



Lodz University  
of Technology

**LODZ UNIVERSITY OF TECHNOLOGY  
ON THE PATH OF SUSTAINABLE  
DEVELOPMENT.  
REPORT FOR THE PERIOD  
2021-2022.**

*Dear Ladies and Gentlemen,*

*at Lodz University of Technology, we fully understand our responsibility as a University and our impact on the environment.*

*We are aware that it is not only about educating students and research, but also about creating socially relevant attitudes. In carrying out these tasks, we are guided by the objectives of sustainable development.*

*This direction of change also accompanies us in the launch of other initiatives.*

*I welcome the increasing awareness of this among the academic community. We are in the process of changing and the results are already visible on our campus, in our infrastructure, educational programmes, HR policy, the popularisation of research, the expansion of the range of projects for our environment.*

*Among such activities is the recently opened kindergarten for children of employees, doctoral students and students. I am proud of this investment, which complements the offer of a friendly place to work and study, and at the same time complements the concept of lifelong learning at TUL.*



*We are faced with many economic and geopolitical challenges. Against this backdrop, the fundamental importance of the goals of Agenda 2030 is particularly clear. We are driven by the conviction that universities have a special role to play in promoting the right attitudes, which will translate into an informed and responsible society.*

*Thank you to everyone involved in the preparation of this Report.*

*Professor Krzysztof Józwiak, Ph.D., D.Sc.*

*Rector of TUL*

*Ladies and Gentlemen,*

*we place in your hands the following publication*

*"Lodz University of Technology on the path of sustainable development" as a report of already implemented projects, but also as an inspiration for your daily activities.*

*I encourage you to read the second such document summarising the tasks taking into account the SDGs (Sustainable Development Goals) at Lodz University of Technology.*

*The information collected here relates to initiatives in the areas of science, education, cooperation with partners, administrative and technical activities and the social responsibility of the university.*

*The report was compiled by the Sustainability Team I lead, to which I thank you very much. Our task is to monitor, plan and coordinate TUL's undertakings aimed at achieving the SDGs. I am glad that the content of the document is so rich, as it proves the growing awareness in this area and the commitment of our university community.*



*Lodz University of Technology has the ambition to continuously strengthen its position in the international higher education arena. Looking to the future and wanting to realise this goal, we should pursue sustainable development*

*Professor Paweł Strumiłło Ph.D., D.Sc.  
Vice-Rector for Development*



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## TEAM FOR SUSTAINABLE DEVELOPMENT

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## RESEARCH CONDUCTED AT LODZ UNIVERSITY OF TECHNOLOGY IN LIGHT OF THE IMPLEMENTATION OF SUSTAINABLE DEVELOPMENT GOALS

The output of Lodz University of Technology in terms of publications indexed in Scopus and attributed to the Sustainable Development Goals between 2017 and 2021 is 1,353 items, almost 30% of which were produced in international collaboration. Figure 1 illustrates the distribution of publications by year. Goals 1-16 are included in Scopus, no publications have been attributed to Goal 17. The key Sustainability Goals for TUL are: Goal 6, Goal 7, Goal 9, Goal 12 and Goal 13. It is within these goals that the most research is conducted and the most publications are published at the university. In terms of the achievements of TUL in the national context measured by the number of publications for the period 2017-2021, the university ranks 8th in the country in Goal 7 (426 publications), in Goal 9 - 11th in the country (259 publications), and in Goal 12 - 15th in the country (138 publications).

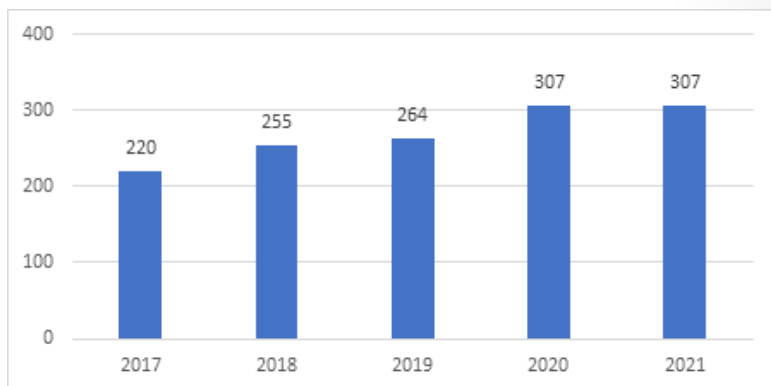


Fig. 1 Distribution of publications of Lodz University of Technology attributed to the Sustainable Development Goals. Source: Scopus, access date 20.10.2022

Figure 2 summarizes the indicators for TUL publications falling within the individual Sustainable Development Goals - the number of publications in each goal for Poland and the share of TUL publications in this number are taken into account. Nationally, the largest number of publications between 2017 and 2021 was devoted to the goals:

- 3 - 34 568 publications,
- 7 - 10 063 publications,
- 9 - 8 208 publications,
- 11 - 7 748 publications,

While the largest share of Lodz University of Technology in these publications was recorded for the goals:

- 7 - 4,23%,
- 9 - 3,16%,
- 6 - 2,62%,
- 12 - 2,59%,
- 13 - 2,44%.

- Goal 1 No poverty
- Goal 2 Zero hunger
- Goal 3 Good healthy and well-being
- Goal 4 Quality education
- Goal 5 Gender equality
- Goal 6 Clean water and sanitation
- Goal 7 Affordable and clean energy
- Goal 8 Decent work and economic growth
- Goal 9 Industry, innovation and infrastructure
- Goal 10 Reduced inequalities
- Goal 11 Sustainable cities and communities
- Goal 12 Responsible consumption and production
- Goal 13 Climate action
- Goal 14 Life below water
- Goal 15 Life on land
- Goal 16 Peace, justice and strong institutions

	LICZBA PUBLIKACJI DLA POLSKI	% PUBLIKACJI Z UDZIAŁEM POLITECHNIKI ŁÓDZKIEJ
Goal 1 No poverty	741	1,35%
Goal 2 Zero hunger	2 890	0,69%
Goal 3 Good healthy and well-being	34 568	1,05%
Goal 4 Quality education	1 858	1,40%
Goal 5 Gender equality	1 106	0,18%
Goal 6 Clean water and sanitation	5 105	2,62%
Goal 7 Affordable and clean energy	10 063	4,23%
Goal 8 Decent work and economic growth	4 862	1,32%
Goal 9 Industry, innovation and infrastructure	8 208	3,16%
Goal 10 Reduced inequalities	2 054	0,63%
Goal 11 Sustainable cities and communities	7 748	1,70%
Goal 12 Responsible consumption and production	5 330	2,59%
Goal 13 Climate action	4 016	2,44%
Goal 14 Life below water	1 886	0,42%
Goal 15 Life on land	3 967	0,53%
Goal 16 Peace, justice and strong institutions	2 247	0,31%

Fig. 2 Number of publications for Poland under each Sustainable Development Goal (for 2017-2021) and the share of Lodz University of Technology in these publications. Source: Scopus, access date 20.10.2022

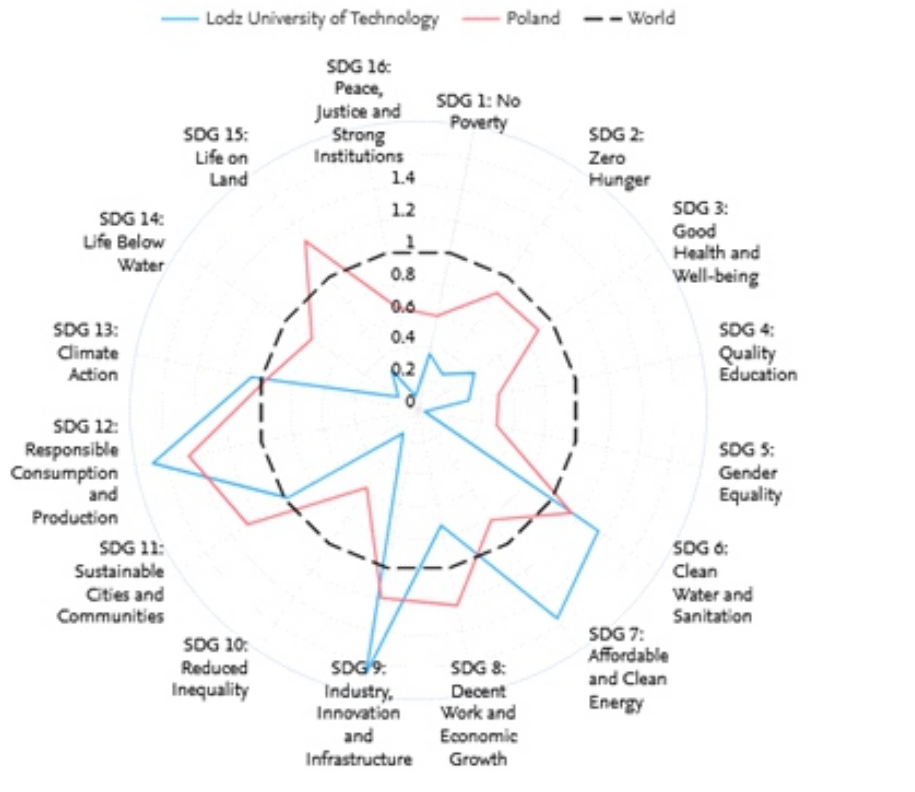


Fig. 3 Relative Activity Indexes for the individual Sustainable Development Goals (for 2017-2021) for the world, Poland and TUL. Source: Scopus, accessed 20.10.202

The above-described trends in research conducted at TUL are confirmed by the Relative Activity Index (RAI) generated in SciVal (Figure 3, Figure 4). This index is defined as the share of university publications in each subject area relative to the global share of publications in that area. A value of 1.0 indicates that the university's research activity in a given area corresponds exactly to the global activity in that area.

