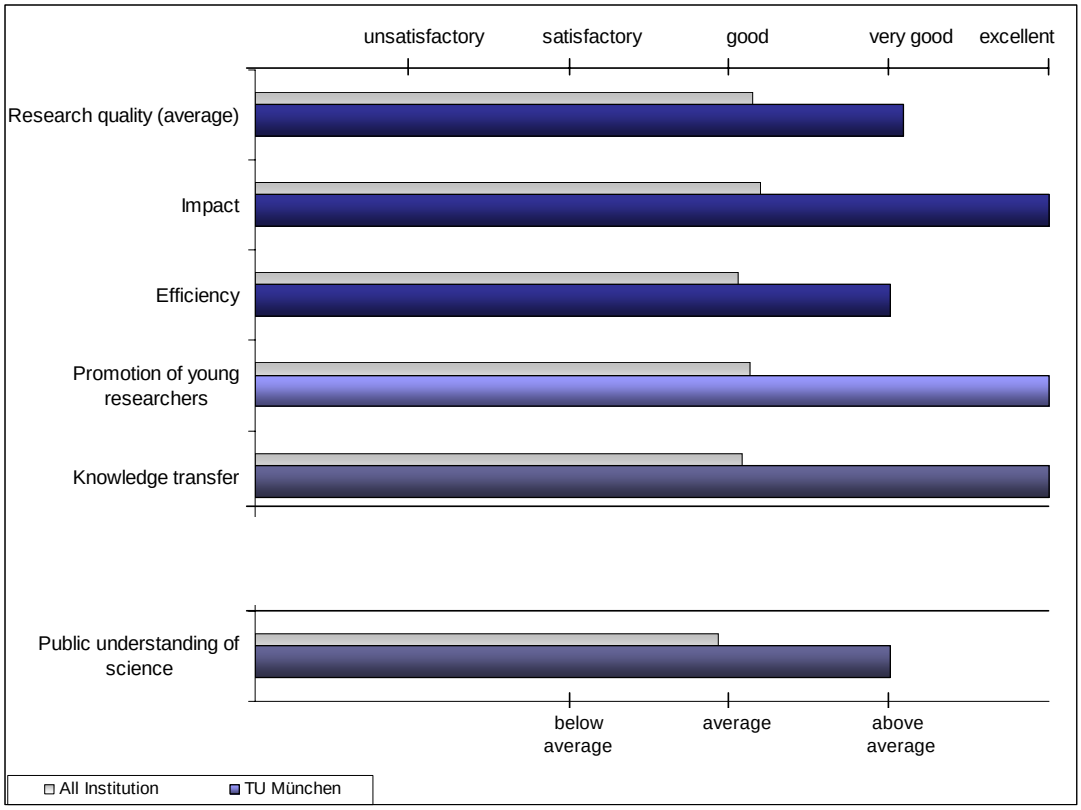
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Technical University Munich

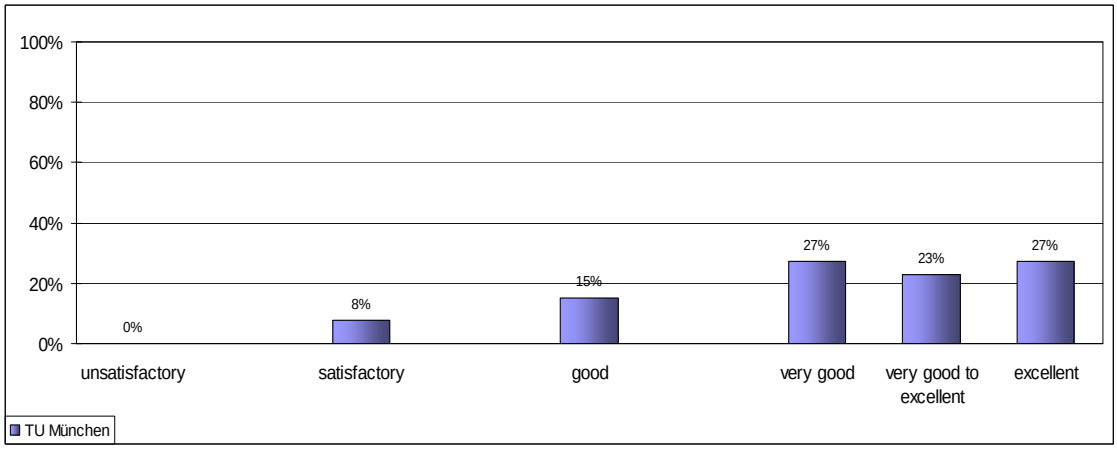
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

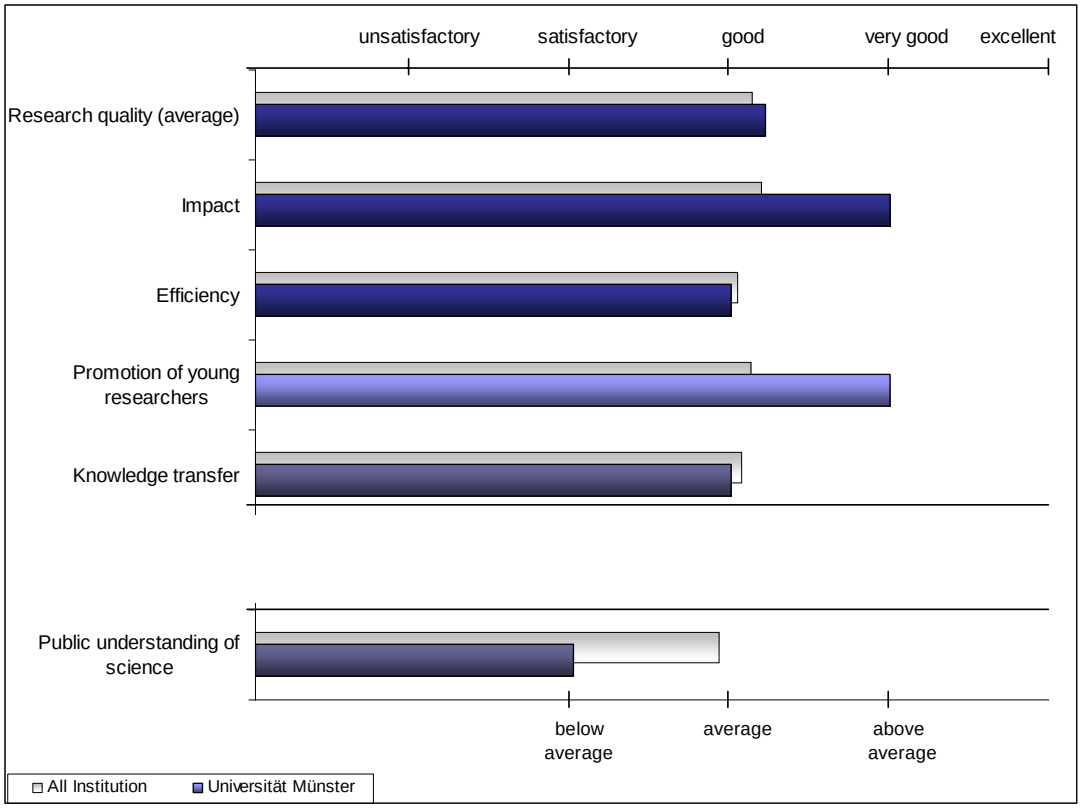
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Münster

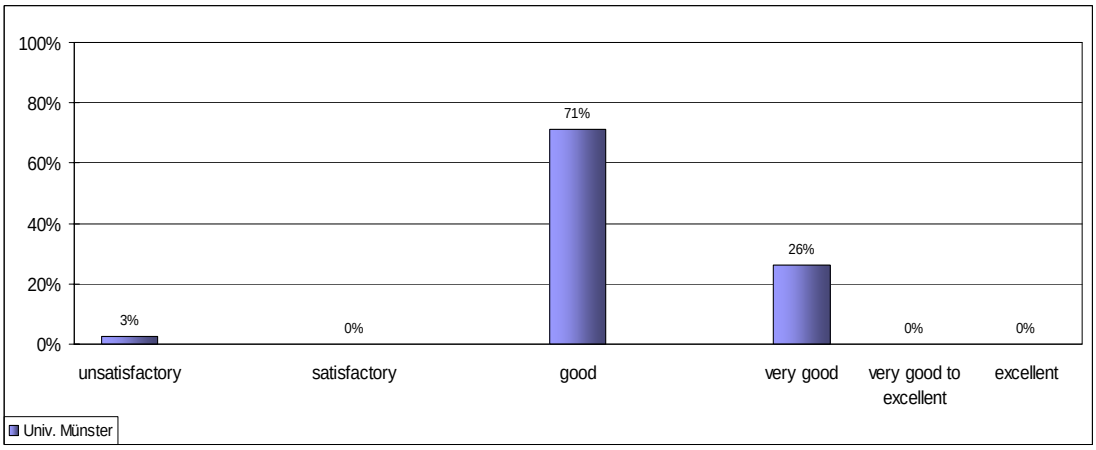
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

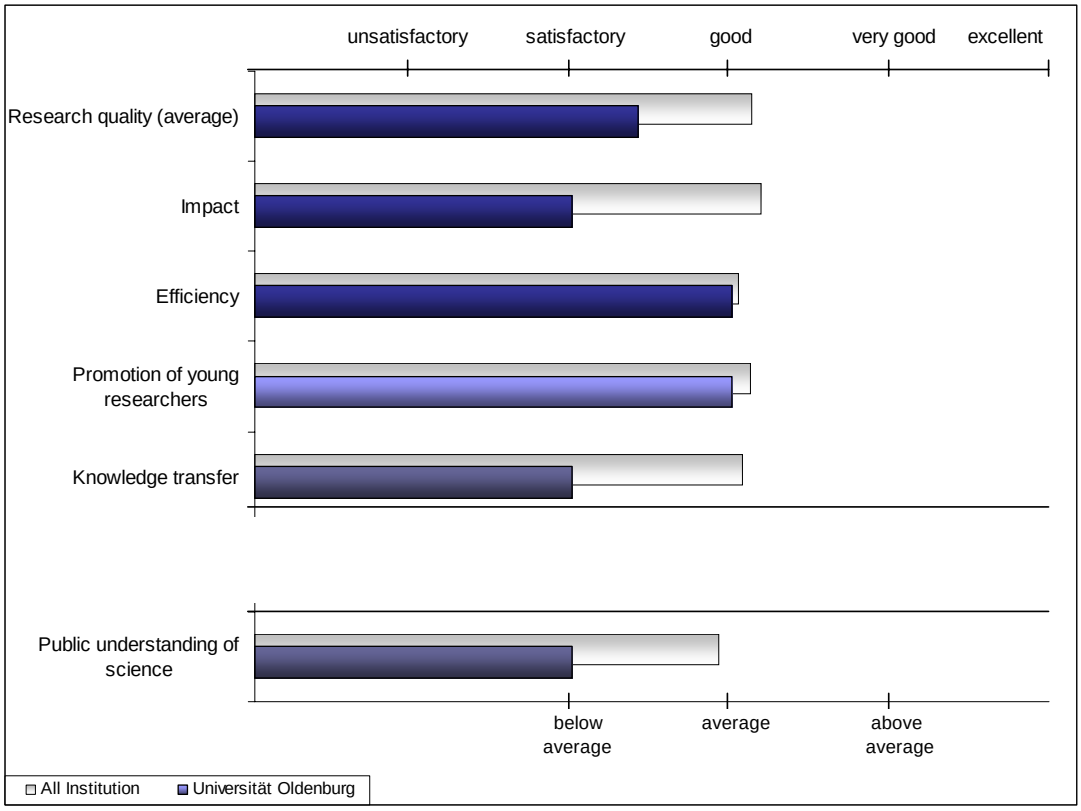
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Carl von Ossietzky University

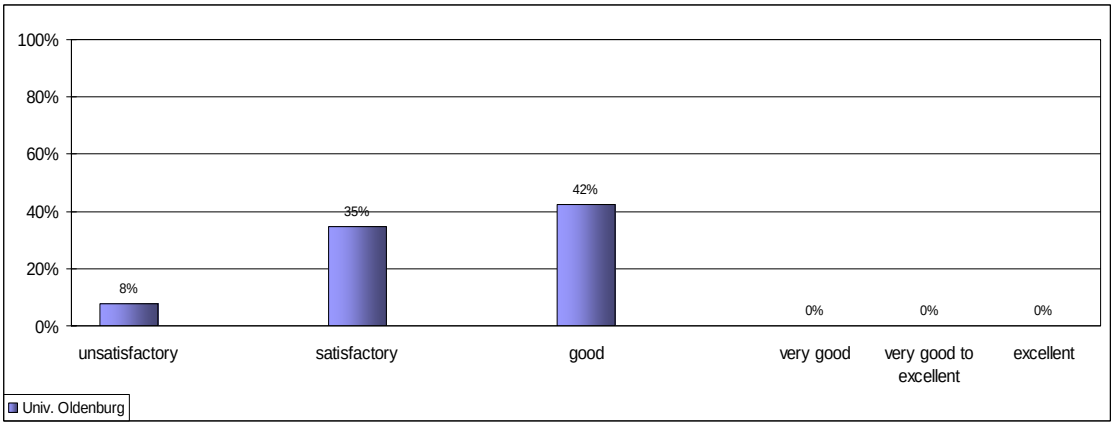
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

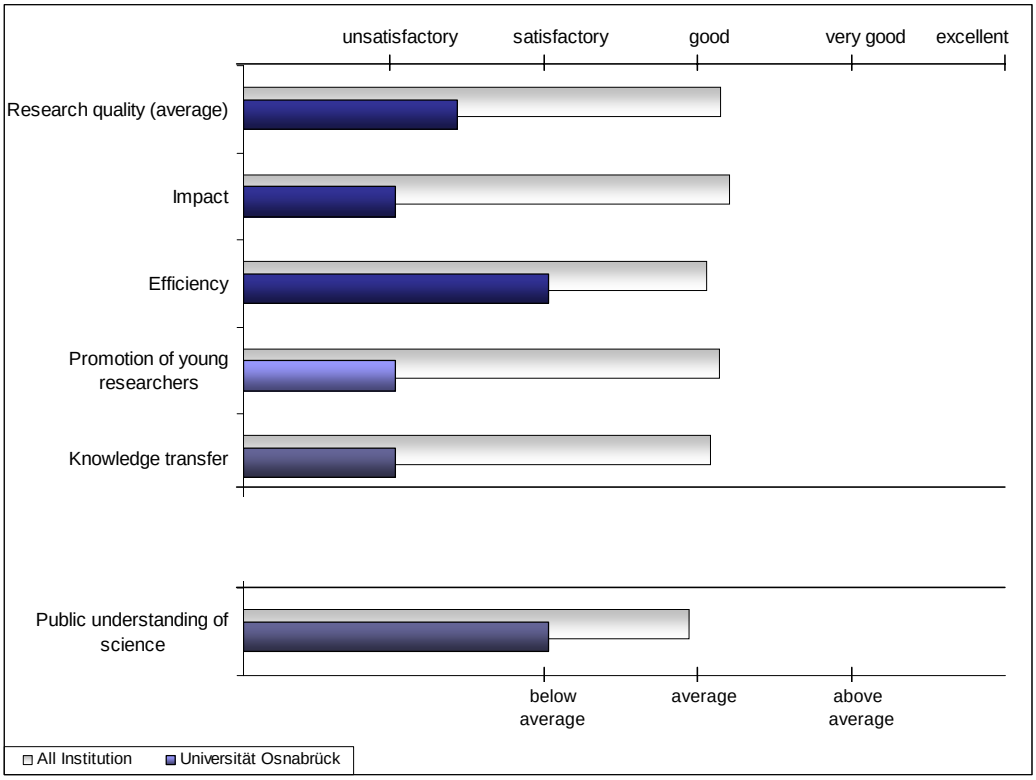
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Osnabrück

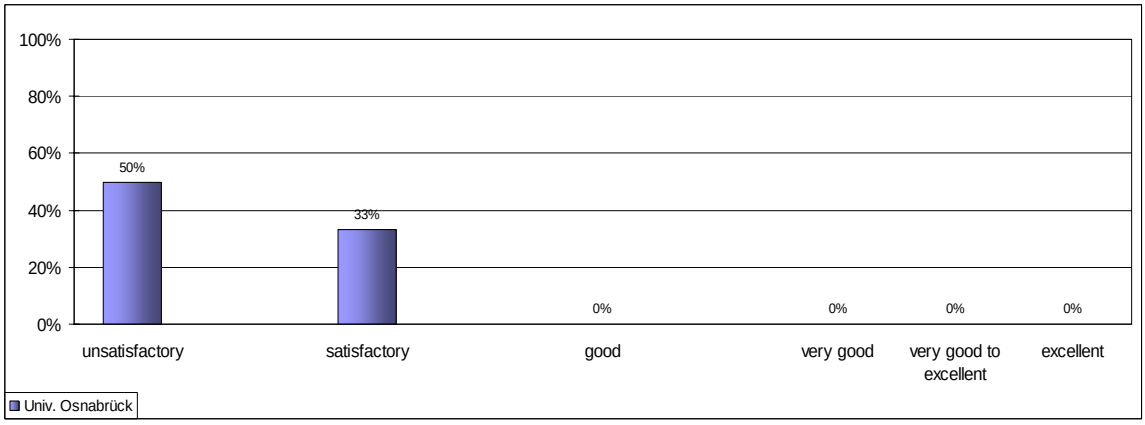
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

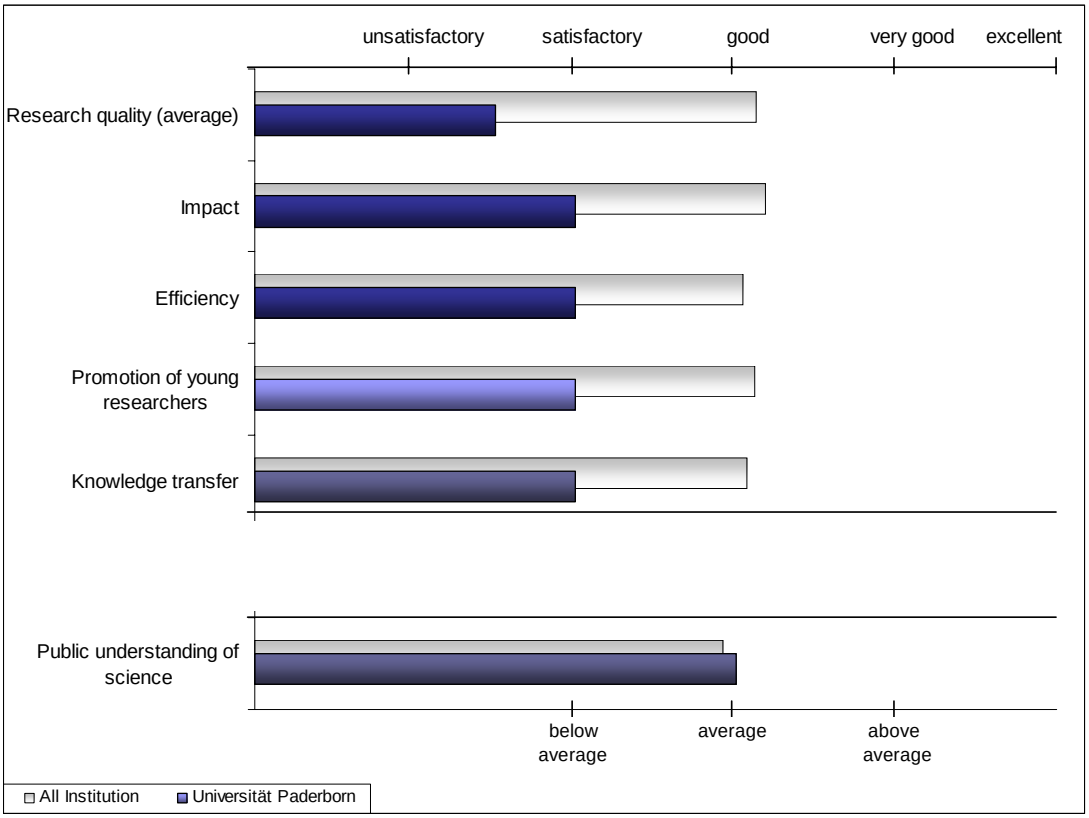


Assessment notes

Until recently, chemistry at the University of Osnabrück only contributed to teacher training. Consequently, independent research capacities could be developed yet to any significant extent. The research units defined for research rating are very detailed at this institution. This, too, affects the ratings.

