

Engirank

METHODOLOGY

engirank.eu

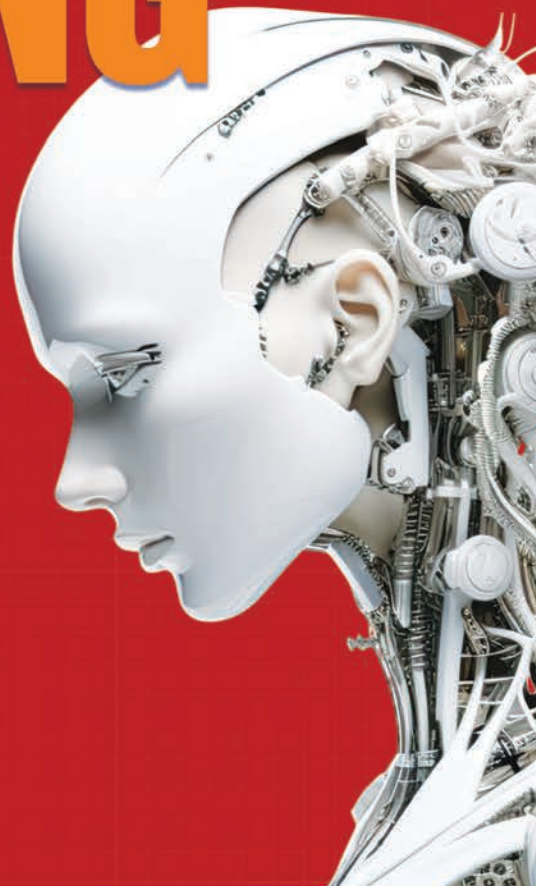
**EUROPEAN
RANKING**

**OF ENGINEERING
PROGRAMS
2024**

Ranking Organizer

Perspektywy

Perspektywy Education Foundation





Ranking ASSUMPTIONS

Engineering education plays a key role in ensuring Europe's sustainable development, it is essential for the creation of innovative technologies and for the training of creative engineers, capable of using science to solve problems, but also aware of the social consequences of their actions. To meet these challenges in the age of growing development of the industry, labor market and education, we need a tool to compare the quality of engineering and technology programs offered by the European universities.

University and programs rankings have become an accepted form of comparison and assessment that is understood by a wide range of stakeholders.



The European Rankings of Engineering Programmes *EngiRank* fills a gap in current and trustworthy information on engineering education, as well as research and innovation, in European universities and other higher education institutions (HEIs)¹ with a strong engineering profile.

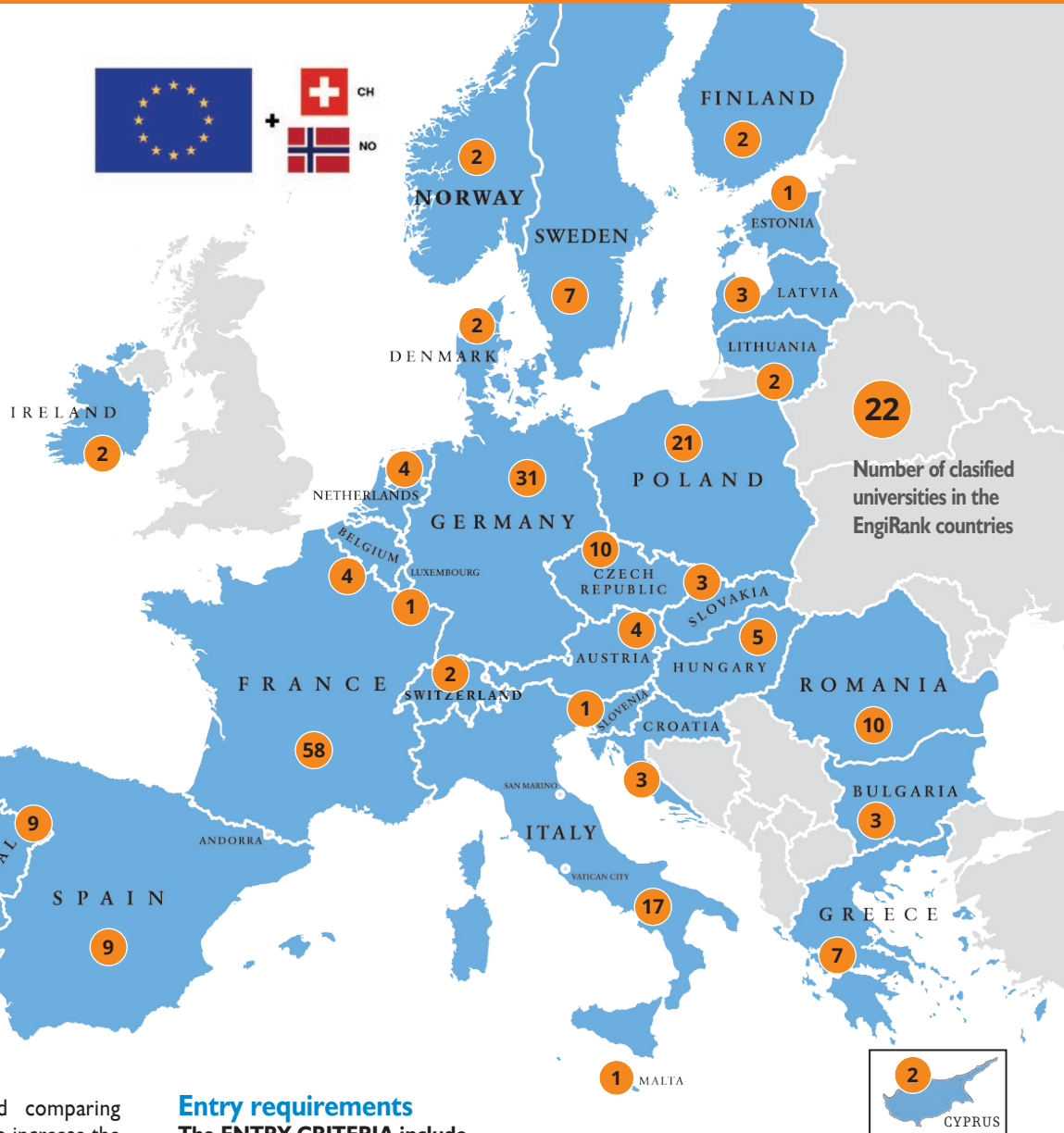
Our main concern in developing *EngiRank* was to ensure the highest reliability of the rankings. The geographical scope of *EngiRank* covers the European Union, Norway and Switzerland. One of the reasons for this