A value higher than 1.0 indicates a greater emphasis on that area and a value lower than 1.0 indicates a lower emphasis. Fig. 3 illustrates the high importance attributed at Lodz University of Technology to the implementation of Goal 12 (1.69), Goal 9 (1.67) and Goal 7 (1.56), and the slightly lower (but still higher than the indicator for Poland and the world) importance attributed to Goal 6 (1.35) and Goal 13 (1.06). Detailed figures are included in Figure 4.

	POLAND	LODZ UNIVERSITY OF TECHNOLOGY
■ Goal 1 No poverty	0,6	0,36
■ Goal 2 Zero hunger	0,88	0,27
■ Goal 3 Good healthy and well-being	0,9	0,42
■ Goal 4 Quality education	0,51	0,32
■ Goal 5 Gender equality	0,5	0,04
■ Goal 6 Clean water and sanitation	1,15	1,35
■ Goal 7 Affordable and clean energy	0,82	1,56
■ Goal 8 Decent work and economic growth	1,24	0,73
■ Goal 9 Industry, innovation and infrastructure	1,19	1,67
■ Goal 10 Reduced inequalities	0,58	0,17
■ Goal 11 Sustainable cities and communities	1,28	0,98
■ Goal 12 Responsible consumption and production	1,46	1,69
■ Goal 13 Climate action	0,97	1,06
■ Goal 14 Life below water	0,8	0,15
■ Goal 15 Life on land	1,27	0,3
■ Goal 16 Peace, justice and strong institutions	0,65	0,09

Fig. 4. Relative Activity Indexes for the individual Sustainable Development Goals (for 2017-2021) for Poland and for TUL. Source: Scopus, access date 20.10.2022



### „SOUP ON PIETRYNA”

One of the TUL students actively supports, as a volunteer, the "Soup on Pietryna" campaign in Łódź, from which over 300 people benefit. These are poor and homeless persons. Every week on Sunday at the corner of ul. Skorupki and Piotrkowska, next to the Łódź cathedral, they can get a hot meal, meet other people and talk. Volunteers share with those in need not only food packages, but also a smile, time and a kind word. The initiative is supported by companies from the Łódź region. Sunday lunches are prepared by volunteers. Members of the "Soup on Pietryna" group are also the originators of a mobile bathhouse for the homeless. There, every person affected by homelessness can have a shower and wash their clothes free of charge or, if necessary, get completely new clothes.



### STUDENT VOLUNTEERING

Since 2015, the Young Staff Group of the Polish Association of Construction Engineers and Technicians in Łódź has been implementing the Workcamp project every year. Young volunteers from Lodz University of Technology acquire sponsors, tools and materials to spend their time during the holidays and renovate the facility that needs such revamping the most. Thanks to the initiative in previous years, new and better living conditions were provided to the residents of four orphanages in Łódź, the building intended for the Support Centre for Children and Families was renovated, as well as the destroyed building of the former junior high school. In the academic year 2021/22, Orphanage No. 15 in Łódź was refurbished. As every year, volunteers invited companies and individuals from the construction sector, but also from other industries, to enter into cooperation.

## GOAL 1

**1 NO POVERTY**



**END POVERTY IN ALL ITS FORMS EVERYWHERE**

Icons describing activities under each goal:

-  didactics,
-  processes,
-  social commitment,
-  research.





## WORKSHOPS FOR CHILDREN FROM COMMUNITY CENTRES AND FOSTER FAMILIES

A few years ago, employees of the Faculty of Biotechnology and Food Sciences carried out an outdoor workshop entitled "The Tent of Merry Science" during the picnic on the Day of Foster Families. During the meeting, which took place on the TUL campus, microbiology workshops for children from foster families were also prepared. These individual events over time evolved into a series of microbiology workshops and outdoor meetings "Science is fun", intended for children growing up in foster families and orphanages. In the academic year 2021/22, these workshops were conducted twice - in March (laboratory workshops for children and youth from Ukraine) and in May (classes for children from foster families as part of a picnic for foster parents' candidates organized by the Administrative Centre for Foster Care).



## HELPING PEOPLE IN THE CRISIS OF HOMELESSNESS

Employees of Lodz University of Technology take part in numerous activities related to helping people in the crisis of homelessness, who are the group most at risk and affected by the economic poverty. An example of activities aimed at these people is the active cooperation of the Office for People with Disabilities at Lodz University of Technology with a street worker (and also an addiction therapist), with whose assistance clothes and hygiene products are donated to the homeless. Individual TUL units also joined the project "With Home-No Home Box", which aims to help people without a home get out of homelessness, as well as help in meeting basic needs on their way to life stability. The support goes directly to the person in need and corresponds to their real needs.



## SAINT NICOLAS DAY FOR NEEDED FAMILIES

Students and employees of the Faculty of Technical Physics, Computer Science and Applied Mathematics have been holding the "Operation: Saint Nicholas' Day". This is an event aimed at helping a family in need, which thanks to the support has a chance to improve their difficult situation and to spend Christmas happily. In order to help a selected family, online fundraising is organized, and the funds are used, for example, for the purchase of a laptop for remote learning. Food products, cleaning products and school supplies for children are also collected. Each donated product is a significant support for a family in need.



## FINANCIAL ASSISTANCE FOR STUDENTS AND EMPLOYEES OF TUL

TUL employees can use various forms of assistance financed by the Internal Social Benefits Fund. In 2021, 2 709 children of TUL employees benefited from co-financing for holidays organized on their own during the winter and

summer holidays. 28 people were granted loans so as to obtain their first independent flat or to improve their housing conditions. Loans for renovation and modernization of flats, granted on favorable terms, were also very popular. 108 people received them. Non-refundable financial aid was provided to 215 people. In 2021, 883 employees received a cash equivalent for a Christmas package for children, and 122 people benefited from subsidies to nurseries and kindergartens.

Students and participants of doctoral studies at Lodz University of Technology can also apply for financial support. In 2021, 509 students received social scholarships, 864 students and 23 doctoral students received the rector's scholarship, 109 students and 4 participants of doctoral studies - a special scholarship for people with disabilities. A student or doctoral student who is temporarily in a difficult life situation may apply for financial aid - 65 people, including 7 doctoral students, benefited from such assistance in 2021.







## POTATO - "SECOND BREAD" WORTH PROTECTING

Potatoes are the most common vegetable grown in large-scale rural areas as well as in home gardens. They are called the second bread. Unfortunately, they are very susceptible to diseases, as a result of which on average up to 20% of the crop is lost. This problem is faced by a team of scientists from the Faculty of Biotechnology and Food Sciences, whose aim is to develop an ecological biopreparation that inhibits the growth of plant pathogens that cause seed potato diseases, as well as an effective method of storing tubers. Many months of intensive work in the laboratory ended successfully. The most active microorganisms and plant extracts were selected. The optimal method of tuber dressing was also selected.

At the same time, scientists strive to develop the most favourable storage conditions for seed potatoes, taking into account the basic parameters of the environment: temperature, humidity, lighting and aeration. The results of laboratory tests are subject to continuous verification at the Institute of Horticultural Research in Skierniewice, where the morphological and physiological characteristics of potatoes are assessed. The result of the project will be an ecological biopreparation for dressing seed potatoes, based on products of microbial origin and plant extracts, fully characterized in terms of species composition, chemical composition and activity against potato phytopathogens. In turn, the prototype of the cooling chamber will be a ready-made solution, especially for small producers, but in the future, it may become the basis for a project dedicated to farms dealing with the large-scale production of seed potatoes.

## GOAL 2

2 ZERO HUNGER



END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION AND PROMOTE SUSTAINABLE AGRICULTURE





## NEW GENERATION FRUIT AND VEGETABLE PRODUCTS

The problem of overweight and obesity in children is becoming increasingly important and noticeable. Scientists from the Faculty of Biotechnology and Food Sciences of Lodz University of Technology are conducting research as part of a project whose main goal is to develop and implement a technology for the production of unsweetened vegetable and fruit preserves enriched with a fibre preparation with prebiotic properties from potato starch and with organoleptic characteristics acceptable to children and adolescents and appropriate stability storage. There are also studies evaluating the effect of enriching vegetable and fruit preserves with a starch fibre preparation with prebiotic properties on overweight and obese children and its metabolic complications.



## SAVE THE BEES

In the last decade, the phenomenon of mass extinction of honeybees has been observed in Poland and in the world. Pathogens, parasites, loss and fragmentation of natural habitats, climate change and environmental pollution are the most common causes. The result is a decrease in the bees' immunity and an increase in their susceptibility to bacterial infections,

such as American foulbrood (*Paenibacillus larvae*) or European (*Melissococcus plutonius*).