University of Paderborn

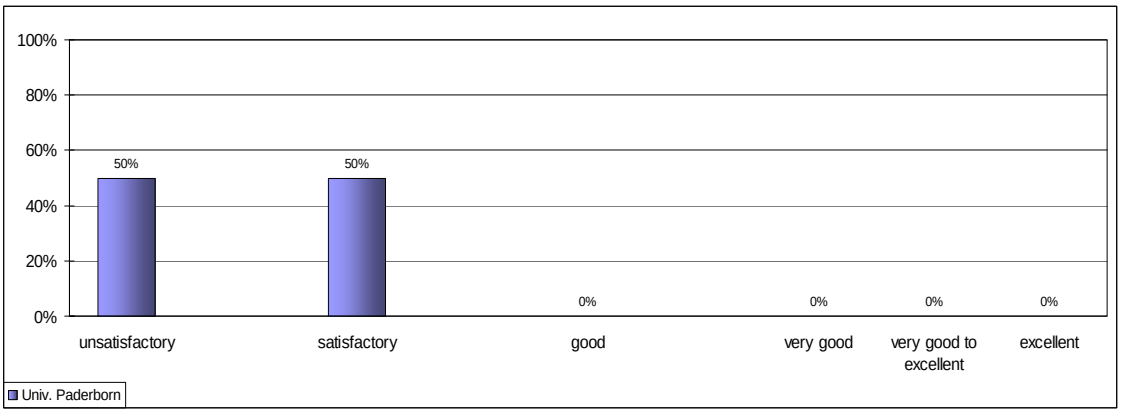
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

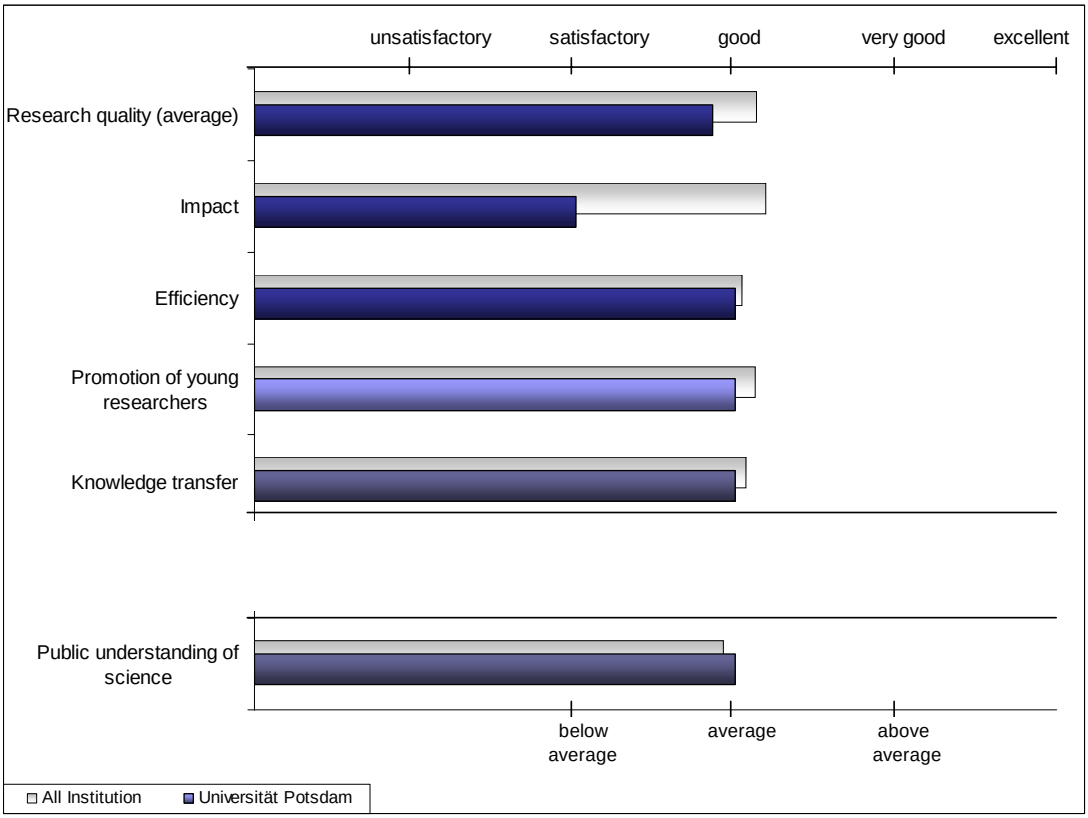
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Potsdam

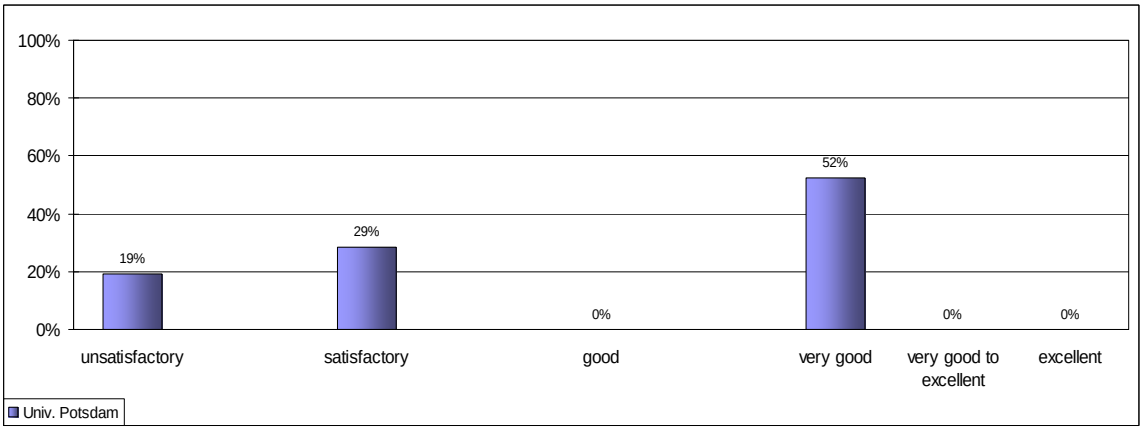
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

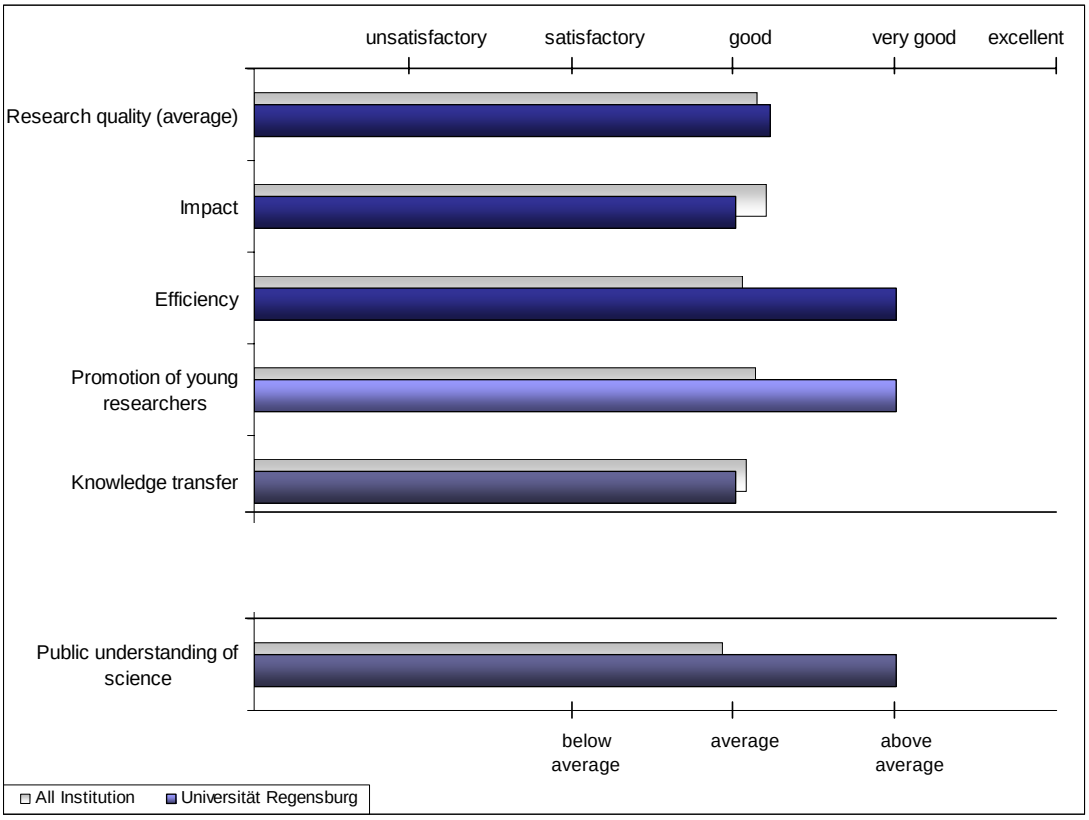
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Regensburg

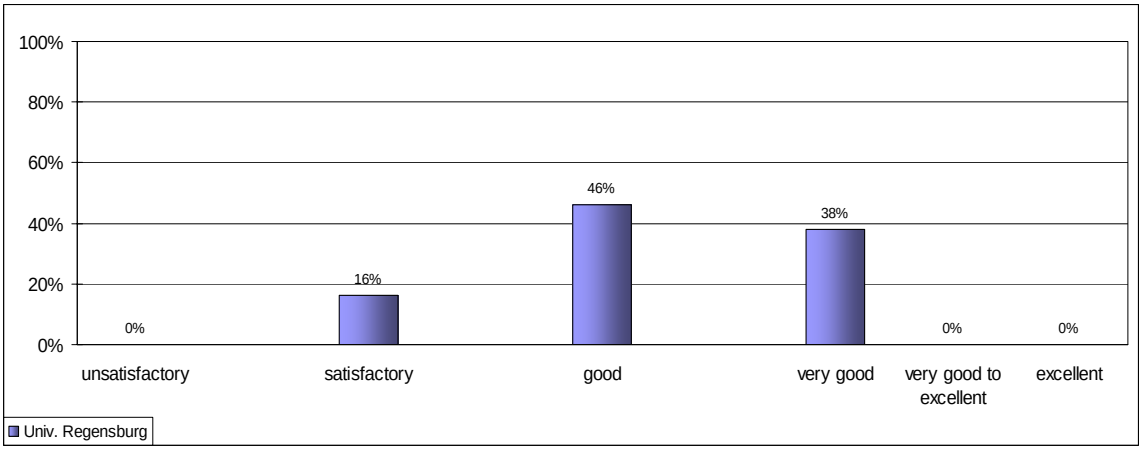
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

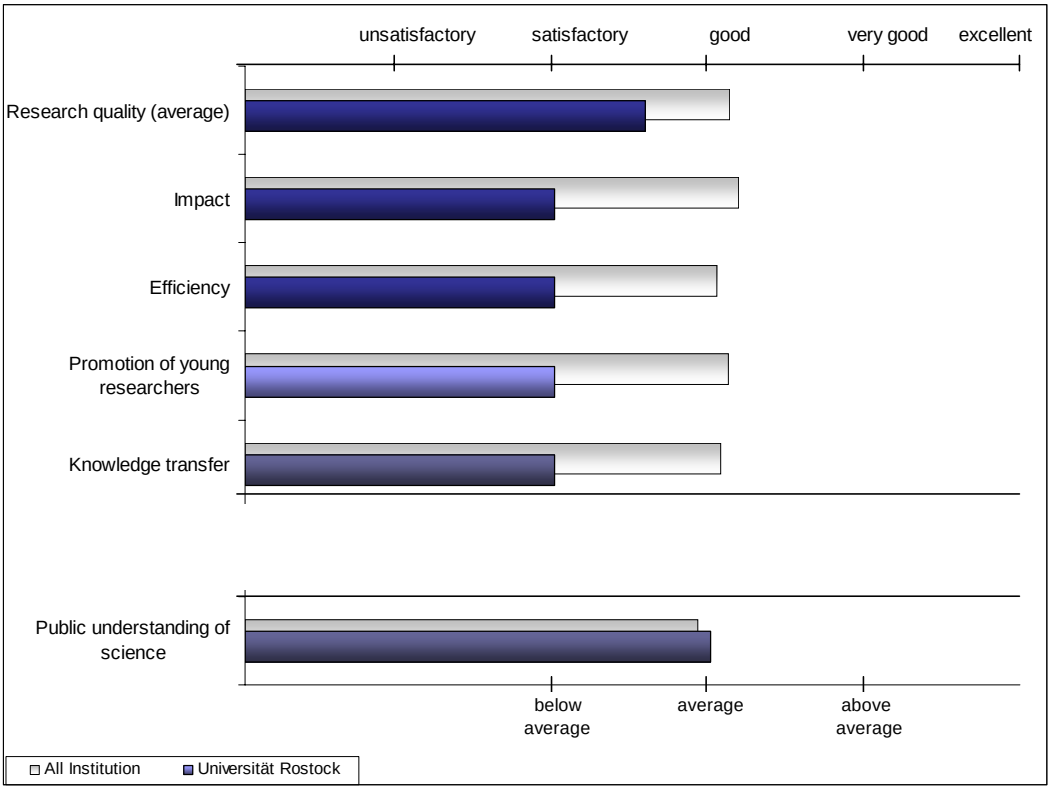
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Rostock

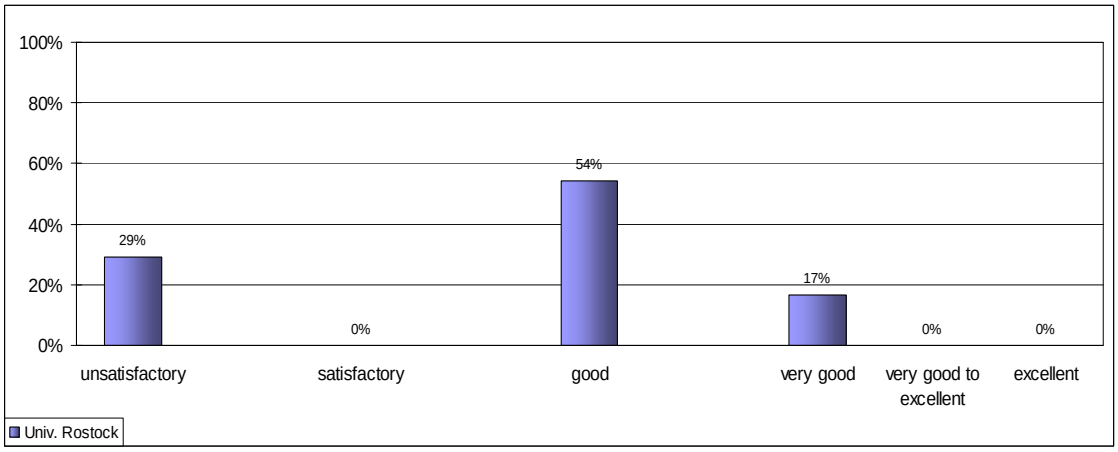
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

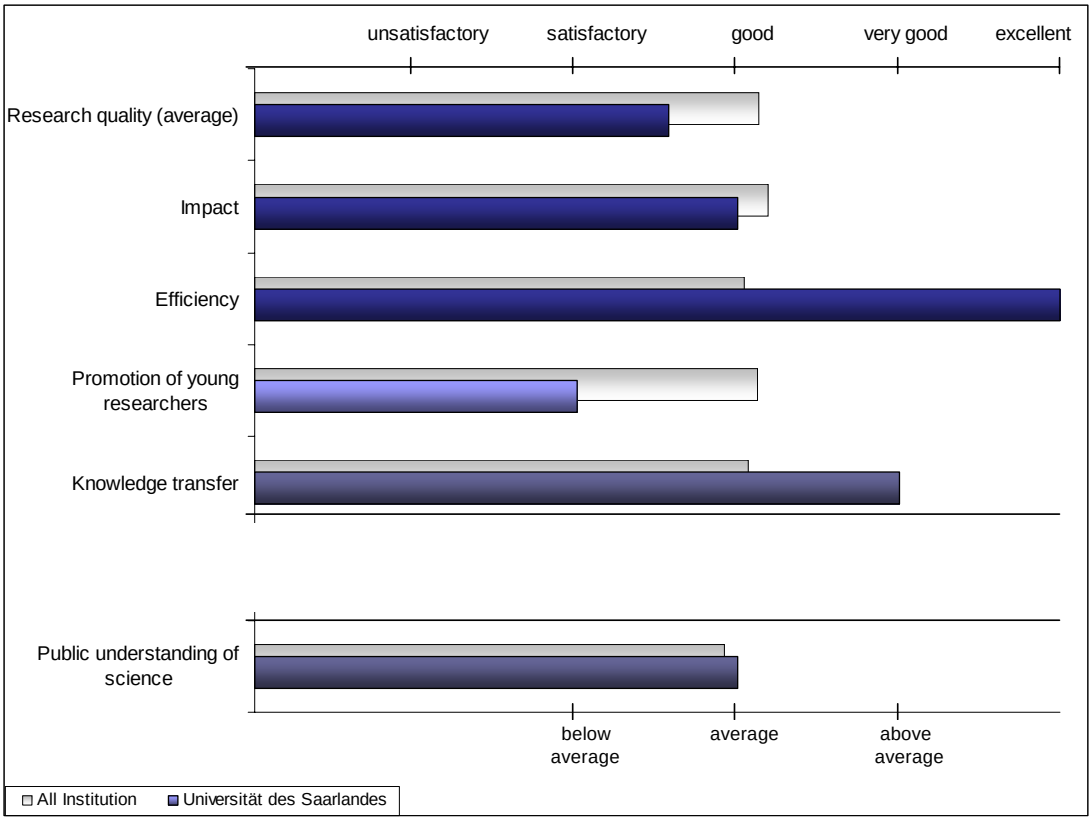


Assessment notes

The cooperation between the University of Rostock and the Leibniz-Institut für Katalyse (see under that institution) is among the strengths of this research location. Both institutions were successful in clearly identifying their individual, specific achievements, and to present them transparently in the survey questionnaire.