coverage of the rankings is related to the right of EU citizens to study in other Member States under the same conditions as nationals, and the promotion of student mobility and graduate employability are the key objectives of the European Higher Education Area (EHEA), which extends beyond the EU. Increased student mobility creates a demand for information on the quality of European higher education institutions. In addition, consortia of institutions from different Member States and Horizon Europe associated countries can apply for research and innovation funding under the

Horizon Europe programmes. The European Universities Initiative, launched in 2017, develops long-term cooperation between European higher education institutions. These measures are levelling the playing field for higher education institutions across the European Union and making comparisons between them more meaningful.

Another factor considered essential for the credibility of the *EngiRank* is the quality and reliability of the data – the rankings are based only on trustworthy external databases containing information on European HEIs collected in a uniform way, such as the Scopus bibliographic database, the EPO Worldwide Patent Statistical Database (PATSTAT), information on participation in European Commission initiatives (Community Research and Development Information Service - CORDIS, European Education Area website), databases of programmes accredited by quality assurance agencies. No information needed to compile the rankings was collected directly from the HEIs.

It was then decided to reduce the diversification of the HEIs listed in the



rankings in order to avoid comparing unmatchable institutions and to increase the relevance of the rankings. This was achieved by including in the EngiRank not only institutions with a strong engineering profile, but also only those above a certain size threshold.

The EngiRank is primarily addressed to the following groups:

- Prospective students and their parents - it will help them choose a field of study and an institution in Europe that will give them the best chance of finding a satisfactory job after graduation. It will also help students interested in exchange programmes such as Erasmus+ to choose the right institution,
- Employers, including Europe's hi-tech industry - it will help them find talented graduates from technology institutions,
- University management – the ranking will help them monitor effects of university governance and improve the operational quality of the institution.

Entry requirements

The **ENTRY CRITERIA** include

a **qualitative condition:**

- Institutions included in the *EngiRank* have been checked against the European Engineering Education Database (EED) maintained by ENGINEERS EUROPE, a federation of professional engineering associations from 33 EHEA countries;

and quantitative conditions:

- The HEIs with a significant share of research output in engineering and technology² at least 30% of publications in the last 5 years (2019-2023) indexed in the Scopus database - were considered. However, institutions with a majority of publications in medical and health sciences or social sciences between 2019 and 2023 were not considered as HEIs with a strong engineering profile and are not listed in the EngiRank;
- The thresholds for the number of publications in the main engineering disciplines over the

last 5 full years that are indexed in the Scopus database are as follows:

- **Chemical Engineering** – 200,
- **Civil Engineering** – 100,
- **Electrical Engineering, Electronic Engineering, Information Engineering** – 200,
- **Environmental Engineering** – 100,
- **Materials Engineering** – 250,
- **Mechanical engineering** – 200,
- **Medical Engineering** – 100.