Reducing the population of these insects has a very negative impact on agricultural production and natural ecosystems.

Therefore, there is a growing interest in ecological preparations, developed on the basis of natural ingredients, which would strengthen the immunity of bees.

They include e.g. probiotic preparations.

The Faculty of Biotechnology and Food Sciences conducts research aimed at developing an ecological protective biopreparation based on probiotic microorganisms. The intensive laboratory research, which has been going on for over two years, has been successful - the strains of lactic acid bacteria with the strongest antagonistic properties against bee pathogens and the most active in terms of pesticide detoxification have been selected. Currently, work is underway to learn the mechanisms of the tested activities and to assess the probiotic features of selected strains. The result of the research will be the construction of an innovative ecological probiotic preparation intended for bees, containing selected, most active strains of bacteria with health-promoting properties.

The research is carried out as part of a project obtained from the Provincial Fund for Environmental Protection and Water Management in Lodz



## INNOVATIVE TECHNOLOGY OF KOMBUCHA PRODUCTION

Kombucha is a fermented tea drink with interesting taste and health benefits.

A big problem for the producers of this drink is to achieve repeatability of chemical parameters and sensory properties.

In addition, kombucha, which contains live microorganisms, requires refrigerated storage and transport, and its pasteurization adversely affects the bioactive compounds present in the drink.

The Institute of Fermentation Technology and Microbiology of Lodz University of Technology is a partner of the project, the aim of which is to implement an innovative technology for the production of kombucha with an attractive taste and aroma, increased health-promoting effect and extended shelf life compared to beverages of this type available on the market. A novel approach to the problem of kombucha stabilization is the use of extracts or pure bioactive substances of plant origin. This will improve the microbiological stability and the taste and aroma of the drink, as well as its health-promoting properties. It will also be possible thanks to the replacement of hot tea brewing with cold extraction of tea leaves and the use of newly obtained strains of microorganisms.



## DIDACTICS - SUSTAINABLE DEVELOPMENT OF THE FOOD ECONOMY

The offer of the Faculty of Biotechnology and Food Sciences includes the field of study Food Technology and Human Nutrition, in which students learn about issues related to the sustainable development of the food economy in the sectors of the food industry, agriculture and biodiversity. The acquired knowledge and competences raise the awareness of the future management staff of production plants and enable them to act in accordance with the assumptions of the 2030 Agenda. Thanks to the acquired skills, students are able to develop safer, ecological and competitive products and services in the agricultural and food industry sectors. A new field of study, Food and Nutrition Manager (engineering studies conducted on a full-time basis), which also launched at the same Faculty. Students of this field gain knowledge in the field of food and nutrition technology, management and marketing, also in the context of sustainable development. After completing their education, they will be able to manage the service of catering companies in the hotel, catering or agritourism industry.



### LODZ CHILDREN'S HOSPICE

"Lodz Children's Hospice — Łupkowa" was the first organization in Poland, undertook permanent home care for terminally ill children breathing with respirators. It operates a 24-hour centre for mechanically ventilated patients. The facility cannot function without efficient medical equipment, mainly serviceable respirators. The tables on which the ventilators stand was originally equipped with adjustable booms, with plastic handles-pendants that hold the tube leading air to the lungs of the patient. Unfortunately, during repeated procedures with the patient, the handles-pendants wear out. TUL Faculty of Mechanical Engineering came to the rescue, producing the necessary specialized fixtures using 3D technology. TUL is also participating in the 'Zostań Super Zakrętki' campaign. This is an ecological project which, by collecting bottle caps, supports the charges of the Lodz Hospice in making their dreams come true. Caps can be left at designated locations at the university or directly at the Office for Persons with Disabilities; they are then collected by BON staff and picked up by the Hospice.



### PSYCHOLOGICAL SUPPORT FOR THE TUL COMMUNITY

Lodz University of Technology has an Academic Trust Centre, which works with an addiction therapist, coach, psychologist, providing specialized educational and psycho-preventive support. It is an initiative implemented by the Office for Persons with Disabilities, in which individual psychological consultations are offered free of charge for students, doctoral candidates, graduates and employees of TUL. The Centre offers development-oriented sessions, psychological short-term support, emergency assistance. Meetings with a psychologist take place either in person at BON or online. As part of this initiative, there were approximately 20 consultations per week during the 2021/22 academic year. Additional support from a psychiatrist was also put in place during this period. Students with disabilities used coaching sessions (approx. 6 hours a week), workshops on communication, emotion management, and art therapy.

## GOAL 3

**ENSURE HEALTHY LIVES  
AND PROMOTE WELL-BEING  
FOR ALL AT ALL AGES**

**3 GOOD HEALTH  
AND WELL-BEING**





## A HEALTHY BODY MAKES A HEALTHY SPIRIT

Students and employees TUL participate in many physical activities organized by the university. In autumn and spring, cycle rallies are organized on routes of varying length and difficulty. Every year, in late spring there are also running competitions — the Rector's Cup run. This sporting event has been held since the 80's. Approximately 800 people attend the event annually. In the academic year 2021/22, due to Covid-19, the event was not held. However, Cooper tests were carried out for more than 300 people. In total, 16 sports events were held for students in the academic year 2021/22 (e.g., TUL Table Tennis Championships, Fitness Marathon, time climbing on the climbing wall), attended by over 1500 people. Sports activities for employees (swimming, fitness, stretching and stabilization, healthy spine, pilates, etc.) were also launched, which were used by about 200 people in the academic year 2021/22.



## ENCAPSULATED HONEY

Honey is a natural product with high nutritional value and health-promoting properties. However, a significant proportion of bioactive compounds do not reach the intestine due to their high lability and degradation due to low pH of stomach acids. Scientists from the Faculty of Biotechnology and Food Sciences at TUL have encapsulated the result of bees' work. They obtained a fixed honey preparation in the form of microcapsules, using the spray drying method. They produced innovative honey microcapsules using natural biopolymers. An innovative method used for the first time in the world allowed to reduce the loss of bioactive compounds found in honey, resulting from the destructive effects of gastric juice and digestive enzymes. Studies have shown broad health-promoting effects of developed microcapsules. The developed method of fixing honey by its encapsulation is protected by patent application. Possibilities of encapsulation of other bee products, i.e., royal jelly, bee venom and other raw materials with high bioactive potential, are also being investigated.



## MINIATURE DEVICES FOR ORTHOPEDISTS

Complete hip replacement is one of the most performed implant operations in the world. One of the main problems during surgery is measuring whether there has been a change in the position of the femur. The difference in the length of the lower limbs is among the postoperative complications that reduce the expected improvement in quality of life. The Faculty of Mechanical Engineering and Robotic Medical Solutions Sp. z o.o. have cooperated on the development of a new product - an orthopedic miniature measuring arm for intraoperative measurements.

The purpose of this collaboration is to design, implement and manufacture an innovative medical device. As part of the project, metrological studies and medical experiments will be carried out to develop the design and software of an orthopedic miniature measuring arm useful during hip replacement implantation surgery. It will be designed to measure the change in length and offset to the side of the lower limb.





## SMART DRESSINGS FOR CHRONIC WOUNDS

Chronic wounds are caused by a prolonged inflammatory phase during the healing process, which consequently prevents skin regeneration. Dedicated wound dressings are helpful in these situations, which are able not only to protect them from the environment, but also to promote skin regeneration and accelerate the healing process. Scientists from the Faculty of Chemistry at TUL are taking part in an international research project aimed at creating a dressing for skin wounds that promotes the healing process and releases antimicrobial peptides against a group of major bacterial and fungal pathogens that are relevant in nosocomial infections.

The designed material opens new directions for next-generation dressing materials, tailored for different types of wounds and to combat life-threatening infections with specialized drugs and thus new treatment concepts that greatly improve wound healing. The partners of the project alongside scientists from the Faculty of Chemistry and the International Centre for Research of Innovative Biomaterials (ICRI-BIOM) of Lodz University of Technology are: Medical University of Lublin, Ulm University (Germany), coordinator of the German side and Max Planck Institute for Polymer Research (Germany).

Prof. Joanna Pietrasik



## VR APPLICATIONS A WAY TO REDUCE STUDENT STRESS

Chronic and intense stress negatively affects the immune system and causes mental and physical health problems. The WHO has called stress a “21st century health epidemic.” Recent research has shown that VR can redefine psychological treatment, creating environments that help patients cope with experiences that are the source of mental crises. Researchers from the Faculty of Electrical, Electronic, Computer and Control Engineering at TUL coordinate the Erasmus+ project “VRxAnny”, whose main goal is to improve the well-being of students suffering from acute, episodic and chronic stress as well as fears and depressive symptoms.

The main result of the project will be the creation of special relaxation points, so-called “chill spots”, located on the campuses of all partner universities, equipped with a VR system for stress and anxiety reduction. Ultimately, as many as 12 such innovative VR relaxation zones will be created at partner universities, which will be able to serve up to a dozen thousand students a year. In these unique places, students will be able to relax in the virtual world. A team of researchers from Lodz University of Technology, the University of Lodz, the University of Vigo (Spain) and the University of Tartu (Estonia) are developing a VR application that is designed to be a relaxation workout.