Saarland University

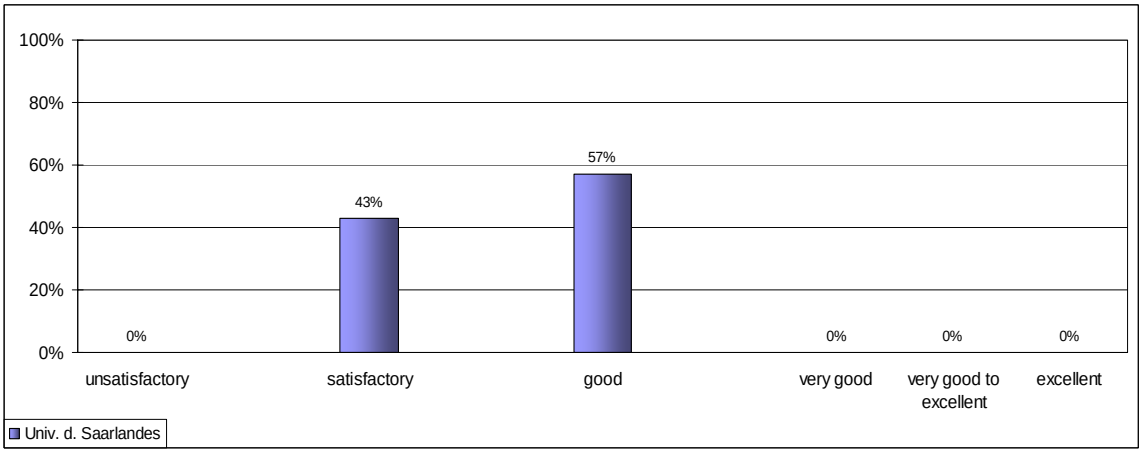
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

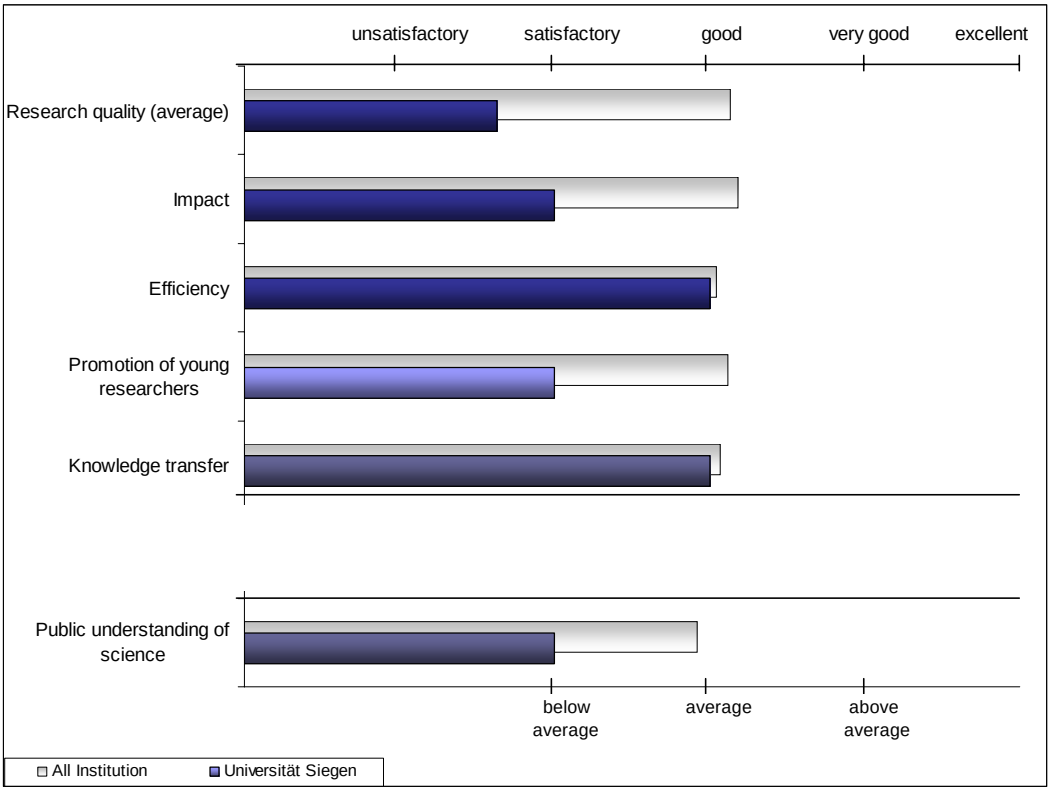


Assessment notes

Sections of the data basis for assessing Saarland University were incomplete.

University of Siegen

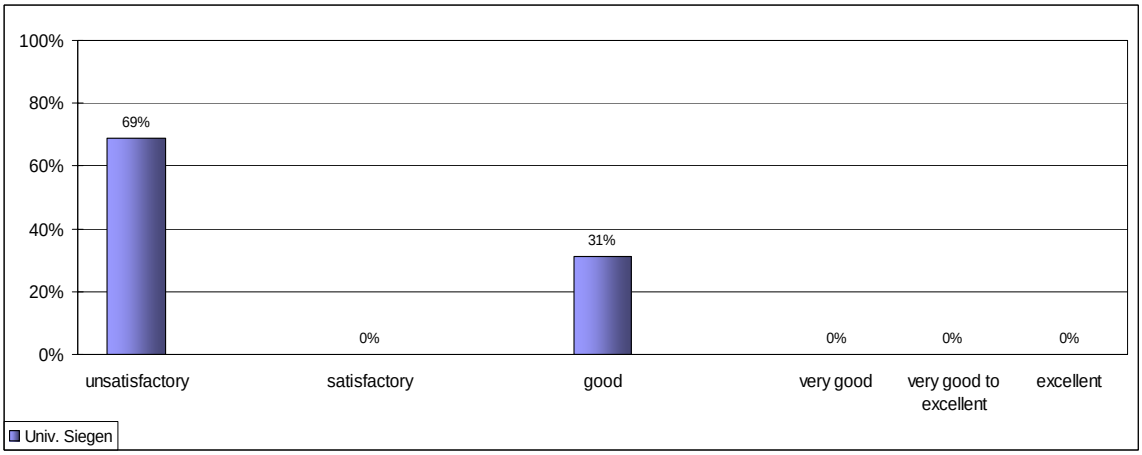
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

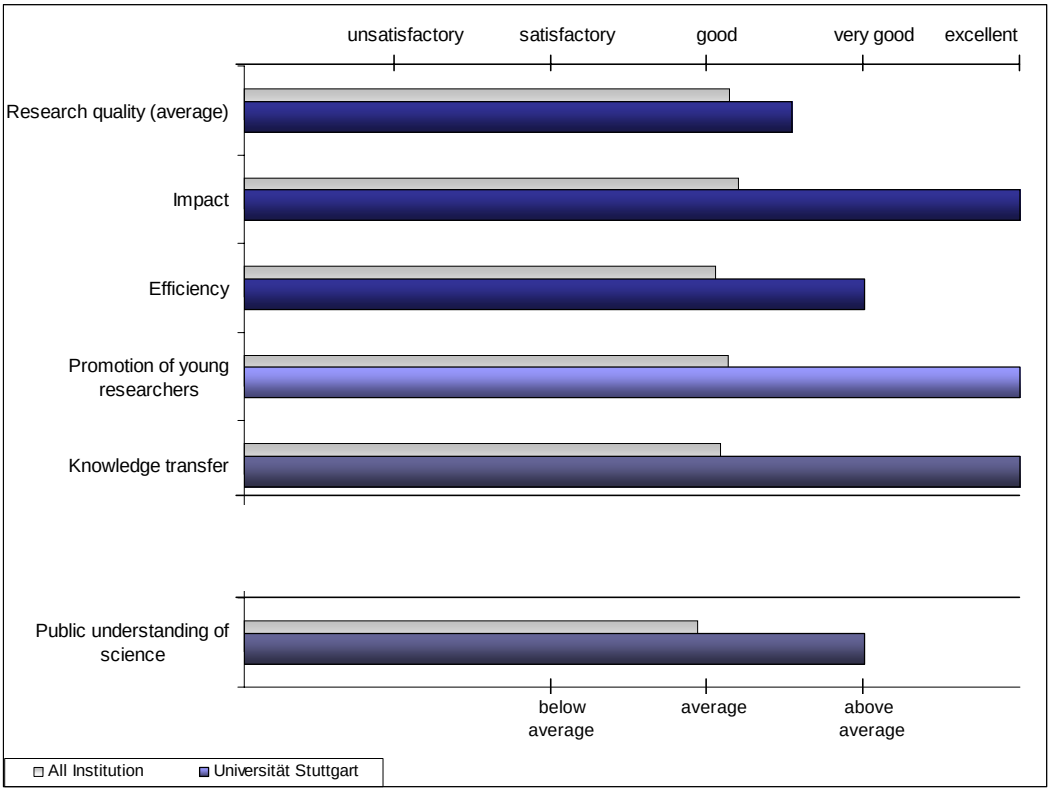


Assessment notes

The ratings for chemistry at the University of Siegen are affected by the very detailed definition and consequent undercriticality of the research units. The effectiveness of chemical research at Siegen could be improved by concentrating on two or three focus areas.

University of Stuttgart

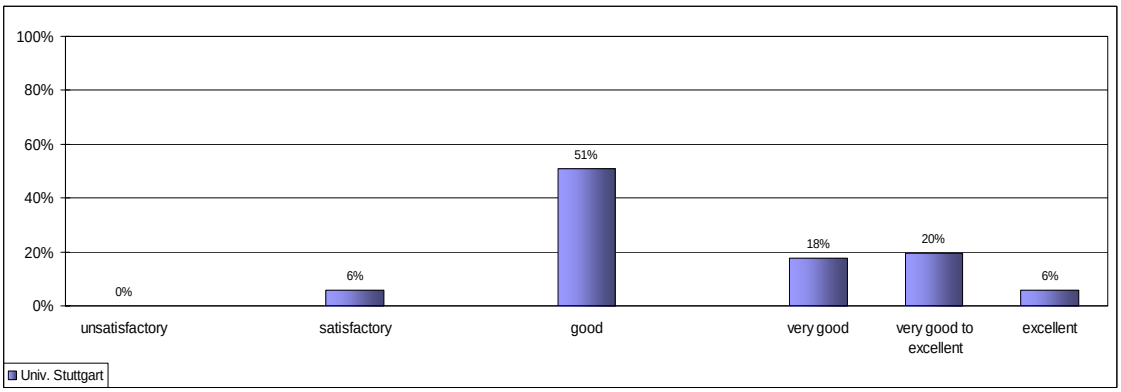
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

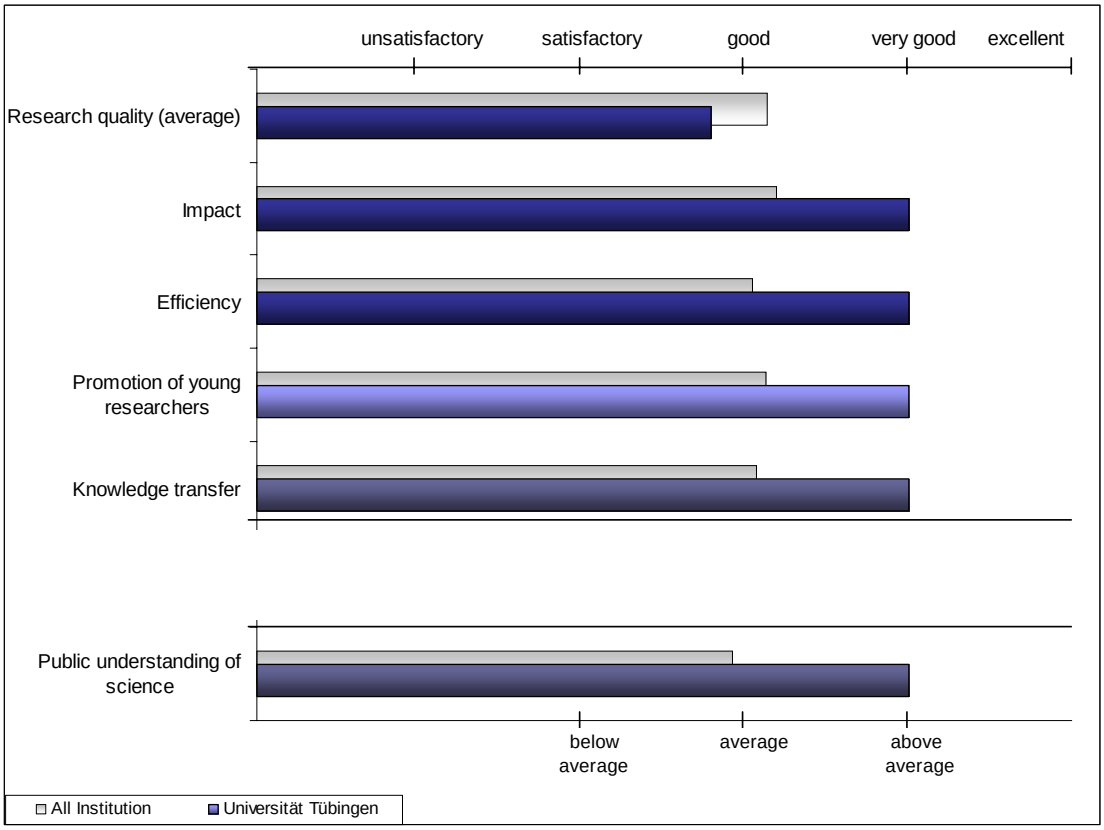


Assessment notes

Chemistry at the University of Stuttgart includes, by personal union, departments of the MPI for Metals Research. University and non-university achievements could not be fully separated.

University of Tübingen

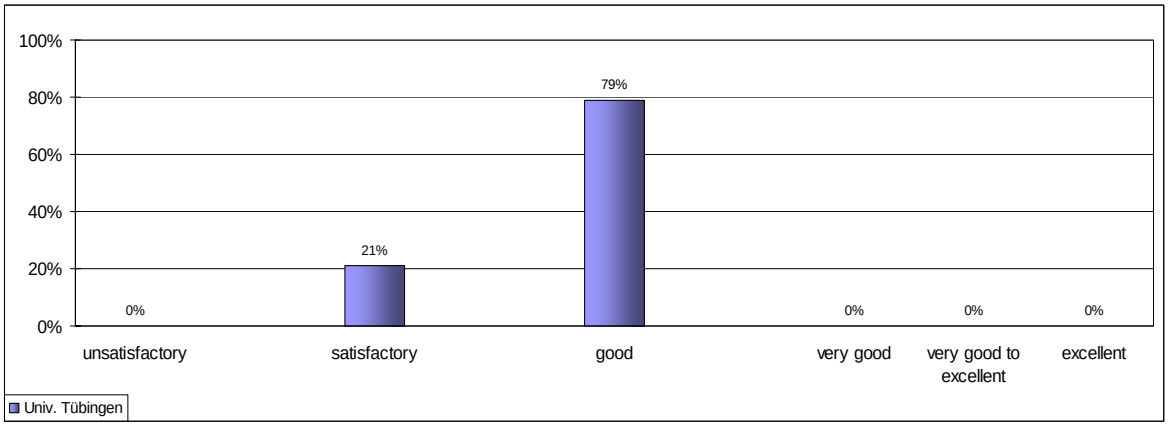
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

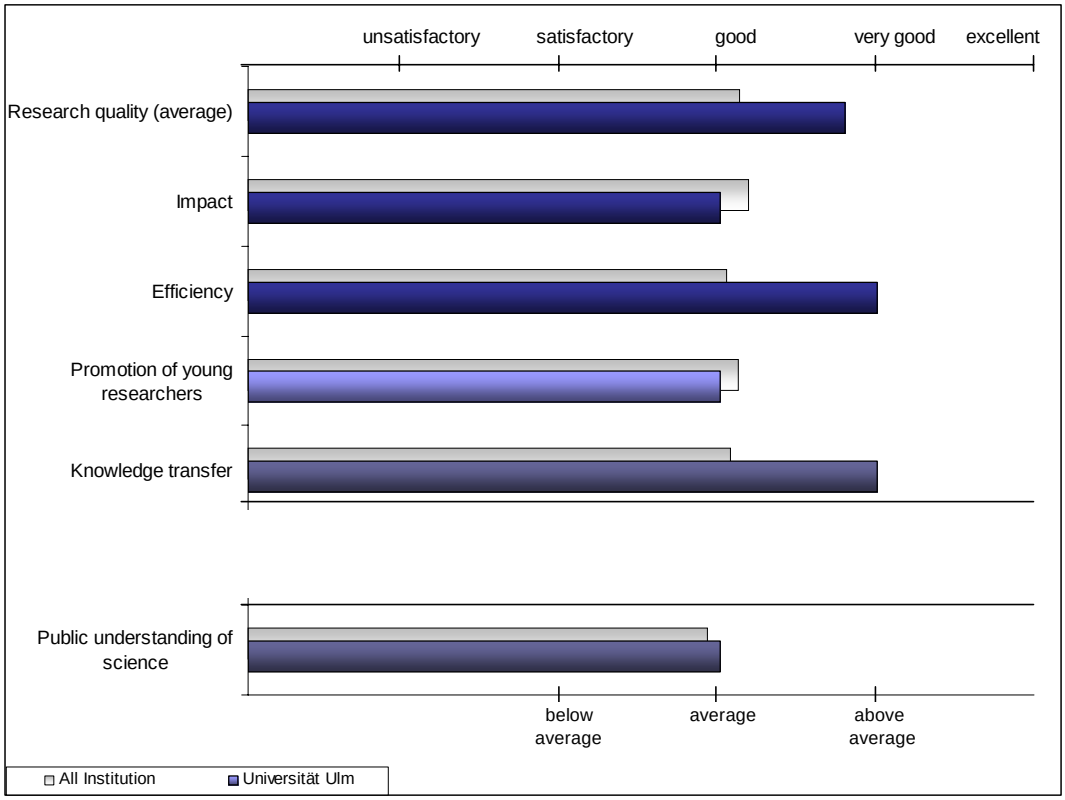
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