The **subject ranking** in each of the above disciplines includes HEIs that meet the qualitative condition and both quantitative conditions: a share of publications in engineering and technology of at least 30% and a number of publications in a given discipline of at least a threshold value³. The **institutional ranking** within *EngiRank* includes HEIs that are classified in at least three subject rankings. ➤

Ranking ASSUMPTIONS

› Innovative approach

In designing the *EngiRank*, we paid particular attention to the degree of commitment of institutions to their economic and social missions. In order to reflect the transfer and application of academic knowledge by universities, we have included in the rankings indicators that measure the collaboration between academia and industry researchers, the use of research outputs in successful patent applications, the universities' own patent activity and - where appropriate - the contribution to sustainable development goals.

EngiRank is a composite of different categories of indicators. We believe that the scale of an institution's activities matters: research and innovation exhibits increasing returns to scale, and the larger the scale of an HEI's activities, the more opportunities there are for students and academic staff. Therefore, size indicators measuring the volume of research output, the amount of research and innovation funding, the number of patents or the number of publications related to the selected sustainable development goals play an important role in the rankings. The inclusion of the subject rankings scores into the institutional ranking reflects returns to scope and the benefits of interdisciplinarity. Then there are the conventional efficiency indicators expressed in relative terms, such as citations per publication, share of publications in the top

EUROPEAN UNIVERSITIES

The **European Universities alliances** are a flagship initiative of the European strategy for universities. European Universities develop and implement an integrated long-term joint strategy for education with, where possible, links to research and innovation, for the benefit of their students, staff and society. Beyond cooperation between higher education institutions, European Universities alliances foster collaboration with other partners, including civil society, and local and regional authorities with the aim to bring education and innovation closer together through joint activities. Currently, there are 50 European Universities alliances, involving more than 430 higher education institutions.

10% journals, number of patent citations received on average by a publication, percentage of publications that are co-authored by industry researchers or foreign researchers. The introduction of a dynamic indicator, the change in citation impact, is something of a novelty in the universe of university rankings. Finally, we have included qualitative indicators representing engineering degree programmes accreditations and membership in a European university alliance. Finally, we have included qualitative indicators representing accreditation of engineering programmes and membership of a European university alliance. These indicators are closely related to the European Higher Education Area (EHEA) and highlight the benefits of a regional approach to academic rankings.

PATSTAT

The **European Patent Office's Worldwide Patent Statistical Database – PATSTAT** is the most prominent patent database that has become a standard in the field of patent intelligence and statistics. The PATSTAT product line consists of two individual databases:

- **PATSTAT Global**, containing bibliographical data relating to more than 100 million patent documents from leading industrialised and developing countries.
- **PATSTAT EP Register**, containing bibliographic and legal event data on published European and Euro-PCT patent applications.

The databases are available as a bulk data set or via PATSTAT Online, which is a web-based interface. PATSTAT Online allows to run queries in the databases, conduct statistical analyses, visualise the data and download it for offline use.