## ANGIOEXPERT'S INNOVATIVE MEDICAL DEVICE

In cooperation with Lodz University of Technology with the spin-off company Angionica, the unique medical device AngioExpert was created for non-invasive diagnosis of vascular circulatory disorders. The device is a response to the needs of diagnosing the health of our society. The basis of the operation of the device is the use of an innovative method developed by scientists from the Faculty of Chemistry, TUL and Collegium Medicum. The method is based on measuring changes in fluorescence intensity of NADH coenzyme in the skin of the forearm in response to forced stop and release of blood flow.

This innovative method, which has worldwide applications, has been patented in Poland, but also in the EU, USA, Canada, China, Japan, Australia, Russia. The most important applications of the developed method include: assessment of microcirculation disorders in diabetes mellitus, cardiovascular diseases and hypertension, monitoring of treatment of difficult healing wounds (including diabetic foot), or assessment of tolerance of physical exertion in amateur and competitive sports. Research using the AngioExpert device is not yet widely available, but in Lodz they are conducted in two medical centers: at the Policlinic Medical Center of the Lodz University of Technology Foundation and in the Medical Center of the Holly Family Hospital.



## STRESS REDUCTION IN VIRTUAL REALITY FOR REFUGEES FROM UKRAINE

Researchers from the Faculty of Faculty of Electrical, Electronic, Computer and Control Engineering, in cooperation with the Institute of Psychology of the University of Lodz, have developed an innovative tool for stress reduction.

Thanks to cooperation with the City Hall, it can help refugees from Ukraine to fight post-war trauma. The pilot programme started on April 7, 2022 at the Urban Activity Bureau in Lodz. 40 people were invited to participate in the programme. Each session lasted about 20 minutes, during which participants moved to a luxurious suite in the mountains, where the guide's calm voice gave basic information about the visual elements of their surroundings and how to breathe during the session. A version in Ukrainian was prepared. The session combines several classic relaxation techniques such as visualization and breathing techniques. It works much like the REM phase of sleep. Virtual reality has been used for several years as a therapeutic method for stress reduction, treatment of depression, phobias or anxiety disorders. Its beneficial action has been proven more than once scientifically, also by a team of scientists from the Faculty of Electrical, Electronic, Computer and Control Engineering, TUL.





## EXOSKELETON A CHANCE TO RECOVER FASTER

Movement disability carries severe consequences for an increasingly large part of society. In addition, in the near future, a significant increase in the burden on the health care system is anticipated, associated with an increase in life expectancy. Accordingly, it is necessary to look for effective ways to rehabilitate patients. Therapy assisted by lower limb exoskeletons is increasingly popular, but there are still many problems that are important in terms of minimizing the costs of implementing proposed solutions as well as their adaptation to individual needs of users while maintaining universality. A team of scientists from the Faculty of Mechanical Engineering, which is conducting work on the exoskeleton of the lower limbs for the early rehabilitation of patients, comes to the rescue.

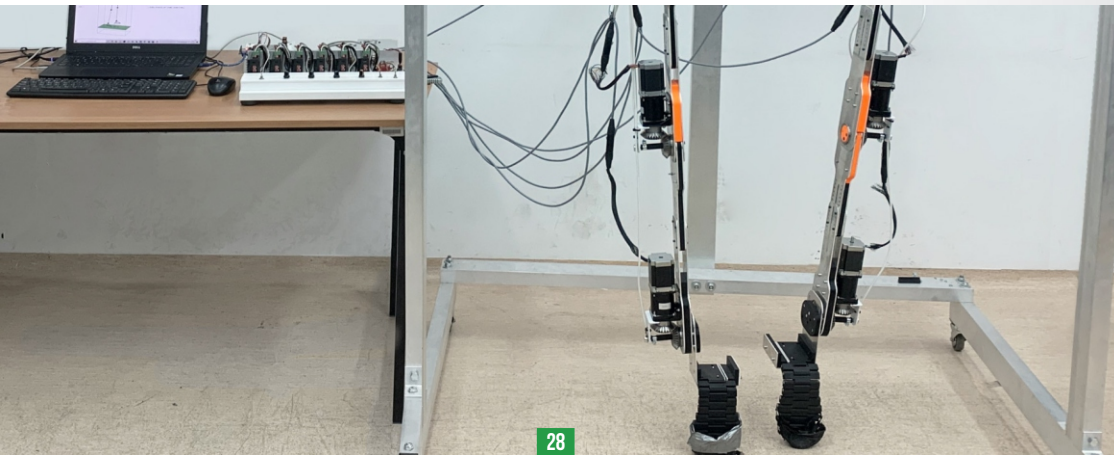
The research uses modern tools such as a motion capture system or ground reaction force platform, purchased through funding from the OPUS grant granted by the National Science Centre. Based on recorded kinematics and dynamics of normal gait, as well as electrical activity of muscles during walking, mathematical models of the gait pattern were developed, which were implemented in the exoskeleton control system. A dedicated simulation model has also been developed, which aims to visualize changes in the position of individual elements of the device during movement implemented according to the proposed patterns. The research is mainly aimed at rehabilitation applications, but the experience gathered during the project will also be able to be used, for example, in the construction of bipedal robots or exoskeletons intended for military and industrial use.



## MOBILLY ACTIVE

In the era of the pandemic, forced to stay at home, we often neglected physical activity, which had a negative impact on our health and well-being. In response to this problem, a mobile application programming competition was organized at the Faculty of Technical Physics, Information Technology and Applied Mathematics. It was attended by 110 participants - students of Applied Computer Science and Information Technology, including exchange students from Portugal. Their task was to create applications that support physical development. The competition organizers expected to design mobile apps that would act as a motivator to get fit. 45 projects were influenced by the competition; the top 10 were selected for the final.

The jury took into account the technical and business layer, as well as practicality and social usefulness. The sponsor of the technology part was BinarApps. The top prize was won by Fit Vein, which is a social-fitness app for iOS mobile devices. It is a product that makes it easy to carry out workouts, track progress, monitor current health parameters and share updates along the lines of Facebook or Instagram. In addition, the user is rewarded with new profile levels and medals for carrying out various activities in the app.





## CHILDREN'S UNIVERSITY OF LODZ (LUD)

Children's University is a non-departmental unit where children develop their curiosity about the world and learn the secrets of technical knowledge in a simple and fun way. Since 2008, he has been successfully organizing workshops and lectures for children and young people, which are held in TUL laboratories. They are mostly conducted by academics at the university, but lecturers and experts in various fields, from home and abroad, are also invited. In 2021, LUD's offer included 256 online workshops, 130 onsite workshops, 16 online workshops 'From a different perspective', five workshops for parents, workshops for young people aged 13-16. 700 children and 250 parents benefited. Winter holidays with LUD were also organized - 26 workshops, 170 participants. LUD is also implementing the international project PHERECLOS (Partnerships for pathways to Higher Education and science engagement in Regional Clusters of Open Schooling), under which 6 education clusters are being established in different countries around the world. The only Local Educational Cluster (LEC) in Poland is being established at Lodz Children's University. The LEC held its first online conference in 2021, titled „Competencies and professions of the future" organized by Junior LUD Volunteers, which was attended by 560 children and parents.



## ACADEMIC TUTORING AT TUL

Commissioned for implementation by the MEiN, the "Masters of Teaching" project is aimed at students who want to benefit from short-term tutoring support. It is provided free of charge, individually or in small groups over a period of one semester. The meetings are led by TUL staff trained for this purpose during study visits abroad to top European universities - University College London, Ghent University, University of Aarhus, University of Groningen and University of Oslo. Classes implemented by the tutoring method develop students' academic, social and personal competencies. Personalized education allows for individualized work with both outstanding students and those struggling with learning difficulties. In the tutoring method, the student learns to think independently, think critically, seek sources of inspiration and present his achievements. Participants benefit from the "student-master" relationship. From the teacher's perspective, cooperation with the mentee is built quite differently than in traditional classes. The teacher learns a lot from and about students, and this knowledge comes in handy in his daily work. In 2020 and 2021, about 500 students will receive tutor support.

## GOAL 4

**ENSURE INCLUSIVE AND  
EQUITABLE QUALITY EDUCATION  
AND PROMOTE LIFELONG LEARNING  
OPPORTUNITIES FOR ALL**

**4 QUALITY  
EDUCATION**







## PUBLIC SECONDARY SCHOOL OF LODZ UNIVERSITY OF TECHNOLOGY

Lodz University of Technology runs the TUL Public Secondary School. It was the first university secondary school in Lodz. It is an important link in the series of training engineering staff for industry. The curriculum includes additional subjects in science (mathematics, physics, chemistry, biology, computer science) and foreign languages (mainly English). Classes in these subjects are implemented with increased number of teaching hours. Thanks to the high demands placed on the teaching staff and students, TUL Secondary School has in a very short time become one of the best educational institutions in Poland. In the 2021/2022 school year, a total of 429 students studied at the Secondary School, and the school gained another 110 graduates.