University of Ulm

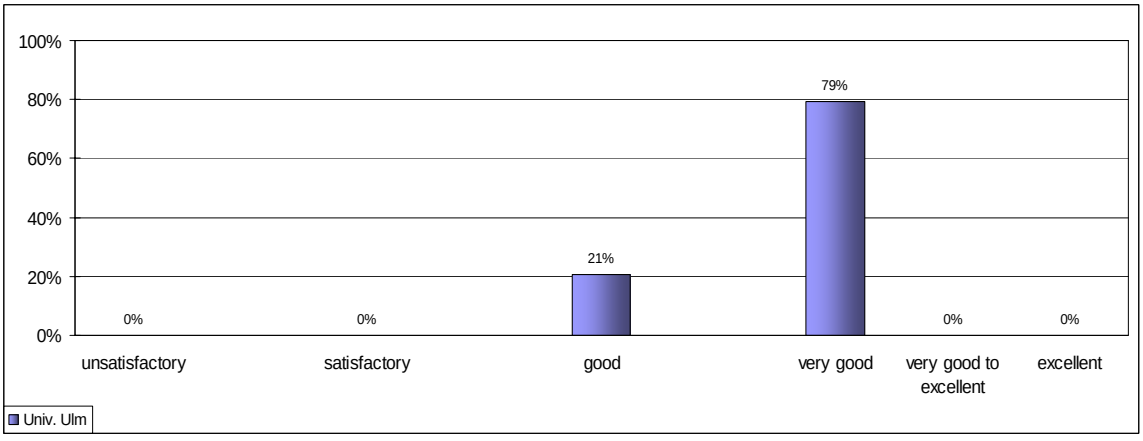
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

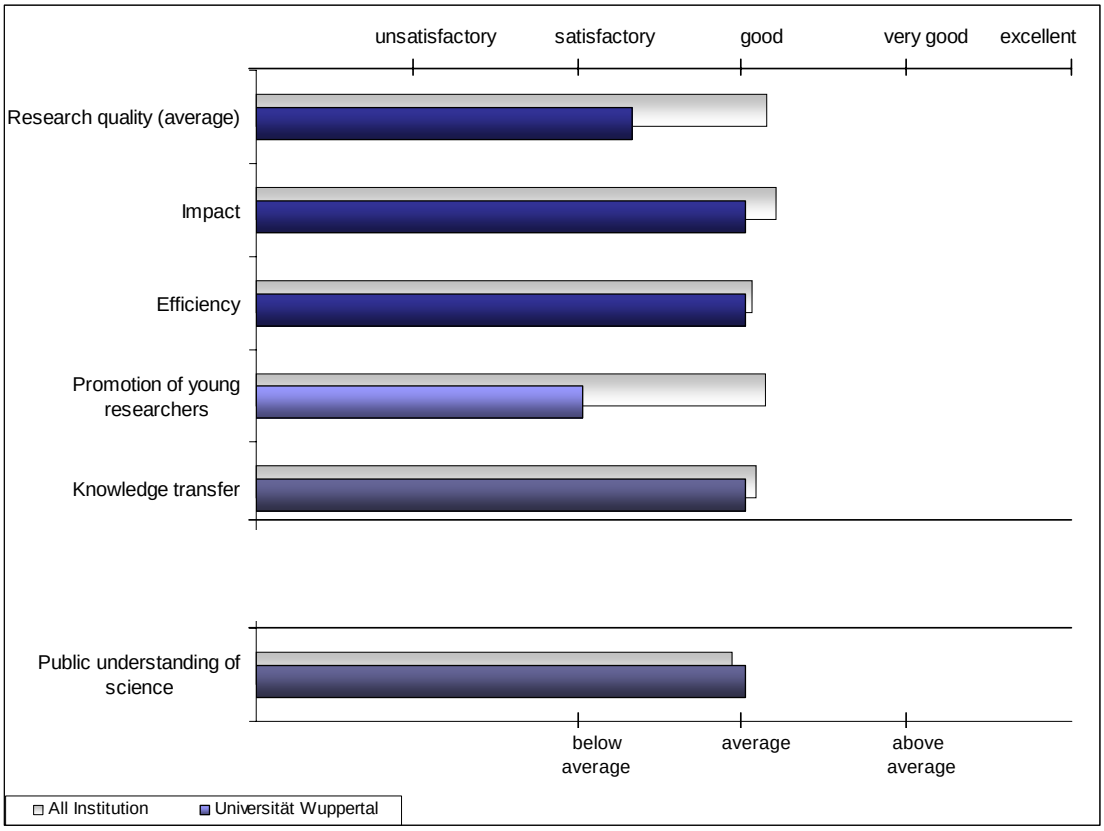


Assessment notes

Chemical research at the University of Ulm developed a focus area in materials / soft matter. This concentration is convincing and promising for the future.

University of Wuppertal

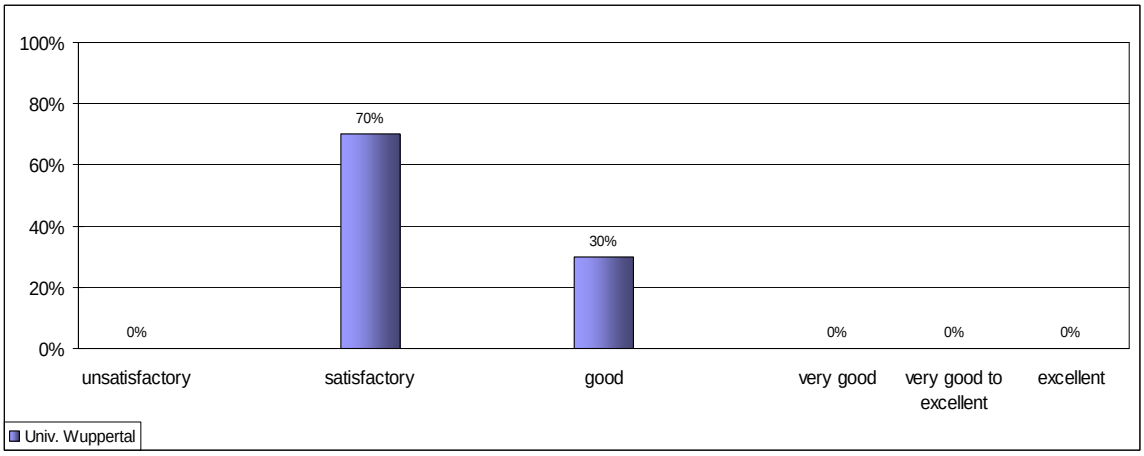
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

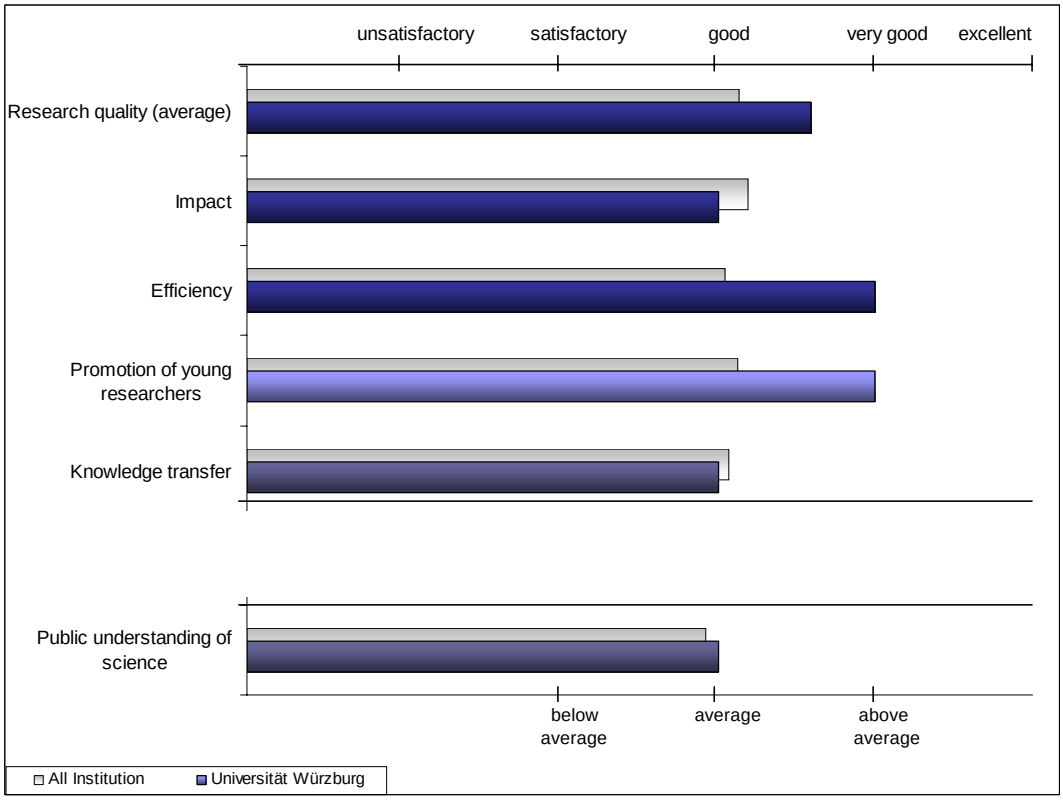
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Julius-Maximilians-University of Würzburg

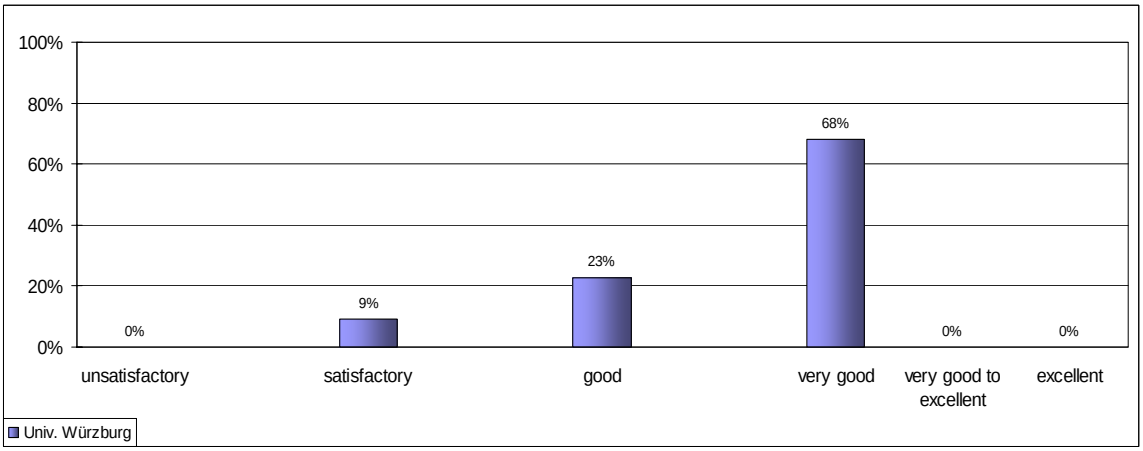
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

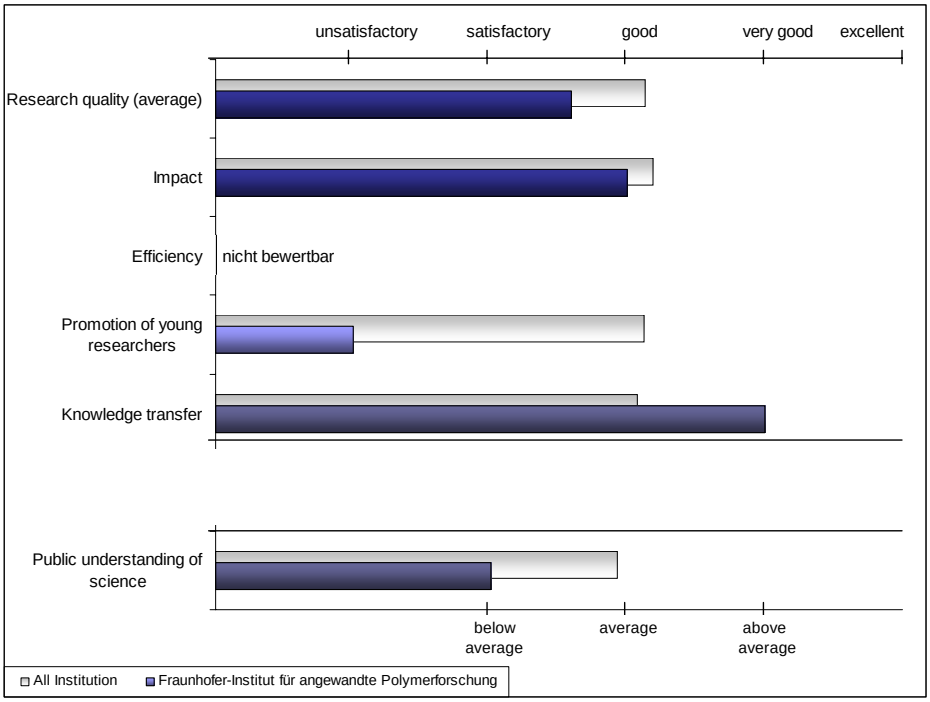


Assessment notes

One full professor at the University of Würzburg is also the director of the Fraunhofer-Institut für Silicatforschung. As the data were cleanly separated, a differentiated assessment was still possible.

Fraunhofer Institute for Applied Polymer Research

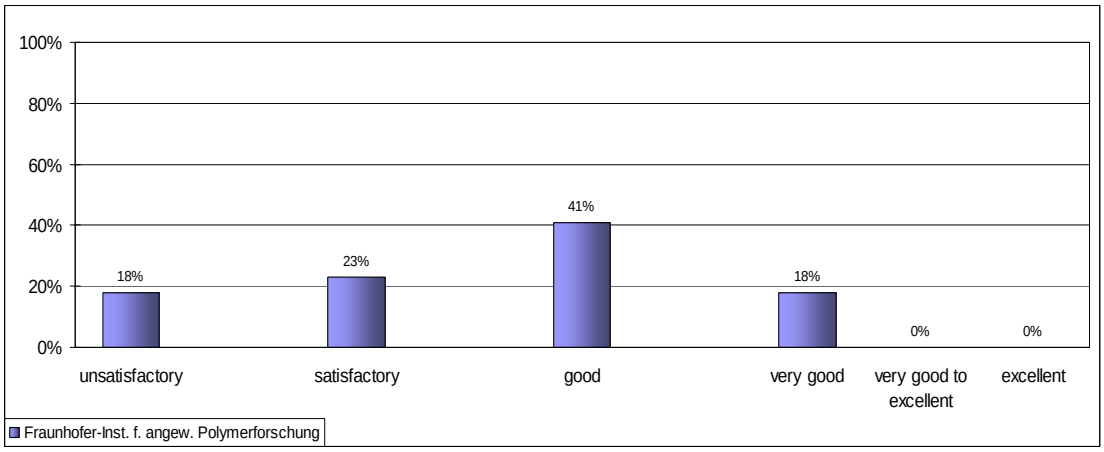
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



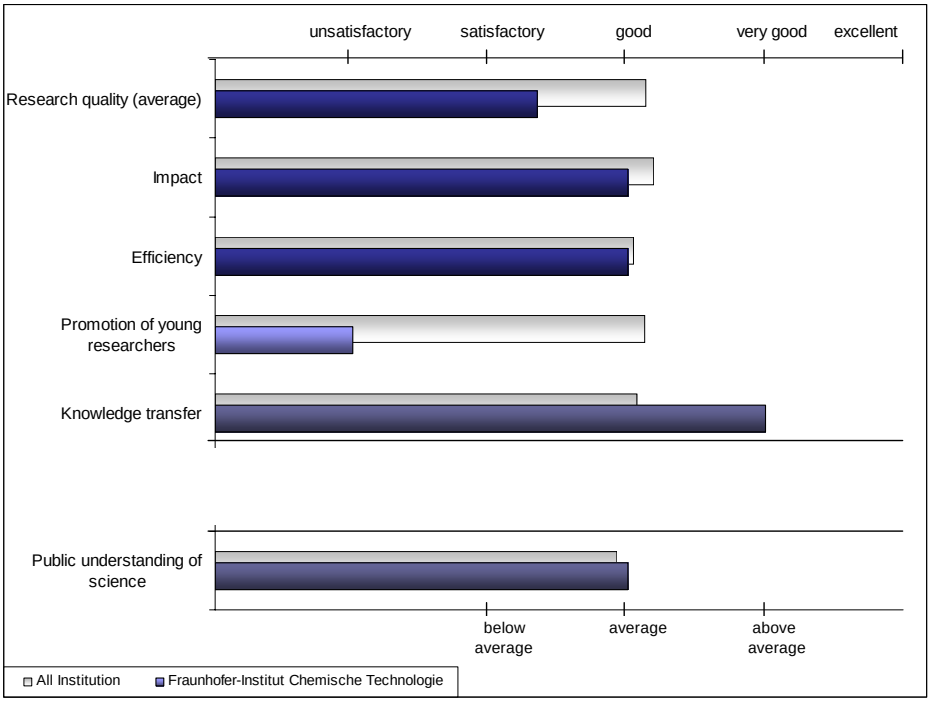
Assessment notes

The efficiency of the Fraunhofer Institute for Applied Polymer Research cannot be rated because data about mainstream-funded staff were not provided. The performance of the Fraunhofer Institutes in the promotion of young researchers is unrateable because the survey indicators mainly cover the promotion of junior academic staff. Where Fraunhofer Institutes engage in the promotion of young academics, these are registered at the neighboring universities.