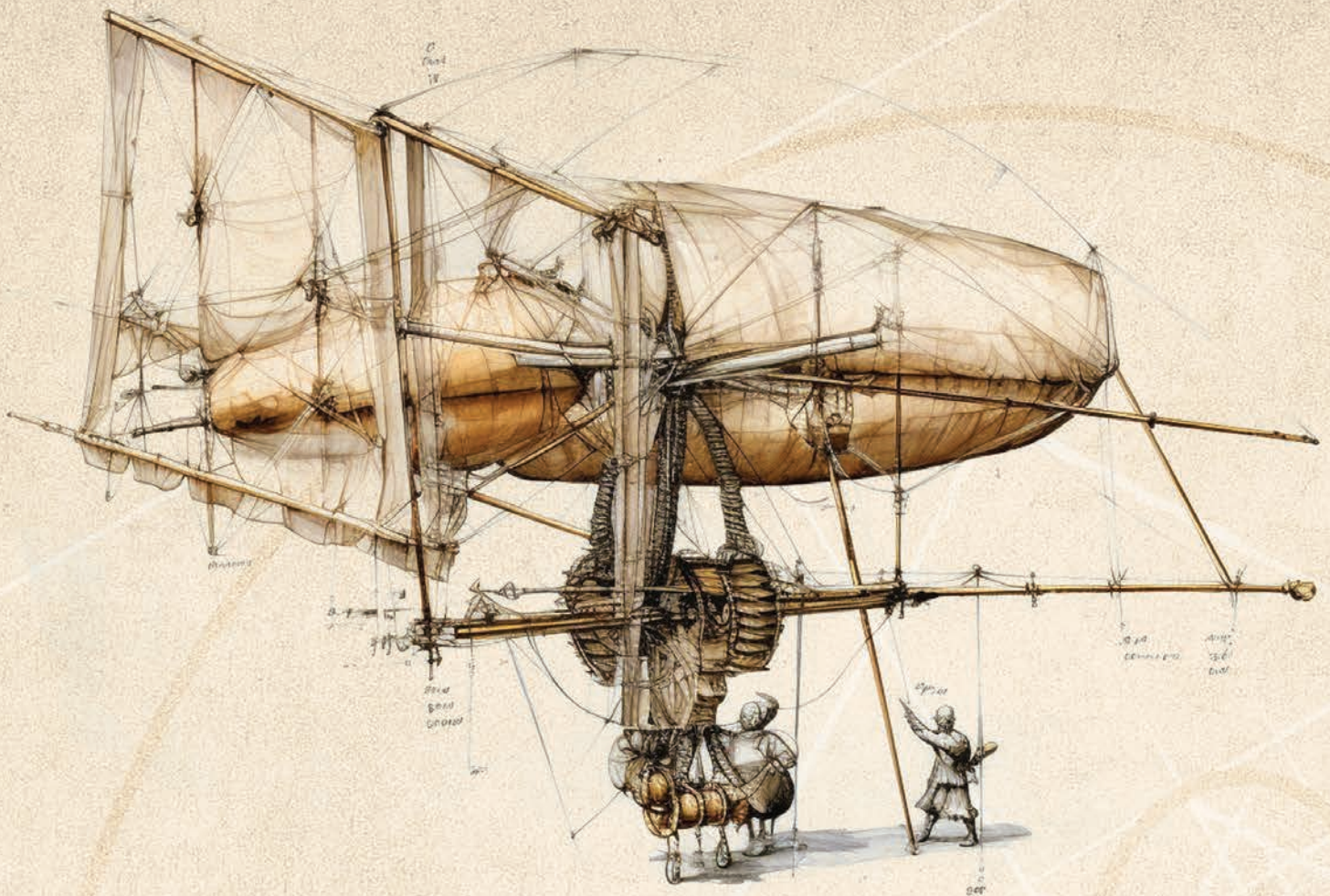
INDICATOR DATA SOURCE

Research and innovation funding	CORDIS: https://cordis.europa.eu
Patents	EPO PATSTAT: https://www.epo.org/patstat
European universities alliances	List of alliances: https://education.ec.europa.eu/education-levels/higher-education/european-universities-initiative/map
EUR-ACE labelled programmes	ENAAE database: https://eurace.enaee.eu
ABET-accredited programmes	ABET-Accredited Program Search tool: https://amspub.abet.org/aps/
HEIs running engineering programmes	European Engineering Education Database: https://www.engineerseurope.com/eed-database
Bibliometric indicators	Scival: https://www.scival.com

¹ The term higher education institutions other than universities refers to institutions such as grandes écoles in France, Sant'Anna School of Advanced Studies in Pisa, Italy or Higher Institute of Engineering of Lisbon, Portugal.

² The classification of disciplines adopted in *EngiRank* corresponds to the OECD Fields of Research and Development (FORD), both at the level of 1-digit major fields (i.e. 2. Engineering and technology, 3. Medical and health sciences, 5. Social sciences) and at the level of 2-digit categories (2.1 Civil engineering; 2.2 Electrical engineering, electronic engineering, information engineering etc.).

³ Only in exceptional cases, in order to include leading HEIs with an engineering profile from all EU27 countries in the *EngiRank* institutional ranking, has the threshold for the share of E&T publications been lowered (and when the scores of the leading institutions were very close, we decided to include all of them in the ranking). This is the case for Croatia, Malta and Flanders.



“ *Scientists study the world as it is, engineers create the world that never has been* ”

Theodore von Kármán

Methodology

EngiRank INSTITUTIONAL

The institutional ranking is based on five criteria. The most important criteria in terms of weight are **Research** (28%) and **Innovation** (25%) - together they account for 53% of the ranking. The third criterion, **SDG 9: Industry, Innovation and Infrastructure**, recognises the institution's efforts to make progress towards Sustainable Development Goal 9 - the weight of this single indicator criterion is 10%. The next criterion is **Internationalisation**, with a weight of 16%, and the last one is **Engineering and Technology Capability** (weight of 21%), which links the institutional ranking with the subject rankings.

RESEARCH (28%)

This criterion is made up of four indicators taken from the Scopus bibliographic database. Publications is the indicator representing the research output of the institution in absolute terms. Then Citations and Publications in Top 10% Journals are indicators expressed in relative terms. The last one, Change of Impact, is a dynamic indicator reflecting a change in citation impact. More detailed information on each indicator is given below.