## UNIVERSITY OF THE THIRD AGE (UTW)

UTW was established in 2006 as an integral organizational unit of the university, in response to the educational needs of senior citizens. The activities of the UTW are aimed at the psycho-physical and social activation of the elderly. Classes are held in an academic year consisting of two semesters. Students attend popular science lectures, covering topics related to scientific and technological achievements, preventive health care, or legal proceedings. They can also develop their skills in the following sections: information technology, new technologies, foreign languages, fine arts, history, bridge, tourism, as well as enjoy a variety of gymnastics classes and the swimming pool at the TUL Sports Bay. A total of 1,376 hours of classes were held in the 2021/22 academic year, benefiting 880 seniors (including 602 regular students and 278 participants in open community classes).



## INSPIRING NEWTON ROOM

The first permanent Newton Room in Poland opened in November 2021 at the Public Secondary School of Lodz University of Technology. This is the result of the university's agreement with global aircraft manufacturer Boeing and the non-profit foundation FIRST Scandinavia. The Newton Room concept was temporarily implemented at the same school back in 2019. It was a successful experience that laid the groundwork for a new partnership. The space has been opened to inspire young people with knowledge in the STEM (science, technology, engineering and math) fields. Modern workstations have been installed in the Newton Room studio. Here, students can experience immersive experiments, pursuing hands-on topics related to math, robotics or renewable energy.

The Newton Room is located on TUL premises but can be used free of charge by students from other institutions. In the 2021/22 academic year, more than 1,800 students from schools in Lodz benefited from classes at the studio. During this time, an Aviation module was mainly implemented, and a Biofuels class was also piloted and included in the full offer from 1 September 2022. The module is aligned with the primary school chemistry and biology core curriculum (module for younger children) and the secondary school core curriculum (version for older children). Participants in this module study two stages of industrial biofuel production: enzymatic degradation of wood to sugar and fermentation of sugar to fuel (ethanol). They also evaluate and discuss biofuels in the context of sustainability.





## ROBOTICS FOR EDUCATION

The Faculty of Electrical, Electronic, Computer and Control Engineering at TUL is coordinating two new international projects that have received funding from the Erasmus+ programme. The project "HEART - Help educators to teach through robotic tools" envisages activities aimed at several groups related to adult education, primarily their teachers and professionals working with adult learners with disabilities, seeking innovative tools and supporting technologies. HEART project partners are: e-Nable Greece (Greece), Associacio Programes Educatius Open Europe (Spain), Lidi Smart Solutions (Netherlands), Fondazione Istituto dei Sordi di Torino ONLUS (Italy) European Development Foundation (Bulgaria).

A complementary project in the area of school education is "Ready, Teady, Go!" aimed at students aged 9-14 with special educational needs, as well as teachers and educators.

Non-governmental organizations, including, among others, public education centres and socio-therapeutic day care centres for children and adolescents, are an important target group for these activities. The project is being implemented in cooperation with foundations and organizations from Italy (Fondazione Istituto dei Sordi di Torino ONLUS), Cyprus (A & A Emphasys Interactive Solutions Ltd.), Spain (Associacio Programes Educatius Open Europe), Greece (e-Nable Greece), Lithuania (Sutrikusio intelekto zmoniu globos bendrija "Vilniaus Viltis") and Poland (Foundation Institute of Social Re-Integration). Examples of the project's results include a platform providing learning materials that additionally includes an interactive space for users, or a mobile app with an avatar of the eponymous Teady bear to support children's learning.



## COOPERATION WITH SECONDARY SCHOOLS

The PE has a wide range of activities implemented for the development of science and technology skills and competencies of children and young people (making modern scientific and teaching laboratories available to students, a wide range of lectures at schools, science subject competitions, the possibility of applying for TUL patronage, etc.). Within the framework of cooperation with high schools, since 2010, lecturers of the Centre of Mathematics and Physics at TUL, in cooperation with the Institute of Physics, have been organizing a "Week with Mathematics and Physics" for students from five schools in the Lodz Voivodship, with nearly 200 students participating annually. The university also takes the initiative every year to support high school students in preparing for the Matura, this support ranges from courses to organizing trial exams. In 2021, the Centre of Mathematics and Physics ran two such courses, and the Faculty of Electrical, Electronic, Computer and Control Engineering, in turn, prepared trial exams in mathematics, computer science, physics and chemistry, which were open to all students nationwide. Trial Matura exams are conducted on the [infimat.p.lodz.pl](http://infimat.p.lodz.pl) platform but are also sent out to schools and posted on the Faculty's website.

The online version was taken by 3,500 students from across the country in the 2021/22 academic year. The faculty also organizes a number of nationwide competitions for high school students, such as: "First Step to Nobel Prize - Lodz University of Technology Rector's Cup Competition", "First Step to Fields Medal - Lodz University of Technology Rector's Cup Competition", "Fascinating Physics", or "InfoSuccess" (IT competition).



## COMPETENCE EXAMINATION USING THE CASE STUDY METHOD

Lodz University of Technology is the only university in Poland that confirms the quality of the qualification awarded, and thus the quality of the university diploma in a comprehensive manner. In addition to the diploma exam, a proprietary competence exam model was developed based on case study methodology. This exam verifies the student's achievement of the aggregate key competencies specified for the study program. It consists of analyzing the descriptions of selected specific events in the field of study with all their complexities and difficulties. Training and organizational support for the implementation of this formula is offered by the Centre for Teaching and Learning - Teaching Support Section.





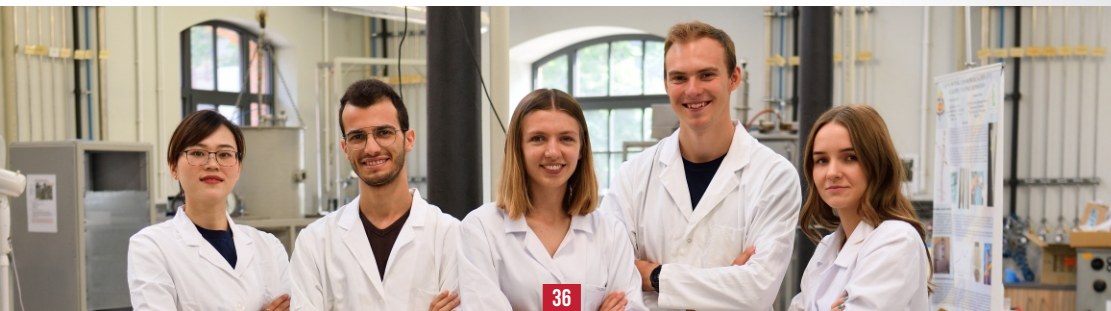
## SUSTAINABLE DEVELOPMENT IN EDUCATION PROGRAMMES

TUL includes in its curricula subjects in which students acquire the knowledge and skills needed to promote sustainable development so that at least one course in each field of study addresses this issue. The university also offers fields of study entirely dedicated to sustainability, such as Bioeconomy, Sustainable Bioeconomy, Environmental Engineering, Environmental Engineering in Construction, Networks and Installations in Environmental Engineering, Information Technology in Environmental Protection, Urban Revitalisation, and conducted in a foreign-language Advanced Biobased and Bioinspired Materials. In turn, all programmes conducted in a foreign language in cooperation with the International Faculty of Engineering (IFE) include the subject Civic Knowledge and Engagement, in which students carry out various activities for the development of themselves, TUL and the social environment. These may include volunteering for a university, or volunteering for a non-profit organization.



## FRENCH YOUNG ENGINEER ACADEMY

IFE, in cooperation with the French Embassy in Poland and the International Association Agence Universitaire de la Francophonie (AUF), runs a prestigious, multi-year project for young people from Lodz and the Lodz region called the French Academy for Young Engineers (FAMI). The aim of the venture is to popularize youth development in the field of French technology and culture, as well as to show young people the great opportunities that knowledge of the French language offers in later professional life. Schools from the Lodz Voivodship that have been promoting the French language and French culture among their students for years have been invited to join the project. Adeptes of the Academy learn French under the guidance of an experienced native speaker and hold a series of workshops with representatives of French companies. Each year, they create unique group projects that address social problems from within the city, region or nationwide. Since the beginning of the project, 140 people have participated, with 22 participants in the 2021/22 academic year.





## GOAL 5

**5** GENDER  
EQUALITY



**ACHIEVE GENDER EQUALITY  
AND EMPOWER ALL WOMEN  
AND GIRLS**



### GENDER EQUALITY IN HR

A significant part of the scientific achievements of Lodz University of Technology due to women, accounting for 37% of employees in the research and teaching staff group, 33% in the research staff group and 42% in the teaching staff group. Among all TUL employees, women account for 51.3% (38.5% among teachers and 61.1% among non-academic staff). In the university's management staff, the deans of four of the nine faculties are women. The proportion of all women among deans and vice deans is 55.26%. The percentage of women among all management positions at the university is 43.40%. Women account for 39% of PhDs, 35% of post-doctoral fellows employed at TUL. Only 26% of those holding the title of professor are women, which reflects the effect of decades of the higher education system and the socio-economic conditions in Poland. Changing this unfavourable trend requires a number of comprehensive measures, also taken outside the field of higher education. Tasks that are feasible to implement at TUL, on the other hand, are proposed in the 2022-2024 Action Plan.

Among students in the 2021/22 academic year, women account for 38.7%, among doctoral candidates - 45.7%, and among graduates - 45.3%.