Although the head of one department of the Fraunhofer Institute for Applied Polymer Research was recruited by shared appointment with the Potsdam University, there is a clear separation of functions, which is transparent in the data, too.

Fraunhofer Institute for Chemical Technology

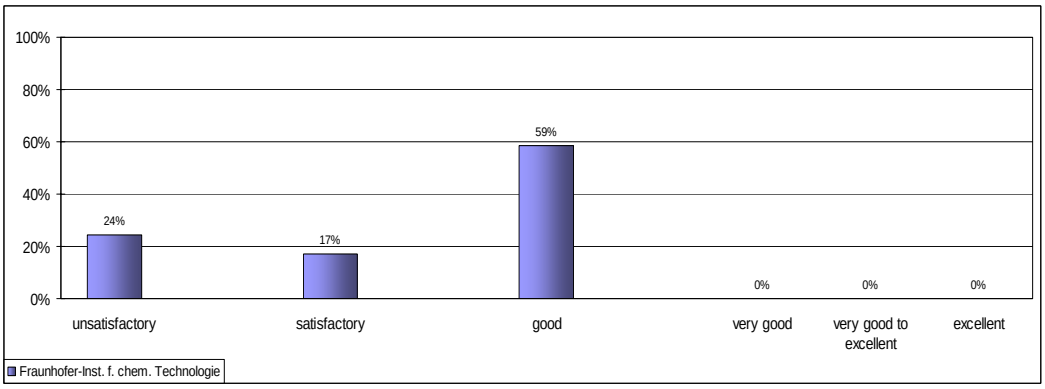
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline. [ ]

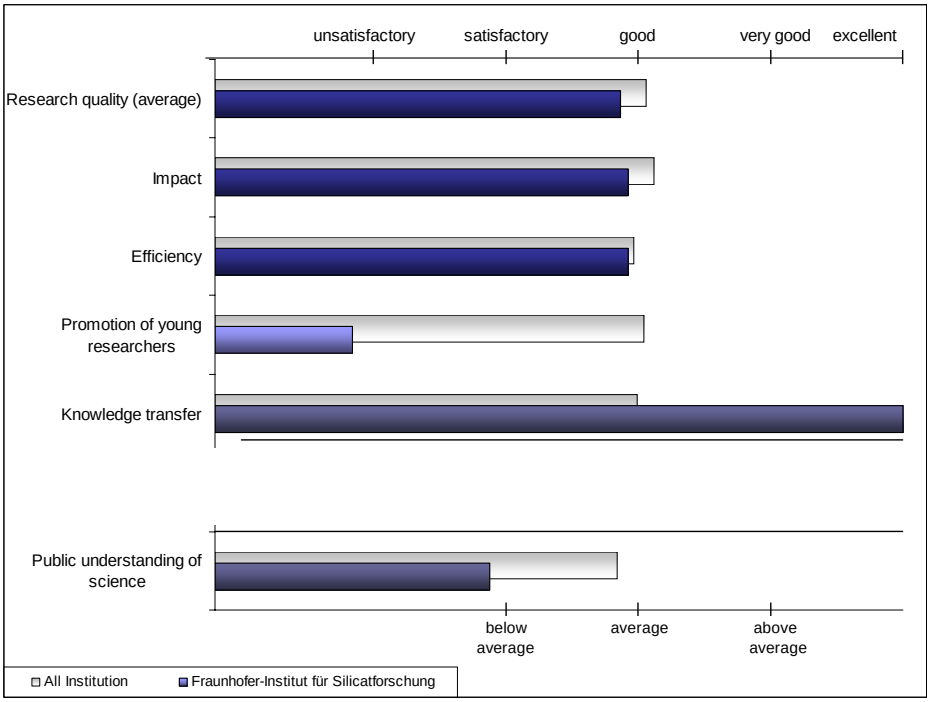


Assessment notes

The performance of the Fraunhofer Institutes in the promotion of young researchers is unrateable because the survey indicators mainly cover the promotion of junior academic staff. Where Fraunhofer Institutes engage in the promotion of young academics, these are registered at neighboring universities.

Fraunhofer Institute for Silicate Research

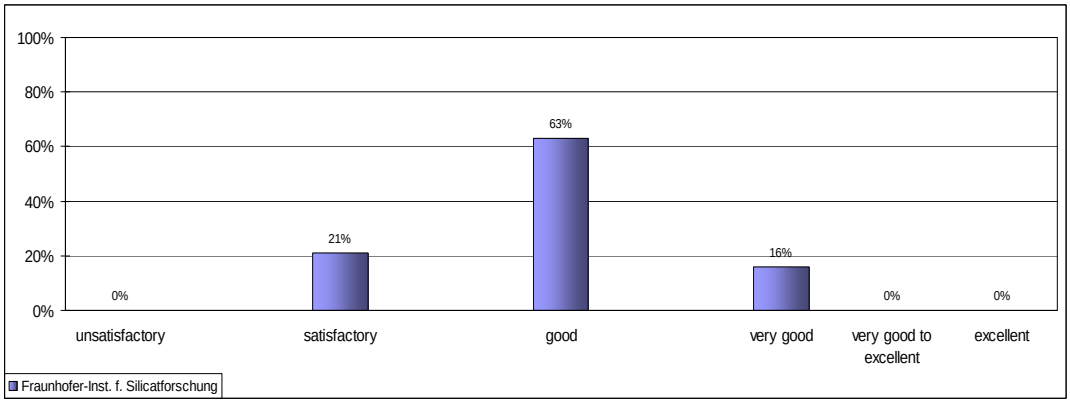
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



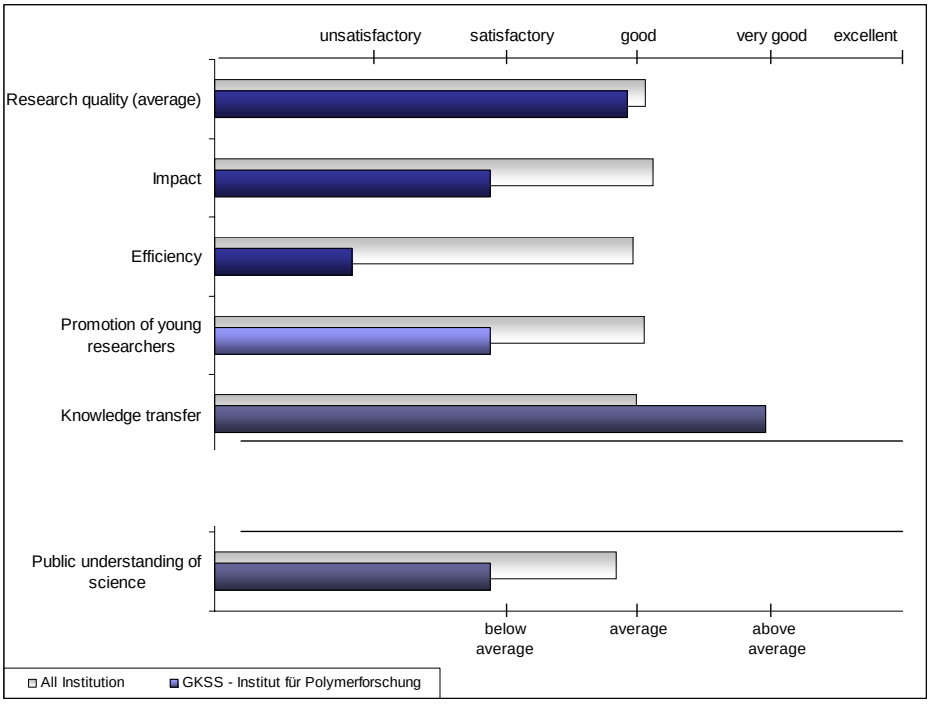
Assessment notes

The director of the Fraunhofer Institute for Silicate Research also holds a professorial chair at the University of Würzburg. Still, the clean separation of the data ensured that individual assessments could be carried out.

The performance of the Fraunhofer Institutes in the promotion of young researchers is unrateable because the survey indicators mainly cover the promotion of junior academic staff. Where Fraunhofer Institutes engage in the promotion of young academics, these are registered at neighboring universities.

GKSS-Research Center

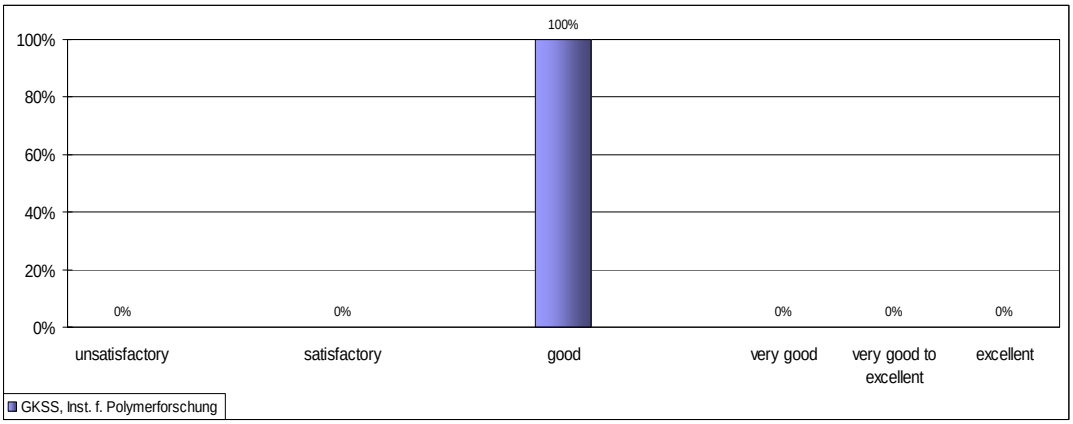
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

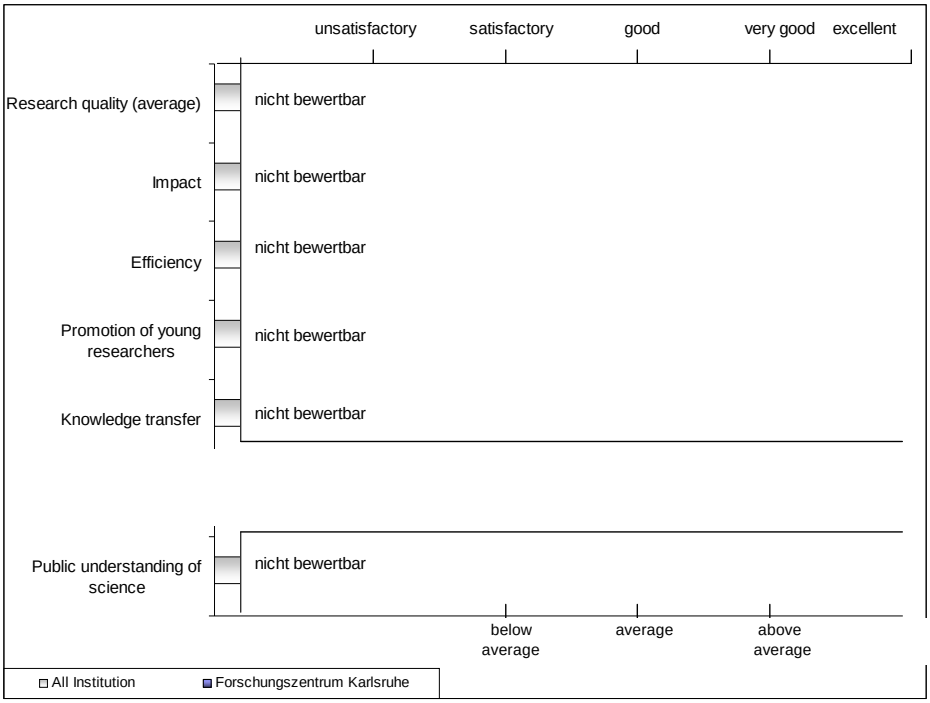


Assessment notes

The decision of the Institute of Polymer Research of the GKSS Research Centre to register the research undertaken at two locations as one large research unit made it impossible to give a differentiated assessment. The Institute was restructured during the survey period. Following the recent, new appointments, the tendency can be regarded as positive.

Forschungszentrum Karlsruhe

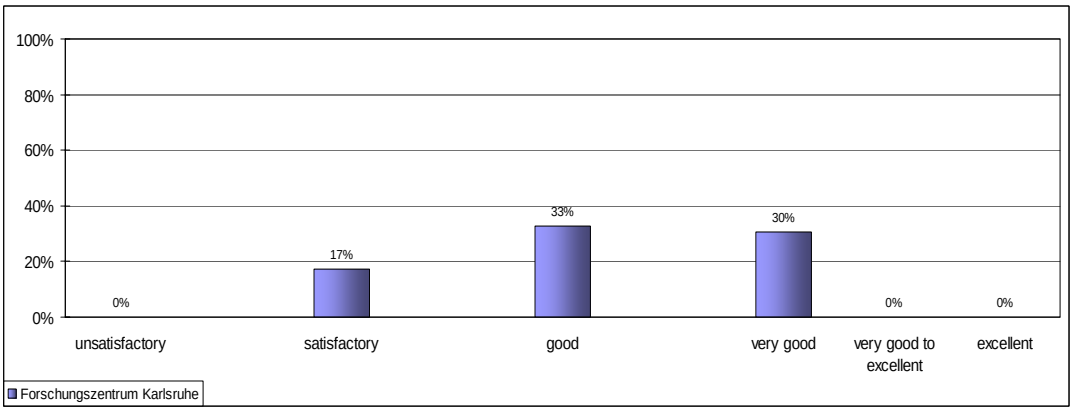
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

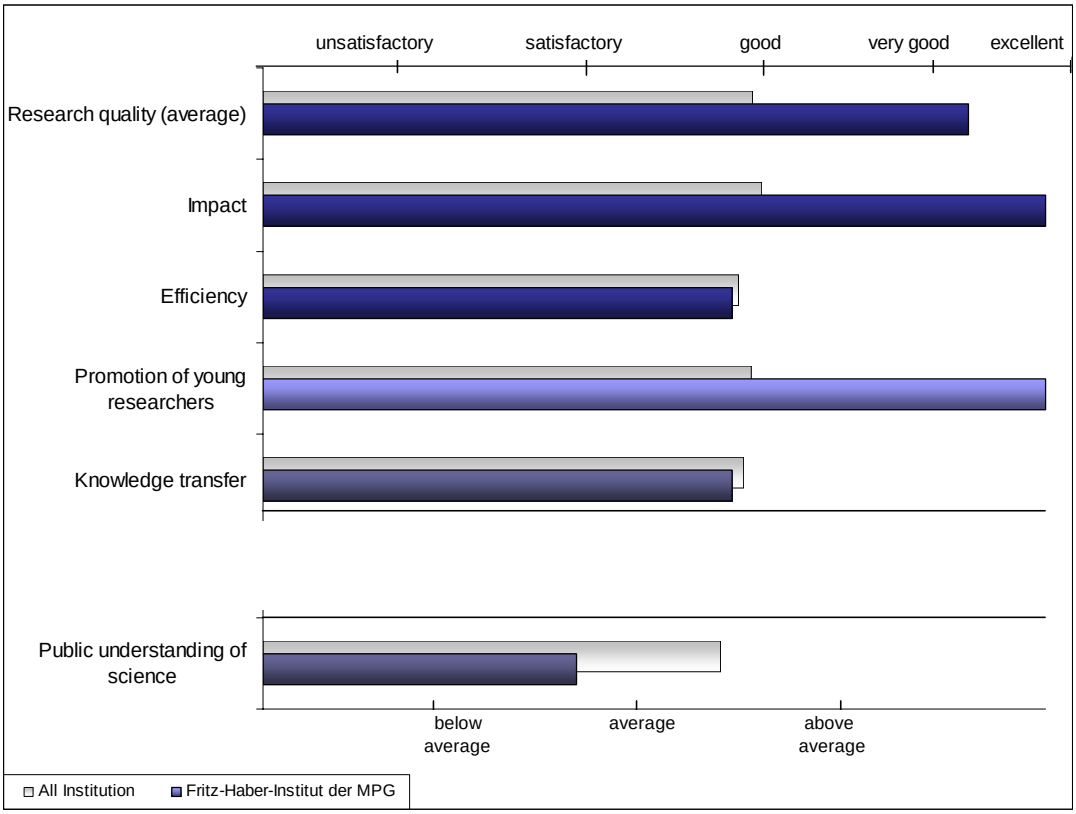


Assessment notes

The data for inorganic chemistry, physical chemistry and theoretical chemistry cannot be clearly separated from the respective data for Karlsruhe University, with which the Forschungszentrum shares the responsibility for appointing the heads of the respective research units. This situation makes it impossible to arrive at an adequate, overall assessment of chemical research at Forschungszentrum Karlsruhe.