- **Publications:** number of publications from the years 2019-2023 in the field Engineering and technology (FORD classification) in the Scopus database that are affiliated with the institution. Source: Scopus/SciVal (10%)
- **Publications in Top 10% Journals:** percentage of the institution's publications

published in the top 10% journals by CiteScore in the field Engineering and technology in the years 2019-2023. Source: Scopus/SciVal (6%)

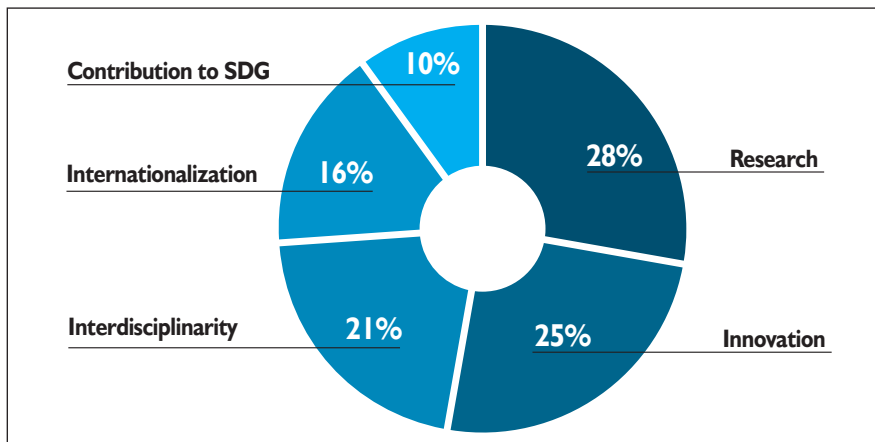
- **Citations:** ratio of the number of citations received by the institution's publications from the years 2019-2023 in the field Engineering and technology, indexed in the Scopus database, to the number of these publications. Source: Scopus/SciVal (6%)
- **Change of Impact:** dynamic indicator calculated as the ratio of the field-weighted citation impact (FWCI) of the institution's publications in 2019-2023 to the FWCI of its publications in 2014-2018 in the field Engineering and technology. Source: Scopus/SciVal (6%)

INNOVATION (25%)

The criterion consists of four indicators. Firstly, **Research and Innovation Funding** and **Patents** are expressed in absolute terms and refer to the European frameworks for research and innovation funding and patenting respectively. The Scopus bibliographic database was the source

for the calculation of the other two indicators: **Patent-Citation Count per Scholarly Output** and **Academic-Corporate Collaboration**. Both are expressed in relative terms. More detailed information on the indicators is given below.

- **Research and Innovation Funding:** value of grants awarded to the institution under the EU framework programmes for research and innovation between 2019 and 2023 adjusted for purchasing-power parity (PPP). Source: CORDIS and World Bank (10%)
- **Patents:** number of patents granted to the institution by the European Patent Office in 2019-2023. Source: EPO-PATSTAT (5%)
- **Patent-Citation Count:** average number of patent citations received per scholarly outputs published by the institution in the field Engineering and technology in 2019-2023. Source: Scopus/SciVal (5%)
- **Academic-Corporate Collaboration:** percentage of publications in the field Engineering and technology published between 2019 and 2023 that are co-authored by researchers affiliated with an institution outside of academia. Source: Scopus/SciVal (5%)





any European university alliance as of 14.08.2024. Source: European Education Area website (4%)

ENGINEERING & TECHNOLOGY CAPABILITY (21%)

The criterion linking the institutional ranking with the subject rankings. This criterion rewards institutions that are classified in a larger number of subject rankings and that achieve higher scores in these rankings.

- **Chemical Engineering (CHE):** scores received in CHE subject ranking. Source: EngiRank by subject (3%)
- **Civil Engineering (CIV):** scores received in CIV subject ranking. Source: EngiRank by subject (3%)
- **Electrical Engineering, Electronic Engineering, Information Engineering (EEI):** scores received in EEI subject ranking. Source: EngiRank by subject (3%)
- **Environmental Engineering (ENV):** scores received in ENV subject ranking. Source: EngiRank by subject (3%)
- **Materials Engineering (MAT):** scores received in MAT subject ranking. Source: EngiRank by subject (3%)
- **Mechanical Engineering (MEC):** scores received in MEC subject ranking. Source: EngiRank by subject (3%)
- **Medical Engineering (MED):** scores received in MED subject ranking. Source: EngiRank by subject (3%).

The EngiRank rankings are modelled on the basis on the Multi-Attribute Value Theory. According to this theory, firstly, it was assumed that it is possible to estimate the value or the total score of each HEI (as well as the disciplines under consideration) by taking into account the impact of the individual criteria as measured by the corresponding indicators. Secondly, it was assumed that if the criteria are not equally important, it is possible to make them comparable by weighting the corresponding indicators with appropriate coefficients. Thirdly, the additivity of the weighted criteria was assumed, which means that the final score is the linear combination of the partial scores. Finally, the indicators with an asymmetric distribution are generally transformed (square root or cube root) to reduce the skewness of the distribution.