### GIRLS AS ENGINEERS!

The campaign "Girls an Engineers!" is the largest project promoting technical, engineering and science majors among young women in Poland and Central and Eastern Europe. The initiative, launched by the Conference of Rectors of Polish Technical Universities and the Perspektywy Educational Foundation, aims to break stereotypes in thinking and encourage girls to pursue technical and science studies. The idea for the project was born in 2006. Since then, the popularity of technical universities among female high school students has increased significantly. The project is guided by the belief that female science and technology graduates must contribute to the creation of new solutions in the scientific and technological field, because their potential and creativity are important for the country's innovation. Lodz University of Technology has been actively participating in the campaign for 16 years.

**51,3 %** 

**OF ALL EMPLOYEES  
OF TUL ARE WOMEN**



## GENDER EQUALITY PLAN

In December 2021, the Rector of TUL signed the Plan for Gender Equality at TUL. The document provides for ensuring equality, in accordance with the principles of the European Charter for Researchers, and is the result of efforts by university authorities to raise awareness of the importance of equality issues. The plan covers all groups of employees and undergraduates of all degrees, including the doctoral group, from which the majority of the research and teaching staff at TUL originates. It contains two parts: a diagnosis of the current situation based on a wide range of figures and an analysis of the university's current institutional and legal situation, and proposals for gender equality measures with an implementation horizon until 2024. The document designates 28 activities assigned to four areas: Institutional infrastructure; Gender balance in leadership, decision-making and research; Gender equality in recruitment and career development; and Work-life balance and organizational culture. Among other things, as part of the implementation of this Plan, equality officer positions were created and an Anti-Discrimination, Anti-Harassment and Anti-Bullying Committee was established. A tab with information about activities undertaken in this area has been launched on the TUL website: <https://p.lodz.pl/pracownicy/rownosc-plci-w-politechnice-lodzkiej>.

With a Gender Equality Plan in place, TUL fulfils a formal condition for participation in competitions announced by the European Commission, under the Horizon Europe program effective from 2022.



## PERSPECTIVES "WOMEN IN TECH"

In 2022, Lodz University of Technology was an academic partner of the Women in Tech Summit event, organized by Perspektywy. It is the largest academic event for women in TECH & IT in Europe, where they share their stories, academic achievements and visions for the technological future of the world. The idea for the Women in Tech Summit Perspective was conceived in 2017. Since then, this event has brought together female representatives from academia and industry, IT professionals, experts in the field of innovation, and students to share their experiences and hint at career planning.



## INTERNATIONAL DAY OF WOMEN AND GIRLS IN SCIENCE

Lodz University of Technology is promoting International Women and Girls in Science Day, which falls on 11 February. As part of its promotional activities, the university participates in projects and campaigns, influencing changes in women's careers. Meetings are being held to highlight the important role of women in science, and initiatives are being implemented to encourage female students to take an interest in research careers. In the academic year 2021/2022, to celebrate this day, the Polish Young Academy - Polish Academy of Sciences invited female students of the first years of their studies to a meeting in the series 'Become a Researcher'. Participation in this free online event with female researchers representing various universities in Poland was an opportunity to meet young female scientists for whom work and science are a passion. During the meeting, Lodz University of Technology was represented by two female researchers from the Faculty of Process and Environmental Engineering and the Faculty of Electrical, Electronic, Computer and Control Engineering, who talked about their scientific interests and work at the university, the benefits of being a researcher and the challenges awaiting women in scientific work.



## EUROPEAN CHARTER FOR RESEARCHERS

The European Charter for Researchers, respected at Lodz University of Technology, specifies, among other things, the principles of gender balance and personnel selection. Grantmakers and/or employers should aim for a representative gender balance at every level of the workforce, including supervisors and managers. This goal should be achieved on the basis of a policy of equal opportunities at the recruitment stage and subsequent career stages, but without lowering quality and qualification criteria. In order to ensure equal treatment in personnel selection and candidate evaluation committees, there should be an appropriate gender balance. Committees, when selecting candidates, should represent a variety of experiences and qualifications and have an appropriate gender balance, and, if necessary and possible, consist of members from different industries (state and private sector) and disciplines, including individuals from different countries with relevant experience to evaluate candidates. If possible, a wide range of candidate selection practices should be used, such as evaluation by an external expert and direct interviews with the candidate. Members of the panel that selects candidates should be properly trained.



## INDUSTRIAL WASTE CLEANING

The textile industry is firmly rooted in the history of Lodz, and the ubiquitous post-industrial architecture does not allow us to forget textiles as the driving force that created and shaped this city. Like any industrial activity, textiles have a negative impact on the environment. The greatest burden on it is the enormous amount of water used and the emission of wastewater, which has a noticeable impact on the local environment. The conservation of water resources is one of the key sustainability goals that can be realised through recycling. Currently, one of the most promising methods that has implementation potential is the ozonation of wastewater in the presence of a catalyst.

This research topic is being tackled by a team of scientists from the Faculty of Process and Environmental Engineering. The most important stage of the project is the generation of the catalyst. Cold plasma comes to the aid of the research, which has produced special thin-film catalysts applied to a solid substrate with an elaborate geometry. Their effectiveness has already been confirmed. The research is geared towards the development of a ready-to-implement technology showing potential for commercialisation. For the research purposes of the project, a special reactor has been developed to enable the practical application of the catalyst, including on an industrial scale. The developed technology will be submitted for patenting.

dr inż. [Lucyna Bilińska](#)

## GOAL 6

**6 CLEAN WATER AND SANITATION**



**ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL**





## EDUCATION - SUSTAINABLE MANAGEMENT OF WATER RESOURCES

TUL's educational offer includes a number of fields of study and specialisations, educating future engineers aware of the challenges of water management, depleting water resources and the need for action. These include:

- Environmental Engineering,
- Chemical and Biochemical
- Engineering, Architecture,
- Construction,
- Urban Networks and Installations in Environmental Engineering.



## COMMON PREVENTION OF THE EFFECTS OF DROUGHT

The Polish Academy of Sciences, 15 universities (including TUL) and the Ministry of Climate and Environment are working together to tackle drought in Poland. Representatives of these institutions signed a letter of intent to cooperate for an in-depth analysis of drought prevention measures in the country. The signing of the letter of intent also marked the inauguration of the susza.gov.pl platform, which covers the issue of drought in the country in a consolidated manner in terms of the activities of government administration and its subordinate units. The cooperation will consist in the exchange of knowledge and experience and the use of the scientific and didactic potential of the scientific community. An important element of this will be working on modern and innovative solutions and technologies to reduce the effects of drought and the scarcity of water resources in the country.



## STORMWATER POLAND 2022

The 6th edition of the Stormwater Poland conference took place in September 2022, under the motto: It's time for rainwater! The Scientific Committee of the Conference included a representative of the TUL's Faculty of Civil Engineering, Architecture and Environmental Engineering. The conference included 4 thematically diverse sessions. The first concerned specific rainwater projects and increasing rainwater retention in Upper Silesian and Zagłębie cities. The second block of the conference addressed the issue of the impact of the quality of rainwater or snowmelt runoff on receiving waters. The third session discussed the status and prospects of smart rainwater infrastructure. Attention was drawn to the recently announced 'Hydrostrateg' programme by the National Centre for Research and Development, highlighting that this is the first such fund dedicated to water in Poland and a huge development opportunity. The final session focused on the maintenance of drainage and retention systems, including good practices and technical solutions to protect drainage infrastructure from devastation and premature decapitalisation. The conference highlighted how great a challenge the increasing water shortages in our country are and that without innovation and without taking care of rainwater, we will not be able to ensure a better future for the next generations.



## RESEARCH FOR SURFACE WATER POLLUTION

Freshwater scarcity is a global problem. An increase in demand for water and, at the same time, a deterioration in its quality results from the intensive development of agriculture and industry. Poland is a country particularly threatened by water scarcity; therefore, in addition to the rational use of water resources, constant control of surface water quality is also necessary. As part of a project carried out by the TUL's Faculty of Chemistry, systematic monitoring of surface water in the Lodz region has made it possible to identify the main sources of pollution and to determine the dynamics of changes in the composition of water in temporal and spatial terms in selected rivers. The results of these studies can be used by local authorities and other entities responsible for developing environmental protection and water management plans in the Lodz voivodeship. The analyses conducted should contribute to an improvement in the condition of surface waters, and thus the quality of life of the region's inhabitants.





## MODERN TECHNOLOGICAL SOLUTIONS IN ENERGETIC BIOMASS VALORISATION - INDUSTRIAL IMPLEMENTATION

Acquiring sustainable gaseous fuels in the form of methane and hydrogen with the simultaneous management of biodegradable waste and its conversion to valuable fertilisers using anaerobic digestion has long been an object of research by TUL scientists. In their current work, TUL scientists are focusing on the implementation of scientific results on a larger scale. Researchers at the Faculty of Biotechnology and Food Sciences are developing an innovative technology for converting fruit and vegetable waste into methane, hydrogen and high-value organic fertiliser. It is based on a two-stage AD process for fruit and vegetable waste, where hydrogen is recovered in the first stage and methane in the second. The results obtained will be used to develop a biogas plant at Warmińskie Zakłady Przetwórstwa Owocowo-Warzywnego in Kwidzyn. Implementation of the technology will allow waste to be managed on-site, and the energy obtained will be used in the production of frozen food. The use of the digestate as a valuable fertiliser will contribute to the introduction of a circular economy at the plant.