Fritz-Haber-Institute of the Max-Planck Society

I. Rating of the institution according to single criteria



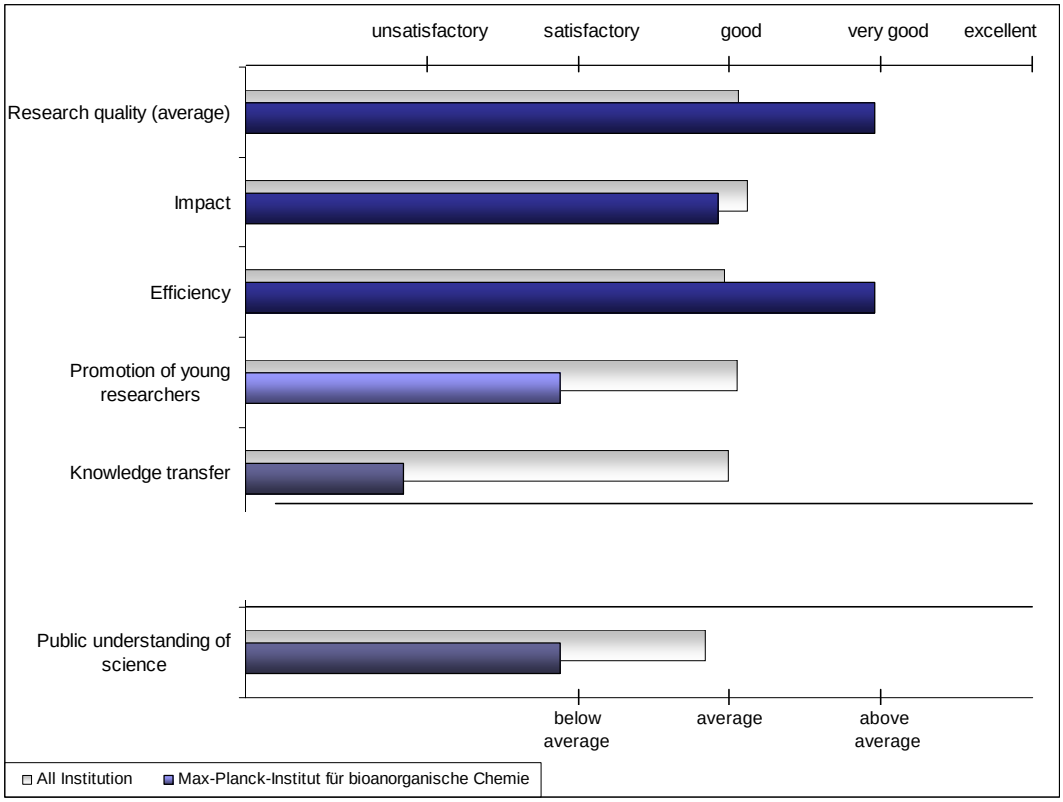
Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

Max Planck Institute for Bioinorganic Chemistry

I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

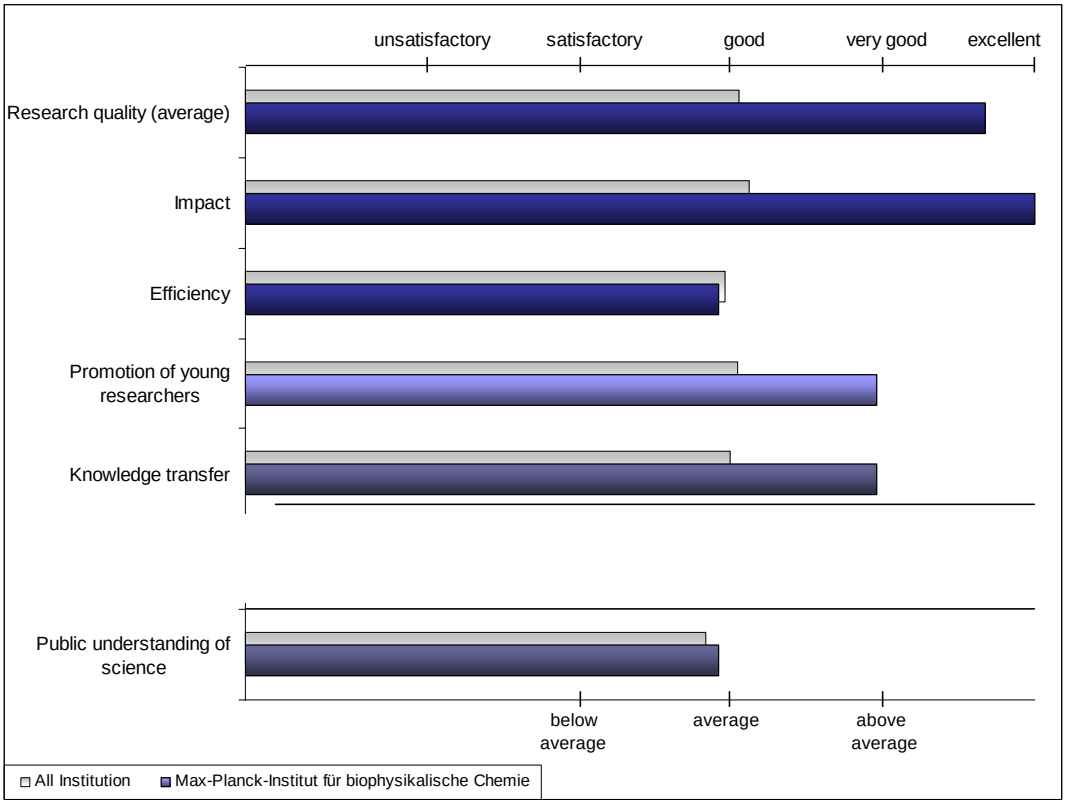
Distribution by percentage, weighted by the number of senior scientists on survey deadline.

Assessment notes

The decision of the MPI for Bioinorganic Chemistry, to register two independent organizational units as one research unit, made it impossible to give a differentiated assessment.

Max Planck Institute for Biophysical Chemistry

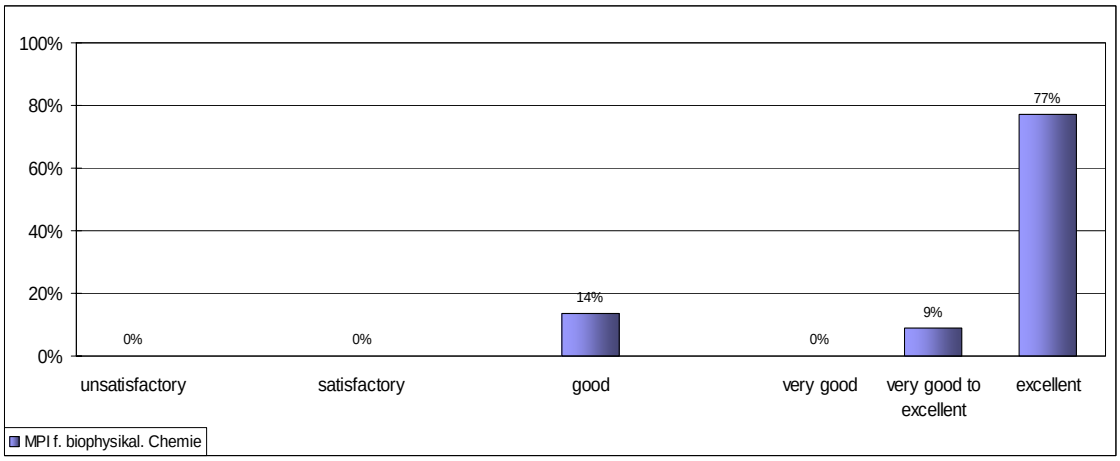
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

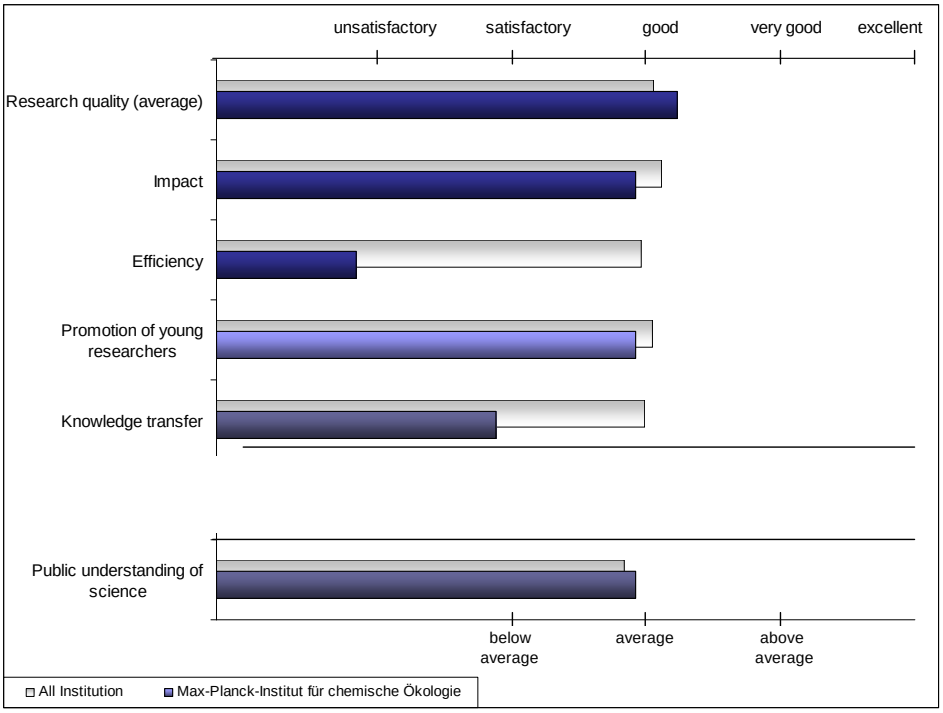
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Max Planck Institute for Chemical Ecology

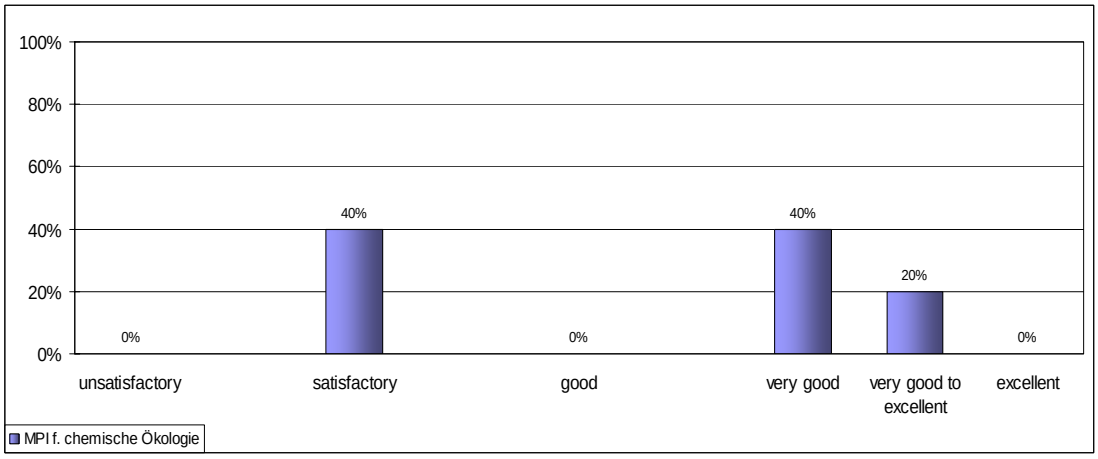
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

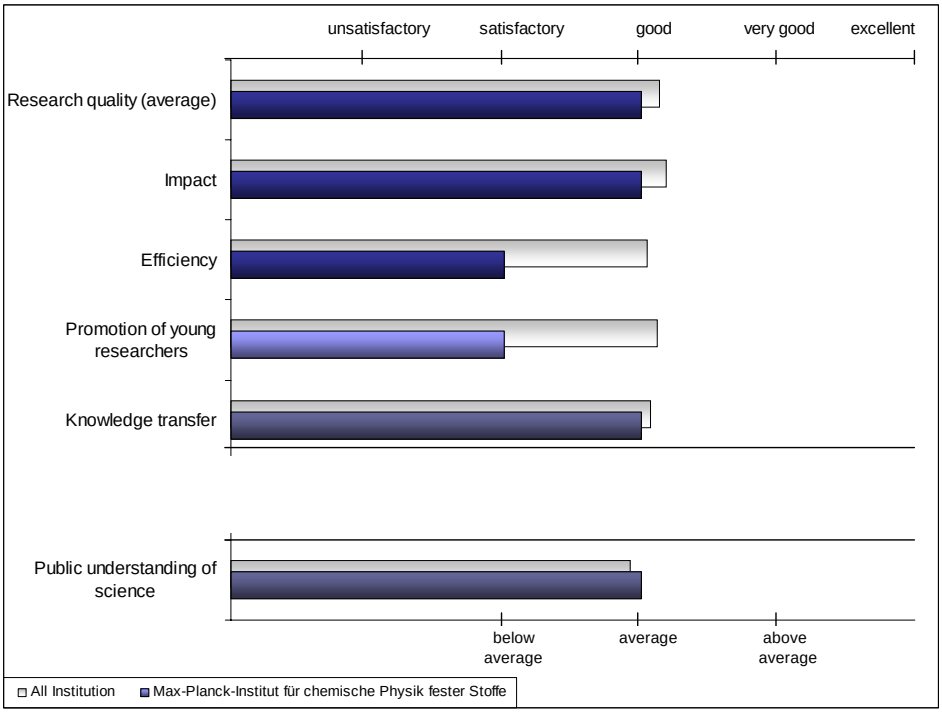


Assessment notes

Since one of the research units registered by the MPI for Chemical Ecology is a service department whose chemistry services, to an unallocatable proportion, also benefit other disciplines, the efficiency of this institute had to be classified as unrateable. The rating of this research unit enters the calculation of the research quality rating of the entire institution only at 40%.

Max-Planck-Institute for Chemical Physics of Solids

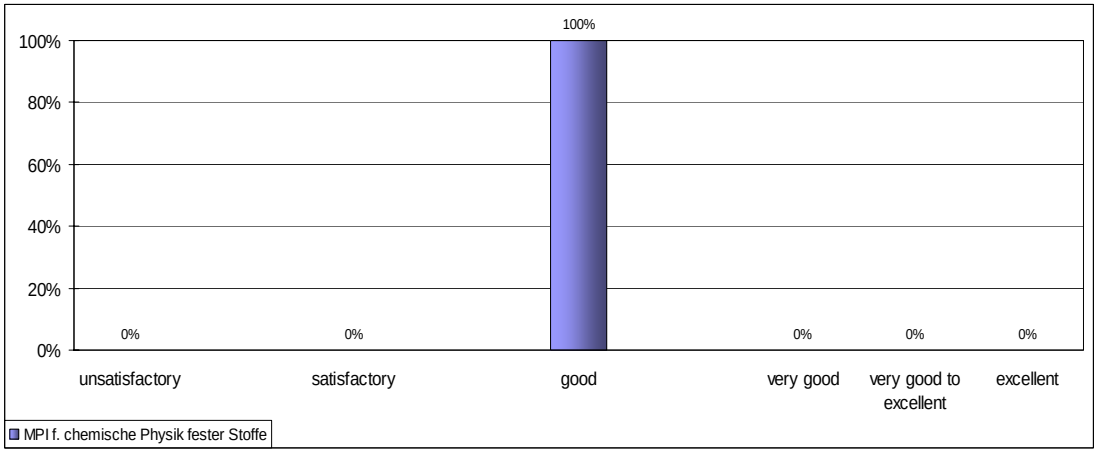
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

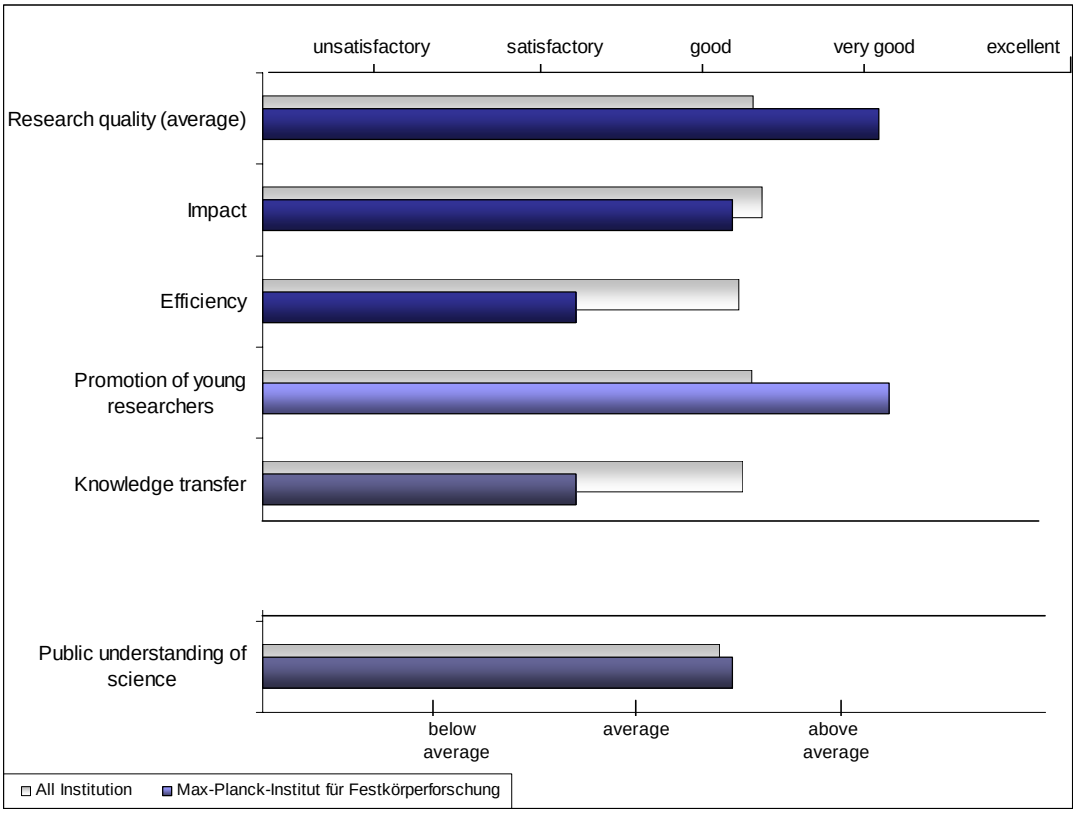
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Max Planck Institute for Solid State Research

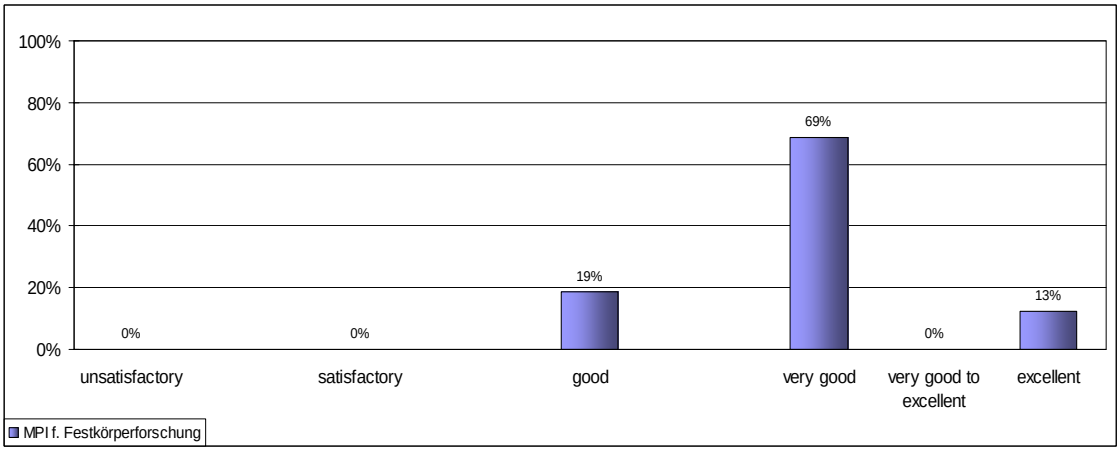
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