The sub-scores for each indicator are calculated in relation to the leading institution. The score of 100 is assigned to the HEI with the highest indicator value, and the scores for the other institutions are calculated as a proportional distance to the leader. The partnership in a European university alliance is a specific binary

ABBREVIATIONS USED IN THE RANKINGS

ABET	– Accreditation Board for Engineering and Technology
ACC	– Academic-Corporate Collaboration
ACCR	– Accreditations
CHE	– Chemical Engineering
CIT	– Citations
CIV	– Civil Engineering
EEl	– Electrical, Electronic, Information Engineering
EHEA	– European Higher Education Area
ENAE	– European Network for Accreditation of Engineering Education
ENV	– Environmental Engineering
EPO	– European Patent Office
EUNI	– European university
FUND	– Research and Innovation Funding
FWCI-C	– Change of Impact
HEI	– Higher Education Institution
IC	– International Collaboration
ICI	– International Collaboration Impact
MAT	– Materials Engineering
MEC	– Mechanical Engineering
MED	– Medical Engineering
PAT	– Patents
PCIT	– Patent-Citation Count per Scholarly Output
PUB	– Publications
SDG	– Sustainable Development Goal
SDG 3	– Good health and well-being
SDG 6	– Clean water and sanitation
SDG 9	– Innovation and infrastructure
SDG 11	– Sustainable cities and communities
TOP-10	– Publications in Top 10% Journals

indicator – a score of 100 is assigned to each of 118 universities listed in the institutional ranking that is a member of any European university alliance.

The sub-scores for all the indicators obtained by the HEI – both in the subject rankings and in the institutional ranking – are summed using appropriate weights. The HEIs are then ranked in descending order according to the weighted sum of the scores. The leading institution is given the final score of 100 and the following institutions are given scores equal to the ratio of their weighted sum of sub-scores to that of the leading institution (as a percentage). The position of HEIs in a ranking is determined by a discrimination threshold of 1 %pt. of the final score. This means that institutions with final scores that differ by less than 1 %pt. occupy the same position in the ranking. ■

SDG 9: INDUSTRY, INNOVATION AND INFRASTRUCTURE (10%)

The single indicator criterion. The indicator measures the institution's contribution to Sustainable Development Goal 9, with the number of publications assigned to SDG9 and the field Engineering and technology.

- **SDG 9:** number of publications from 2019-2023 simultaneously assigned to the United Nations Sustainable Development Goal 9: Industry, innovation and infrastructure and to the field Engineering and technology (FORD classification). Source: Scopus/SciVal (10%)

INTERNATIONALISATION (16%)

The criterion is made up of three indicators. The **International Collaboration** and **International Collaboration Impact** indicators are derived from the Scopus bibliographic database. The last indicator relates to the institution's participation in a European university alliance. More detailed information on each indicator is provided below.

- **International Collaboration:** percentage of the institution's publications in the field Engineering and technology in the years 2019-2023 that have co-authors from multiple countries. Source: Scopus/SciVal (10%)
- **International Collaboration Impact:** citation impact of the institution's publications in the field Engineering and technology in the years 2019-2023 that have international co-authorship. Source: Scopus/SciVal (2%)
- **European university:** binary flag indicating whether the institution is a full member of

Methodology

EngiRank by Subject

The EngiRank rankings in the following disciplines:

- **chemical engineering,**
- **electrical engineering, electronic engineering, information engineering,**
- **materials engineering,**
- **mechanical engineering,**

are based on three criteria: **Research** (64%), **Innovation** (26%) and **Teaching Quality** (10%). We then looked at the potential and expected contribution of university activities in the remaining disciplines to the following Sustainable Development Goals (SDGs):

- **civil engineering** – SDG 11: Sustainable cities and communities,
- **environmental engineering** – SDG 6: Clean water and sanitation,
- **medical engineering** – SDG 3: Good health and well-being.

Thus, for each of the above-mentioned disciplines, the additional criterion: **Contribution to SDGs** (5%) was added for each of the above disciplines,

while at the same time the weights of the other criteria were reduced: Research – to 60% and Innovation – to 25%.

Each indicator in the subject rankings refers strictly to a given discipline. Some indicators in the institutional ranking and in the subject rankings are based on the same metrics, differing only in the scope of publications or grants taken into account. Although such indicators from the subject rankings are indirectly included in the institutional ranking (via the Engineering and Technology Capability criterion), this should not be considered as a duplication of indicators. It should be noted that some HEIs are not classified in all subject rankings (in particular, about half of the HEIs listed in the institutional ranking are classified in the medical engineering ranking). Moreover, even for HEIs classified in all subject rankings, there are publications and grants not covered by the subject ranking indicators, such as those in general engineering; nuclear energy and engineering; control and systems engineering; safety, risk, reliability and quality; media technology; bioengineering; other miscellaneous engineering. They are only included in the institutional ranking.