## WIND ENERGY

The GUST (Generative Urban Small Turbine) team from Lodz University of Technology took second place in the International Small Wind Turbine Contest 2022, organised by Delft University of Technology in the Netherlands and held in June 2022. As part of the competition, students from TUL presented a backyard four-bladed wind turbine with a horizontal axis of rotation in two different versions due to the geometry of the blades. The turbine with the latest blade geometry with an oblique tip proved to be the most effective. Its prototype produced more than 1 KWh of electricity in 13 m/s winds. This is both the best result of all the teams taking part in the event and a record for the team in its seven years of operation. GUST is a student project launched in October 2015. It is run by members of the Student Scientific Circle of Energy Scientists (SKNE), operating at the Institute of Turbomachinery of the Faculty of Mechanical Engineering at TUL. However, GUST brings together students from a number of TUL faculties who are united by the idea of working on a problem concerning wind energy

## GOAL 7

**ENSURE ACCESS TO AFFORDABLE, RELIABLE, SUSTAINABLE AND MODERN ENERGY FOR ALL**

**7 AFFORDABLE AND CLEAN ENERGY**







## SOLAR ENERGY

Solar energy generation is studied at TUL in various aspects, including modern solar panel designs as well as their operation in terms of grid stability.

### HYBRID PANELS

A team of researchers from the TUL's Faculty of Process and Environmental Engineering, in collaboration with foreign partners under the Hiperion project, is researching the development of breakthrough technology in the area of highly concentrated photovoltaics - hybrid photovoltaic cells. The project involves building a pilot installation of photovoltaic panels using optical micro-tracking technology that lenses sunlight onto the solar panels, significantly increasing the efficiency of the panels. The TUL team's role is to determine the environmental effects associated with the production and operation of the panels, including the determination of the environmental payback time, i.e. the time after which the clean energy produced by the panels will compensate for the environmental expenditure incurred in their construction.

## MODERN DESIGN SOLUTIONS

The same faculty is also developing, in collaboration with partner countries, complex systems for energy-activated external thermal insulation, a novel multifunctional building component based on a combination of existing advanced energy technologies: phase-change materials and flexible photovoltaics. The project identifies, tests and implements innovative ways to promote energy efficiency in buildings and supports technologies that are environmentally friendly, economically sound and implementable, encouraging more sustainable energy use. The use of flexible photovoltaics (FPV) as an external ETICS finish is an innovative approach that will allow on-site energy production, but also addresses the demand for modern design, facade aesthetics. Moreover, this solution will transform the future market for building-integrated photovoltaics (BIPV) from a niche activity to a potential mass market. The proposed system is expected to be more cost-effective compared to traditional BIPV facades. The project will create a new product for external walls, characterised by ease of application and flexibility. Furthermore, through the use of PCM, the proposed solution is a new step in the development of thermal insulation material technology allowing for a product categorised as a smart material.



## HETEROGENIC CATALYSERS IN THE PRODUCTION OF ALTERNATIVE FUELS

New methods for the synthesis of heterogeneous catalysts developed at the Institute of General and Environmental Chemistry make it possible to produce multifunctional, unique catalytic systems allowing fuels from renewable sources (e.g. alcohols or hydrocarbons) to be obtained by reforming, Fischer-Tropsch synthesis, transesterification reactions and hydrocracking. Depending on the process conditions and the catalyst used, it allows the production of alternative fuels ranging from light hydrocarbons and isoalkanes (petrol and jet fuel) to ethyl esters of higher fatty acids (biodiesel). New extremely efficient, selective and stable heterogeneous catalysts, applied to oxide systems or carbon nanotubes, are being developed, among others, for the production of hydrogen, a clean, green fuel, in the oxy-steam reforming of methanol, methane or LNG. Both modern liquid and gaseous fuels obtained through catalytic processes reduce, or entirely reduce, exhaust emissions, thereby reducing environmental pollution.



## ARTIFICIAL INTELLIGENCE IN REDUCING ELECTRICITY COSTS

In many companies and institutions, electricity related to heating, ventilation or air conditioning (HVAC) accounts for more than 60% of total consumption. Researchers from the TUL's Institute of Applied Computer Science are working on a smart system project that will help save electricity and take care of the comfort of the working environment. They are working on optimising energy management in companies together with the IDANET company and the STIPENDIUM Institute of Science and Technology. The new energy management system will guarantee automatic control of energy efficiency. By intelligently monitoring the most important air parameters (such as temperature, humidity, pressure, VOC concentration), as well as noise and light levels, it will be possible to ensure the highest workplace standards while rationalising electricity consumption. The system under development - METERNET-EnMS - is an intelligent extension of one of the flagship products of IDANET, the project leader. The product created within the consortium, thanks to the intelligent algorithms developed at the Faculty of Technical Physics, Information Technology and Applied Mathematics, is an innovation on a European scale and has the potential to revolutionise the market for automatic electricity management systems.



## SUSTAINABLE CAMPUS

### PASSIVE BUILDING

A passive office building for TUL's administration and students was completed in 2021. The structure, with a total area of 1,600 m<sup>2</sup>, is powered solely by solar energy, significantly reducing running costs. The building has been modernised according to the latest technology. It is equipped with photovoltaic panels, located in the windows, on the roof and on the facade of the building. In addition, heat pumps are installed in the building, making it possible to reduce the energy required for day-to-day operation. This translates into correspondingly lower emissions of harmful substances into the atmosphere.

### MODERNISATION OF THE BUILDINGS OF TUL

The Ministry of Funds and Regional Policy has provided TUL with PLN 11.5 million for the thermal modernisation of the university's two buildings. The funds come from the EU's Infrastructure and Environment 2014-2020 programme. The first of the modernised buildings is the future home of the Centre of Excellence for Universal Design (a place to train staff who will create new solutions to ensure social accessibility), and the second will house a kindergarten for the children of TUL staff, doctoral students and students. The project will effectively adapt two old buildings located on Campus A. The facilities will be brought up to current standards and technical conditions. Thermomodernisation of the buildings at Lodz University of Technology will contribute to reducing energy consumption and carbon dioxide emissions.



## DIDACTICS

Lodz University of Technology offers a number of courses that include subjects related to the production and processing of clean energy. The subjects focus on energy production, transfer and distribution. Ecological energy sources is an example of a specialisation implemented at second-cycle studies at the Faculty of Process and Environmental Engineering of TUL as part of the Environmental Engineering course. On the other hand, at the Faculty of Civil Engineering, Architecture and Environmental Engineering, courses related to both alternative/renewable energy sources and sustainable construction are offered, e.g. in the course Environmental Engineering in Construction.

TUL graduates find employment in companies and institutions involved in the design and installation of equipment using renewable energy sources, in the energy and heating sectors, as well as in regional and local government agencies working in the field of renewable energy sources and energy efficiency, and in scientific institutions. Students take part in scientific projects related to renewable energy sources. TUL has state-of-the-art teaching laboratories, e.g. for waste management, or modern laboratory stations for testing heat pumps and solar collectors.



## 8 DECENT WORK AND ECONOMIC GROWTH



### GOAL 8

**PROMOTE SUSTAINED, INCLUSIVE AND STABLE ECONOMIC GROWTH, FULL AND PRODUCTIVE EMPLOYMENT AND DECENT WORK FOR ALL**



### DEVELOPMENT OF STAFF COMPETENCES

As part of the implementation of the Integrated Program of Lodz University of Technology, the competencies of the university's teaching staff are being improved in the following areas: English language, didactics, e-learning, presentation skills and attractiveness of education. Management and administrative staff develop their skills in areas such as: language competence, project management (certified and non-certified), team management, interpersonal communication, work organization, delivering presentations, stress management or preventing professional burnout. In addition, training courses are conducted on the use of the POL-on system and Excel, public procurement in EU projects, public procurement law, technology transfer as well as coaching and mentoring. There are also a number of study visits and foreign training sessions in leading institutions around the world. In 2021, as many as 516 teaching staff, research and teaching staff and 567 administrative staff took part in the training courses under the TUL Integrated Programracyjnych.



### HR EXCELLENCE IN RESEARCH

Lodz University of Technology, being aware of the impact of the assumptions of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers on ensuring a high-quality work and research environment, has included the provisions of these documents in internal legal acts, procedures and practices applied at the university. The crowning achievement is awarding the title of HR Excellence in Research to Lodz University of Technology in 2016. In 2019, the European Commission extended TUL certification of HR Excellence in Research, and in 2022 TUL received another extension, which results in the approval of the Action Report for the years 2018-2021 and the adoption of a new Action Plan for 2022-2024. Positive external evaluation of activities in this area proves that the procedures introduced at TUL enable creating a positive and friendly workplace for scientists.