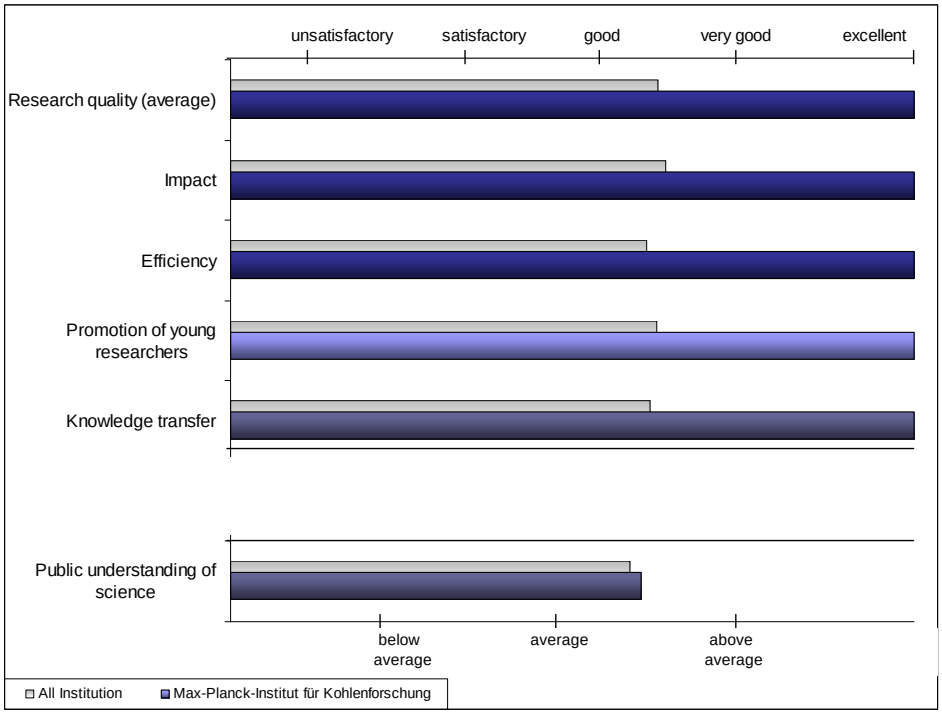
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Max Planck Institute for Coal Research

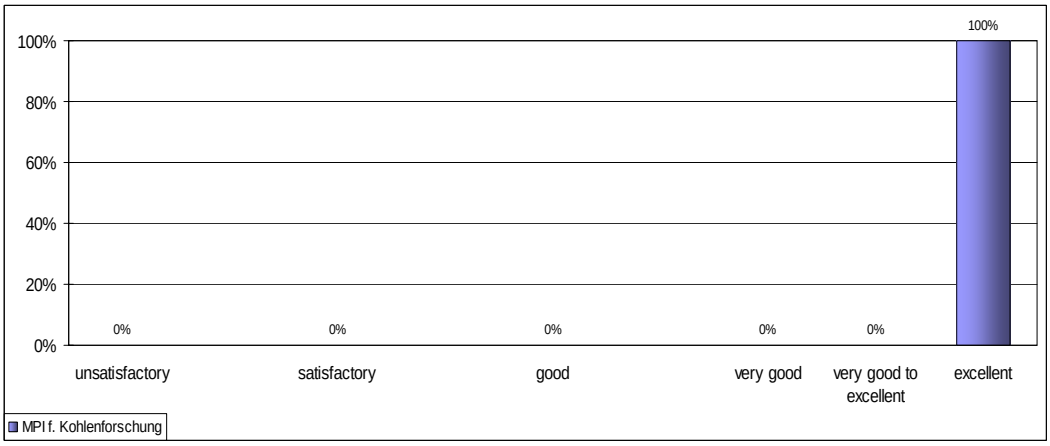
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

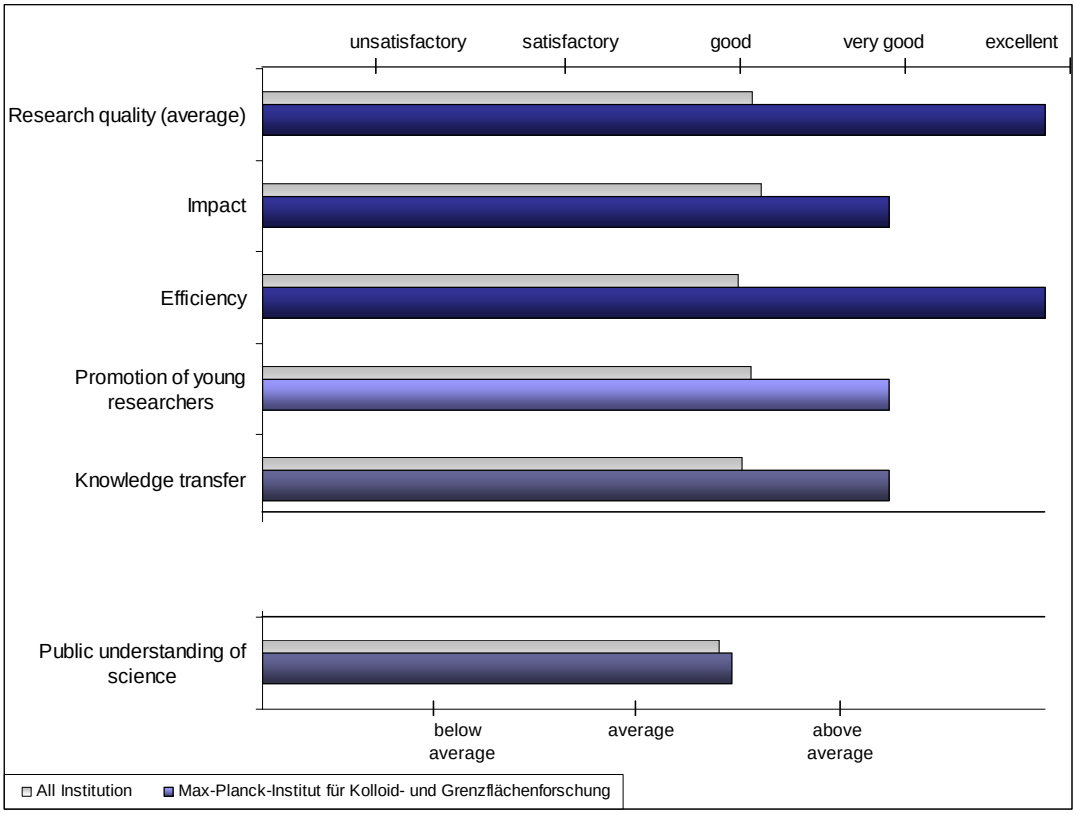


Assessment notes

The decision of the MPI for Kohlenforschung (coal research) to register all its departments as a single research unit made it impossible to give a differentiated assessment of the research quality.

Max Planck Institute of Colloids and Interfaces

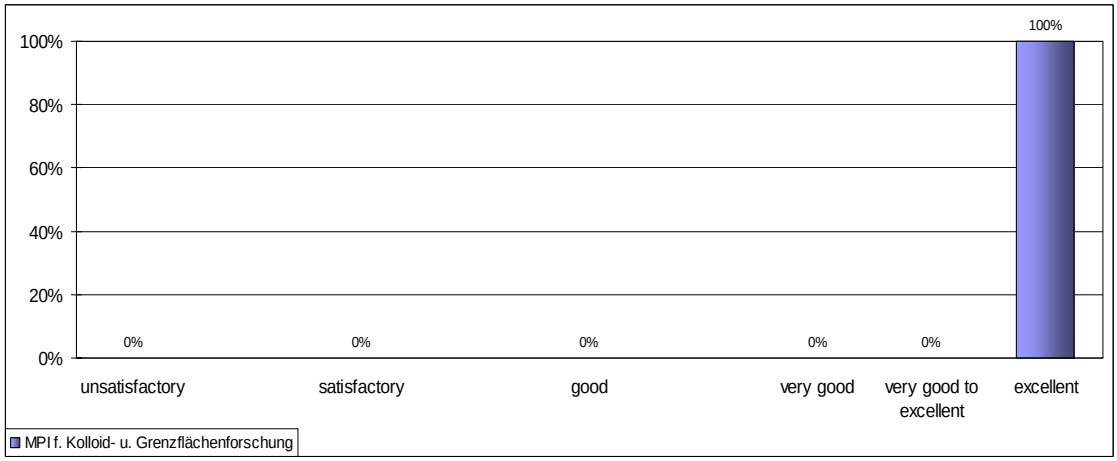
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

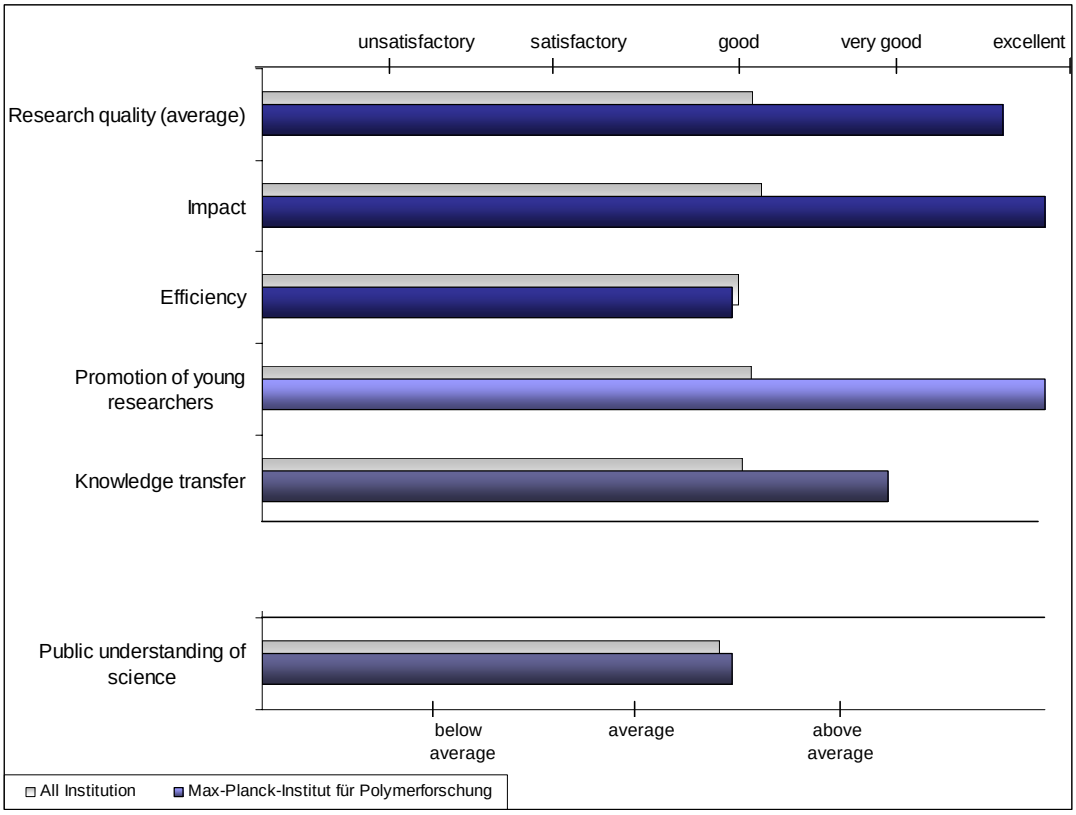
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Max Planck Institute for Polymer Research

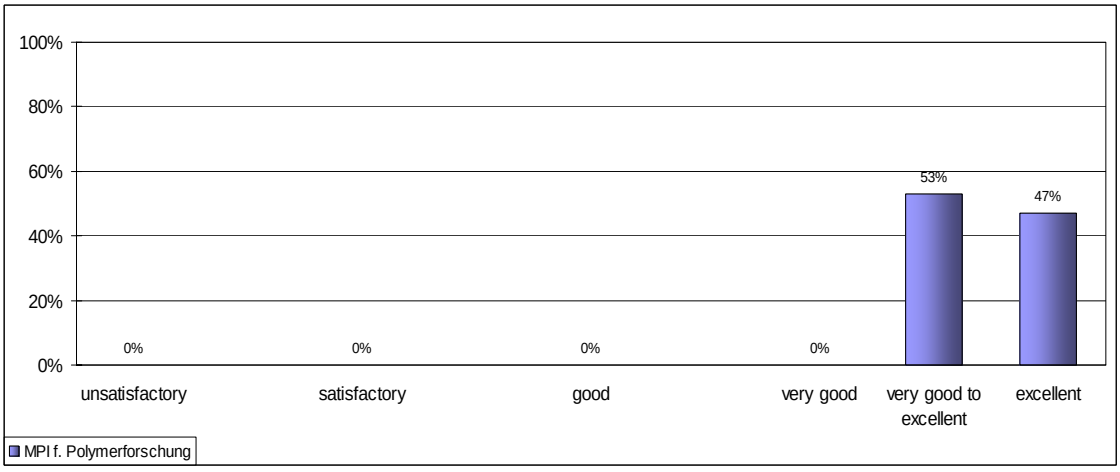
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

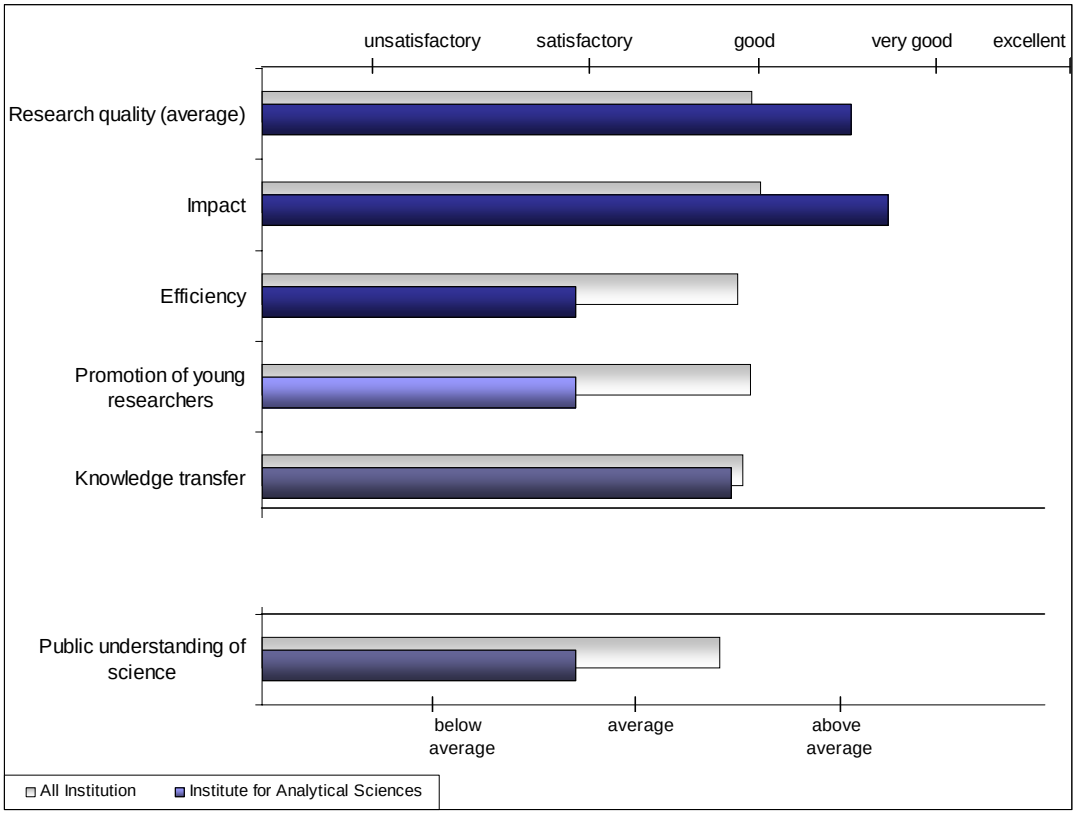
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Institute for Analytical Sciences (ISAS)

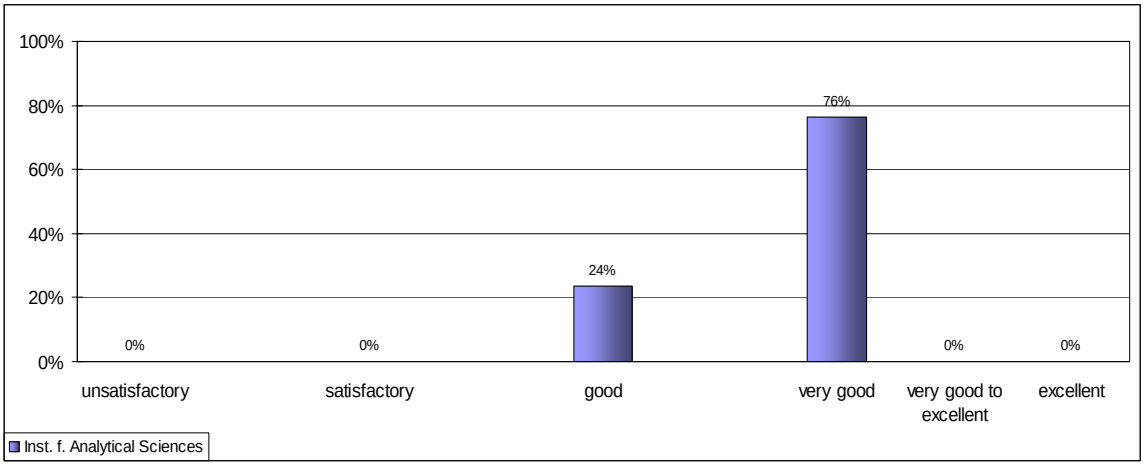
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