The table below summarises the weighting of the indicators in specific subject rankings.

EngiRank BY SUBJECTS	RESEARCH				INNOVATION		TEACH	SDG		
	Publications	Publications in Top 10% Journals	Citations	Change of Impact	Academic-Corporate Collaboration	Research and Innovation Funding	Accreditations	SDG 3: Good health and well-being	SDG 6: Clean water and sanitation	SDG 11: Sustainable cities and communities
Chemical Engineering	16%	16%	16%	16%	16%	10%	10%	-	-	-
Civil Engineering	15%	15%	15%	15%	15%	10%	10%	-	-	5%
Electrical, Electronic and Information Engineering	16%	16%	16%	16%	16%	10%	10%	-	-	-
Environmental Engineering	15%	15%	15%	15%	15%	10%	10%	-	5%	-
Materials Engineering	16%	16%	16%	16%	16%	10%	10%	-	-	-
Mechanical Engineering	16%	16%	16%	16%	16%	10%	10%	-	-	-
Medical Engineering	15%	15%	15%	15%	15%	10%	10%	5%	-	-

RESEARCH (60%/64%)

The criterion is made up of four indicators calculated on the basis of the Scopus bibliographic database.

- **Publications:** number of publications from the years 2019-2023 in the relevant discipline in the Scopus database which are affiliated to the institution. *Source: Scopus/SciVal (15%/16%)*
- **Publications in Top 10% Journals:** percentage of the institution's publications published in the top 10% journals according to CiteScore in the relevant discipline in the years 2019-2023. *Source: Scopus/SciVal (15%/16%)*
- **Citations:** ratio of the number of citations received by the institution's publications from the years 2019-2023 in the relevant discipline indexed in the Scopus database to the number of these publications. *Source: Scopus/SciVal (15%/16%)*
- **Change of Impact:** dynamic indicator calculated as the ratio of the field-weighted citation impact (FWCI) of the institution's publications in the years 2019-2023 to the FWCI of the publications in the years 2014-2018 in the relevant discipline. *Source: Scopus/SciVal (15%/16%)*

INNOVATION (25%/26%)

The criterion consisted of two indicators. The Scopus bibliographic database was the source for the calculation of the Academic-Corporate Collaboration indicator. The values for the Research and Innovation Funding are based on information from the CORDIS database.

- **Academic-Corporate Collaboration:** percentage of publications in the relevant discipline published between 2019 and 2023 that are co-authored by researchers affiliated to an institution outside academia. *Source: Scopus/SciVal (15%/16%)*
- **Research and Innovation Funding:** value of grants awarded to the university under the EU framework programmes for research and innovation to finance research projects in the relevant discipline between 2019 and 2023. *Source: CORDIS database (10%)*

TEACHING QUALITY (10%)

The single indicator criterion. The indicator is measured by the number of the degree programmes accredited by ENAEE authorised agencies or by ABET (more information on ENAEE and ABET in the frame below)

- **Accreditations:** number of engineering degree programmes related to the relevant discipline accredited by the agency authorized by the European Network for Accreditation

SDGs

The **Sustainable Development Goals (SDGs)** are a collection of seventeen interlinked objectives adopted in 2015 by the 193 countries of the United Nations General Assembly (UNGA) as a part of the 2030 Development Agenda titled "Transforming our world: the 2030 Agenda for Sustainable Development." The SDGs emphasize the interconnected environmental, social and economic aspects of sustainable development by putting sustainability at their center and serve as a "shared blueprint for peace and prosperity for people and the planet, now and into the future."

The *EngiRank* recognises the potential and expected contribution of HEIs with strong technical profile to achieving SDG 9: Industry, innovation and infrastructure. Similarly, activities of HEIs in certain engineering and technology disciplines can support implementation of particular SDGs:

- Civil Engineering – SDG 11: Sustainable cities and communities,
- Environmental Engineering – SDG 6: Clean water and sanitation,
- Medical Engineering – SDG 3: Good health and well-being.

of Engineering Education (ENAAE) or by the Accreditation Board for Engineering and Technology (ABET) valid in 2024. *Source: databases of EUR-ACE labelled programmes (ENAAE authorised) and ABET accredited programmes (10%)*

CONTRIBUTION TO SDGs (0%/5%)