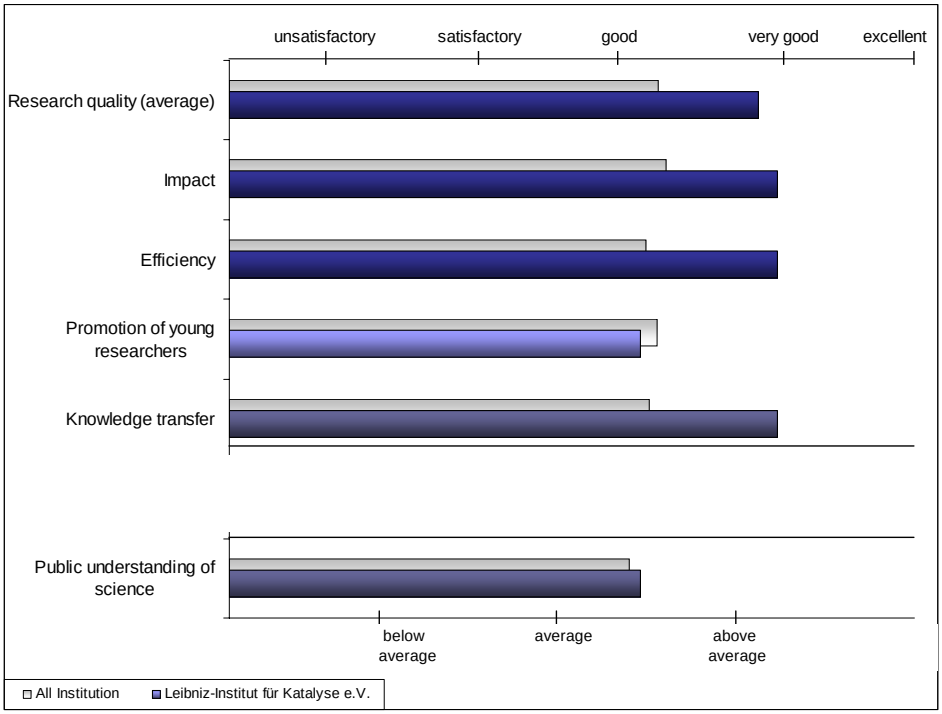
II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



Leibniz Institute for Catalysis

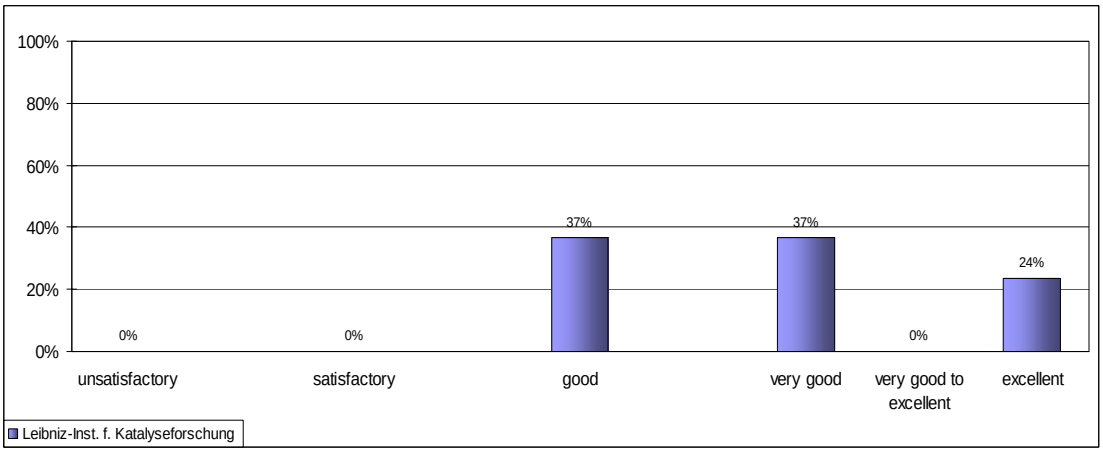
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

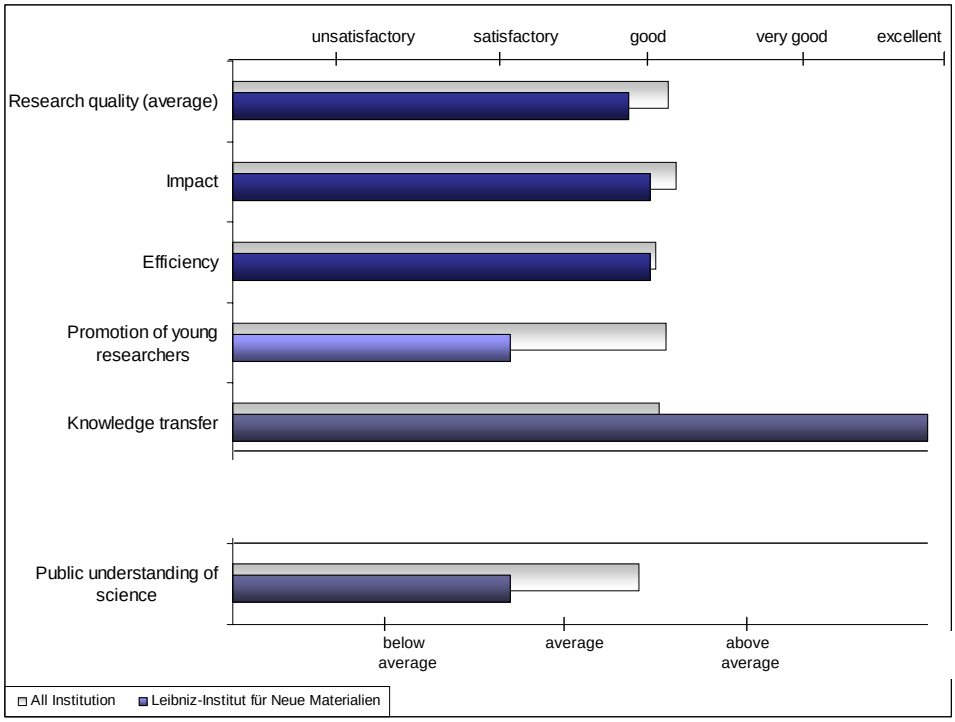


Assessment notes

The inclusion of the Leibniz Institute for Catalysis (LIKAT) into the Leibniz Association and the supra-regional integration of the locations in Berlin and Rostock were very successful. The effects on the University of Rostock are positive as well.

Leibniz Institute for New Materials

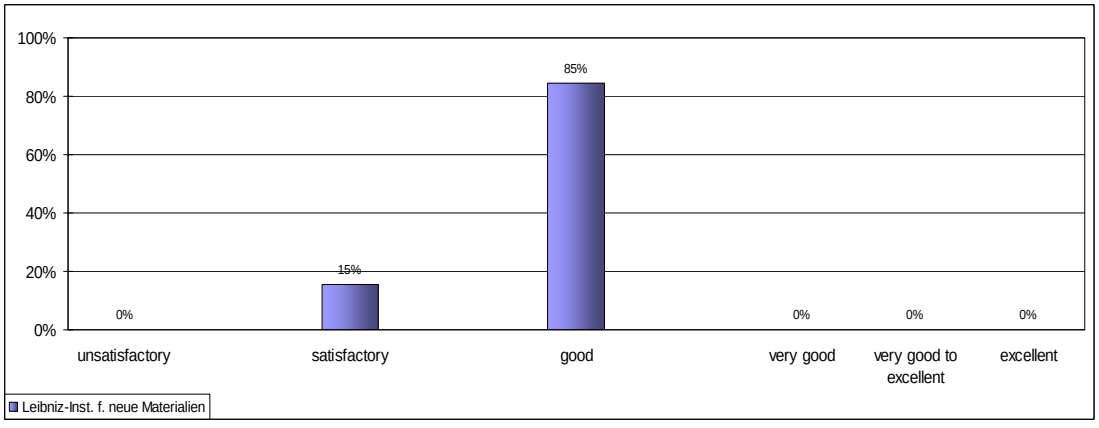
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.



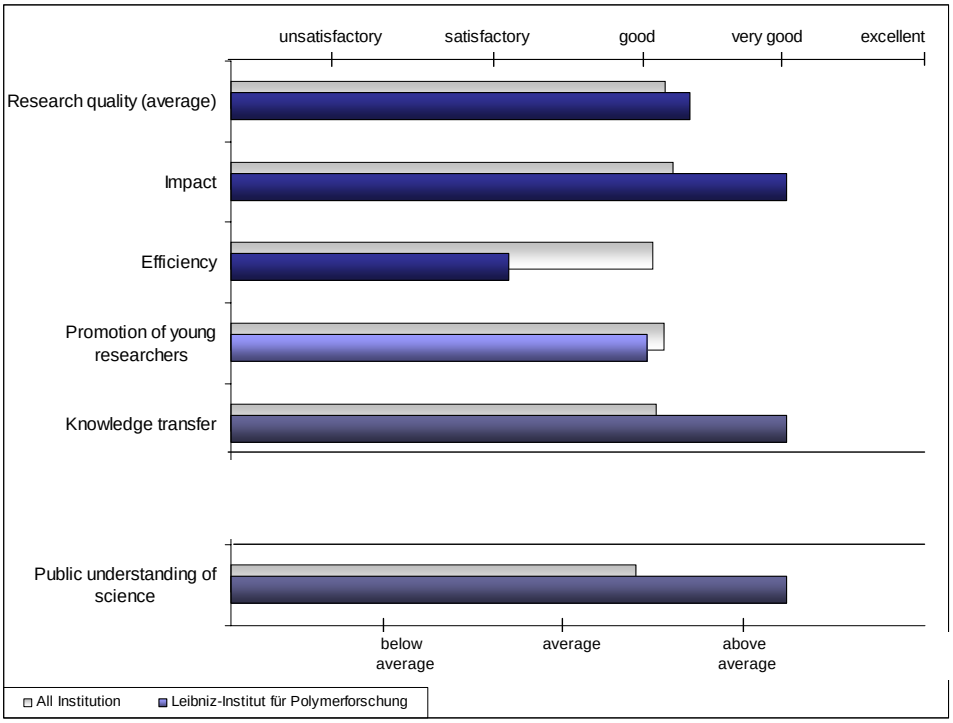
Assessment notes

In keeping with the mission of the Leibniz Institute for New Materials, the impact/effectiveness assessment is primarily based not on its publication and citation performance, but on its patenting and third party-funded activities.

Two research units at this institution are linked by personal union to chemistry at Saarland University. Although this led to a partial overlap of the data, the research contributions could be clearly allocated to one or the other institution.

Leibniz Institute of Polymer Research

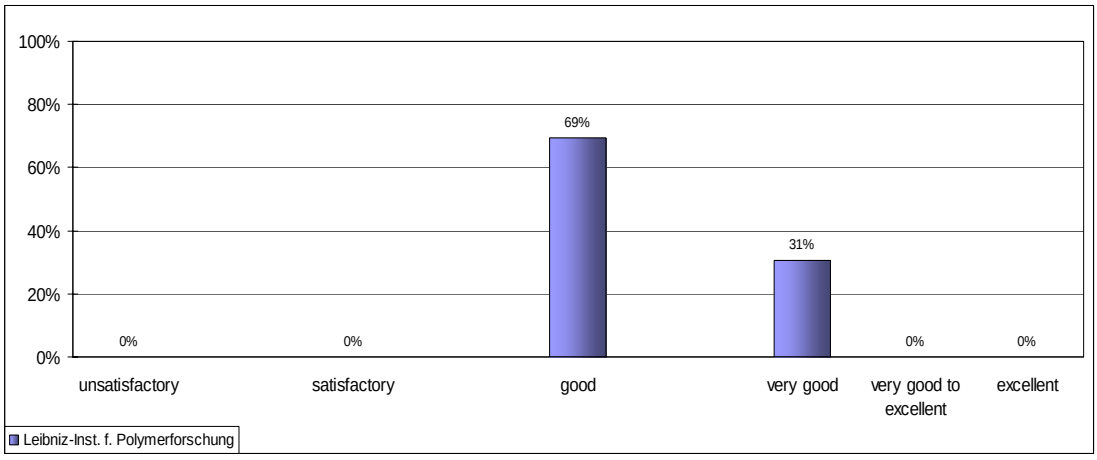
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

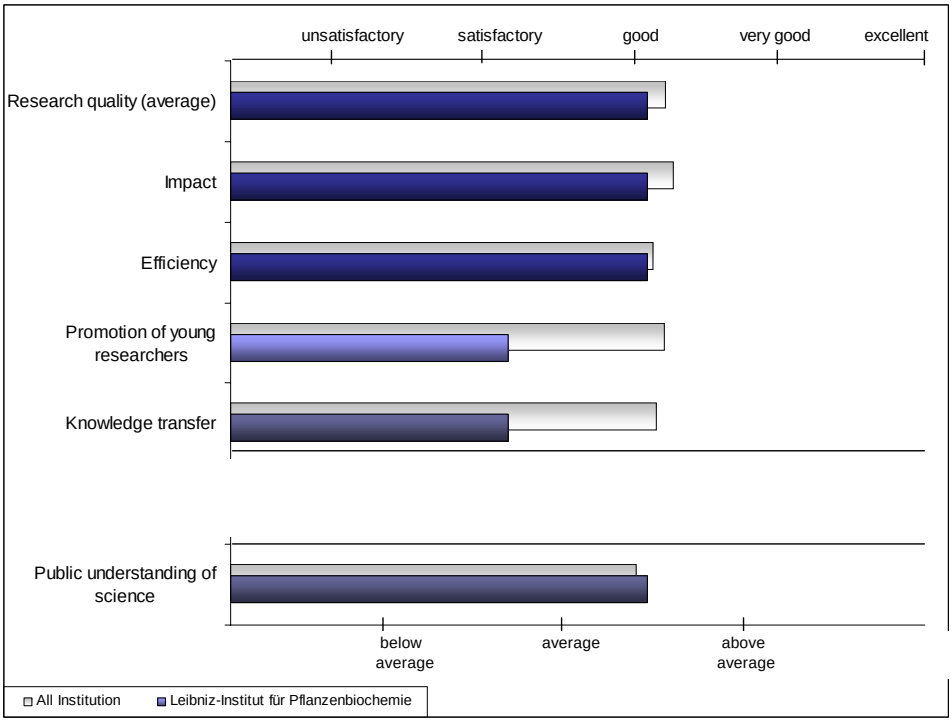


Assessment notes

Although, as a successor institution of an institute of the Academy of Sciences of the GDR, the Leibniz Institute of Polymer Research in Dresden had to cope with considerable structural issues, it has experienced a positive development for some years now.

Leibniz Institute of Plant Biochemistry

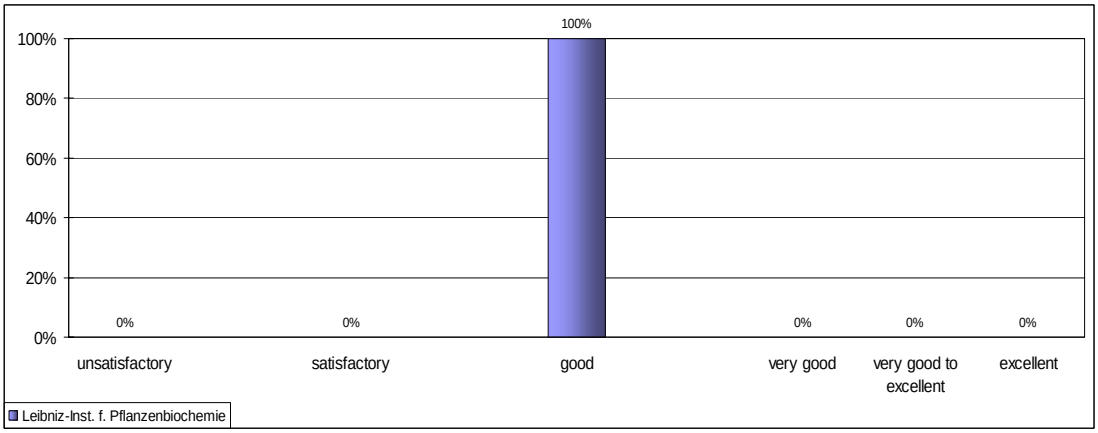
I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.

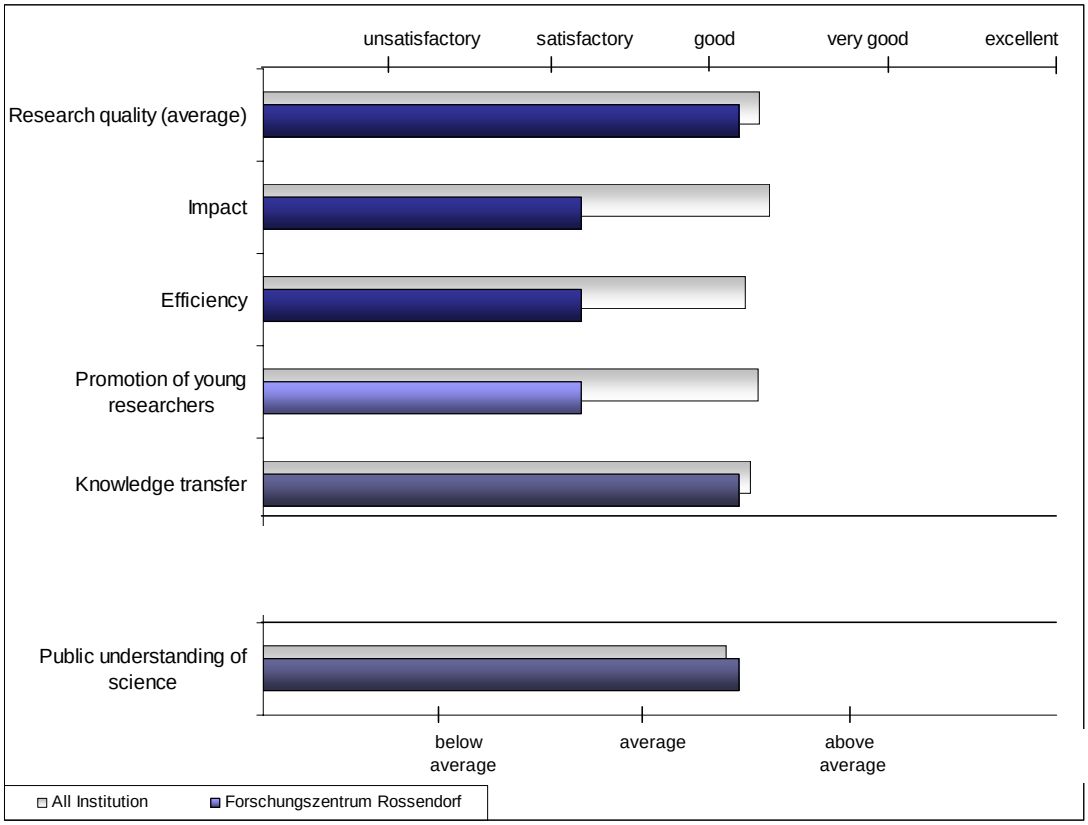


Assessment notes

Due to new appointments finalized in the survey period, the research quality at the Leibniz Institute of Plant Biochemistry promises further positive development.

Forschungszentrum Rossendorf

I. Rating of the institution according to single criteria



Average of research quality is weighted by the number of senior scientists on survey deadline.

II. Rating of research quality

Distribution by percentage, weighted by the number of senior scientists on survey deadline.