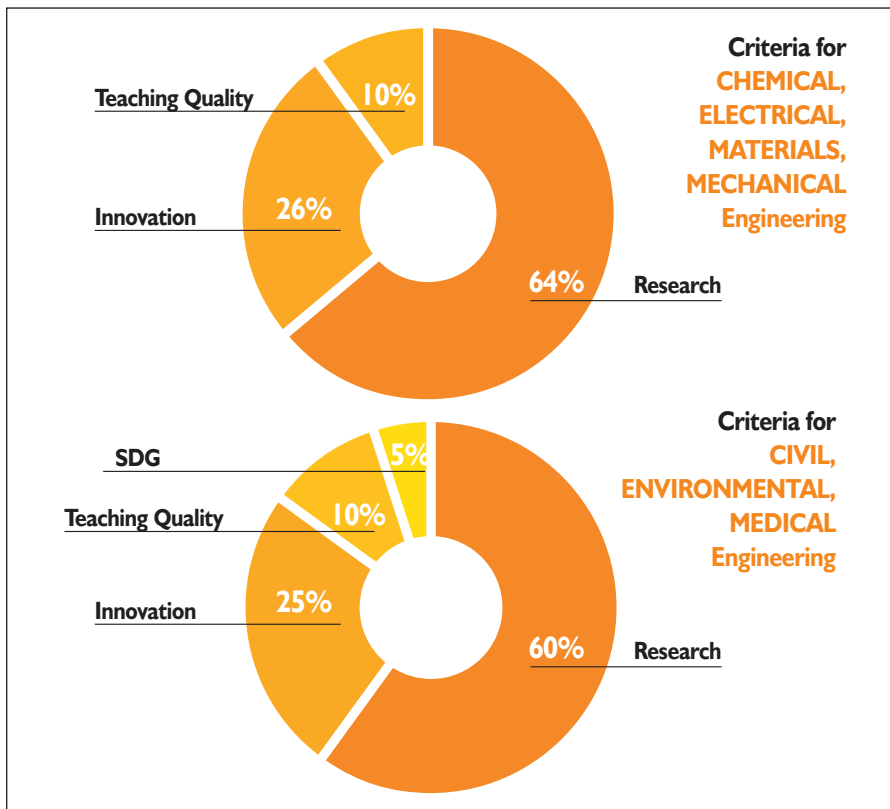
The single indicator criterion. The indicator measures the institution's contribution to selected SDGs in defined disciplines through the number of publications.

- **SDG 3: Good health and well-being** (medical engineering only): number of publications from 2019-2023 simultaneously

ACCREDITATIONS

The **European Network for Accreditation of Engineering Education (ENAAE)** is a non-profit organization that gathers accreditation and quality assurance agencies from various countries (mostly EU) and builds a pan-European framework for the accreditation of engineering education programmes. ENAAE has established the EUR-ACE (European Accredited Engineer) label, although it does not accredit directly engineering degree programmes itself. After positive evaluation of policies and procedures followed by member accreditation and quality assurance agencies, ENAAE authorizes them to award the EUR-ACE label to the engineering degree programmes accredited by these agencies. Currently, 15 agencies are authorized by ENAAE; they signed a Mutual Recognition Agreement, known as the EUR-ACE Accord.

The **Accreditation Board for Engineering and Technology (ABET)** is a non-governmental organization established in 1932 in the United States (originally as the Engineers' Council for Professional Development). Currently, there are 4564 post-secondary education programmes in applied and natural sciences, computing, engineering and engineering technology accredited by ABET, that are distributed over 895 institutions in 40 countries.



assigned to the United Nations Sustainable Development Goal 3: Good health and well-being and to medical engineering (FORD category 2.6). *Source: Scopus/Scival*

- **SDG 6: Clean water and sanitation** (environmental engineering only): number of publications from 2019-2023 simultaneously assigned to the United Nations Sustainable Development Goal 6: Clean water and sanitation and to environmental engineering (FORD category 2.7). *Source: Scopus/Scival*
- **SDG 11: Sustainable cities and communities** (civil engineering only): number of publications from 2019-2023 simultaneously assigned to the United Nations Sustainable Development Goal 11: Sustainable cities and communities and to civil

engineering (FORD category 2.1). *Source: Scopus/Scival*

The subject rankings list the following number of HEIs:

- **Chemical Engineering** – 169,
- **Civil Engineering** – 143,
- **Electrical Engineering, Electronic Engineering, Information Engineering** – 178,
- **Environmental Engineering** – 160,
- **Materials Engineering** – 196,
- **Mechanical Engineering** – 177,
- **Medical Engineering** – 97.

The institutional ranking includes 183 HEIs.

CORDIS

Community Research and Development Information Service (CORDIS) is the European Commission's principal and official service for delivering information on projects funded by the European Union's framework programmes for research and innovation, from the First Framework Programme (1984–1987, budget €3.8bn) to Horizon Europe (2021–2027, budget €95.5bn). CORDIS has a single search service that allows to perform simple searches (by term), combine them with filters that apply to selected content collections as well as edit queries to use advanced search syntax (with Boolean operators). Total number of projects in the repository is 125.962 and their cost exceeds €350bn.



Engirank

engirank.eu

Ranking Organizer

Perspektywy

Perspektywy Education Foundation