HR EXCELLENCE IN RESEARCH



## LODZ UNIVERSITY OF TECHNOLOGY AS AN EMPLOYEE

TUL has a system of financial support, e.g. non-refundable financial aid in a difficult life situation, or low-interest loans for the renovation and modernization of housing. Numerical data on the beneficiaries of this system are presented in the description of SDG1. TUL also cares for the well-being of employees and their families. The university has four holiday resorts: in Wiartle in Masuria, in Jastrzębia Góra in the Baltic Sea region, in Szklarska Poręba in the Sudety Mountains and in Konopnica on the Warta River. Stays in the guesthouses are co-financed from the Company Social Benefits Fund. 1,420 people benefited from such co-financing in 2021.



Employees may also benefit from co-financing of holidays in a non-accounting form, the so-called 'holidays under the pear tree' (3,028 people benefited in 2021), as well as co-financing summer and winter camps for children (2,709 children took advantage of such an opportunity in 2021). TUL Sailing Club has a sailing base and its own yachts in Roganty, on Lake Dargin in Masuria, which the members of the Club can use on very convenient terms and where, among other things, training camps under the name "First Step Under Sail" are organized for employees and their families (a total of 150 people received funding in 2021), as well as camps for doctoral students. 1,139 TUL employees benefited from co-financing under the employee pension scheme. There is also a Senior Club at TUL which organizes trips, tickets to theaters and concerts, as well as a Fishing Club. Both clubs also receive funding from TUL. The university also has a cultural offer for its employees and students: monthly meetings "Music at the Lodz University of Technology" and "Thursday Culture Forum". TUL Academic Orchestra and the Academic Choir of the Lodz University of Technology are thriving. Four art galleries ("Biblio-Art", "Politechnika", "Krótko i Węzłowato" and "Pod napięciem") exhibit works by recognized artists as well as amateur artists from TUL. In 2021, the University allocated over PLN 13,860,000 to support its employees and their families in the field of recreation and culture.



## TRADE UNION REPRESENTATIVES

There are three trade unions at Lodz University of Technology. Their representatives play a very important role in ensuring cooperation between management and staff. They support TUL employees in their efforts to obtain better working conditions, pay rises and social security. In connection with the implementation of these tasks, representatives of the unions participate in the work of all collegial bodies of the university, consult all legal acts developed at TUL regarding employee and student matters, ensure the protection of employees' rights and entitlements in the field of employment, disciplinary matters and remuneration. In their offer, trade unions also have material and legal assistance as well as a cultural offer, e.g. cinema/theatre tickets with discounts, or sightseeing trips.



## HUMAN RESOURCES DEVELOPMENT POLICY

Lodz University of Technology enables conducting research or development work and educating scientific staff at the highest world level. This is done in accordance with the principles of freedom of science and freedom of creativity with respect for academic values.

With a view to further dynamic development, the university takes strategic actions resulting from the implementation of the principles of the European Charter for Researchers and the Code of Conduct for the recruitment of researchers. They cover the following areas: implementation of good practices in the recruitment of employees and strengthening the competences of administrative staff; supporting worker mobility; promoting and disseminating the results of scientific research; career counseling and support for young scientists; specialized training in the area of commercialization and knowledge transfer and other forms of support in the field of cooperation with the industry.



## PUBLIC PROCUREMENT POLICY AT TUL

All TUL activities related to the procurement of goods and services must comply with applicable laws, regulations, directives, etc. The University manages its assets in accordance with the principles of economy, efficiency and legality. Managing public expenditure is also guided by the principles of purposefulness and economy, taking into account the need to obtain the best results from given expenditures, the optimal selection of methods and means to achieve the assumed goals, and the need to complete tasks on time.



## GOOD PRACTICES IN ORGANIZING COMPETITIONS FOR POSITIONS OF ACADEMIC TEACHERS AT TUL

The Code of Good Practices in the Organization of Competitions for the Positions of Academic Teachers at TUL regulates the issues of open, transparent and merit-based recruitment. This document is the implementation of the HR Strategy for Scientists, which was developed at the Lodz University of Technology as part of the application with the HR Excellence in Research logo.

The good practices presented in the Code also refer to the provisions of the "European Charter for Researchers" and the "Code of Conduct for the Recruitment of Researchers". The Charter defines the rights and obligations to which scientists and institutions employing them are subject, while the Code defines the rules of recruitment of scientists that employers should follow.



## COMPULSORY PRACTICES IN STUDY PROGRAMS

Out of concern for the good preparation of students for their future work, TUL takes care of the practical aspect of learning, and the implementation of internships is a significant part of it. In first-cycle studies, it is a mandatory requirement in the syllabus. Although internships are a recommended but not obligatory in second-cycle studies, they are carried out in most majors. TUL attaches great importance to verifying the competences acquired in the course of studies in the work environment.

The university - taking advantage of its extensive contacts with industry and with the strong Career Office support - assists students in the implementation of this element of study program. Students are provided with a range of offers and they have the opportunity to adapt the internships to their needs - internships can take various forms: from holiday exchange internships, internships under IAESTE to industrial internships in the largest Polish and global companies. Students also have the opportunity to complete extra-curricular internships in the form of so-called additional practices and internships.





## CAREER OFFICE

The Career Office actively operates at TUL, supporting the academic community in dealing with the labour market. It establishes and develops contacts with entrepreneurs. Career Office also verifies the expectations of the labor market towards students and graduates of TUL thanks to regular meetings with employers and presentations of their companies at the university. During such meetings, employers present the business profile of their company, familiarize interested students with its mission, values, achievements, present the requirements and forms of recruitment. The office also offers job placement, apprenticeships and internships, prepares handbooks, conducts career coaching and career counselling, professional aptitude

tests as well as development programs and training aimed at professional activation conducted by trainers from the Career Office and representatives of companies. The activities of the Career Office in 2021 include registering 1,843 job offers, providing support to 278 people through career counseling and entrepreneurship counseling, 69 training courses and workshops for 3,218 students and graduates of Lodz University of Technology, 440 hours of business coaching. The TUL Career Office is also a co-organizer of Europe's largest job fairs, which are a periodical event - the 17th edition of the Academic Job Fair, which took place in May 2022, attracted 18,000 visitors, 140 exhibitors, 40 training courses on various topics, attended by approx. 1000 participants.



## PARTICIPATION OF EMPLOYERS IN IMPROVING EDUCATIONAL

TUL cooperates with employers in upgrading study programs. Employers participate in class visits, monitor students' progress and achievement of learning outcomes defined for internships, but above all, they support TUL in adapting programs to the current challenges of Polish industry. Business councils operate at individual faculties. Their task, as an advisory body, is to evaluate the education process and provide substantive support

in its implementation and continuous improvement of programs. The activity of business councils allows for monitoring the needs of the industry in the context of specific competencies of graduates. Thanks to this, it is possible to modify the program and adapt it to trends in a given industry. An important role in the education and improvement of programs is also played by the clusters to which Lodz University of Technology belongs:

- ICT Polska Centralna Klaster,
- LODZistics,
- Energy Wave.

Employers' representatives also define the scope of student projects, transitional theses or diploma theses. In 2021, 77 design works and 93 diploma theses were carried out in cooperation with the industry. Lodz University of Technology is also a member of the Lodz Regional Council of Industry of the Future, which includes economists, scientists and entrepreneurs from the Lodz Voivodeship. Its purpose is to outline development strategies, support the digital transformation of enterprises and build the competitiveness of the economy. The role of TUL in the Council is to identify development trends in various areas of industry and to train highly-qualified personnel.





## PACTT SCIENCE BUSINESS INNOVATION EXPO 2022

TUL is one of the 81 members of the Joint Venture of Technology Transfer Centers (PACTT), which is a nationwide association of university units dealing with the management and commercialization of intellectual property. The purpose of establishing the agreement is the cooperation of similar entities in the field of broadly understood commercialization of research results and the exchange of good practices. One of PACTT's initiatives was the National Fair of Innovation of Polish Universities and Research Institutes (PACTT Science Business Innovation EXPO 2022), which took place on May 18-19, 2022. The event was addressed to Polish entrepreneurs, universities, research institutes and investment funds and gave a unique opportunity to get acquainted with the university's offer in one place:

know-how, technologies, services from all industry branches. Thanks to the investment funds, the participants of this event could get acquainted with the offer of financing the implementation of technologies in the industry. The aim of the project was to present technologies and services to entrepreneurs and encourage them to purchase or use licenses that have a significant impact on the company's value, strengthening its competitiveness and innovation. This is the first initiative of this type in Poland, combining an invention convention and a forum for the exchange of knowledge and experience, which is dedicated to Polish entrepreneurs. The author of the idea of the organization of this event was the Center for Innovation and Entrepreneurship of TUL

## GOAL 9

**BUILD RESILIENT INFRASTRUCTURE,  
PROMOTE INCLUSIVE AND  
SUSTAINABLE INDUSTRIALIZATION  
AND FOSTER INNOVATION**

**9 INDUSTRY, INNOVATION  
AND INFRASTRUCTURE**





## BETTER LYOPHILIZED STRAWBERRIE

The Faculty of Process and Environmental Engineering of Lodz University of Technology is a partner in the implementation project, the aim of which is an innovative technology of freeze-drying of strawberries. Freeze-dried fruit is very popular among customers, because it retains nutrients and vitamins contained in fresh fruit and can be eaten all year round. Lyophilization is used on an industrial scale. Currently, batch machines are used in this process. According to the contractors of the project, the periodicity is burdensome and the operating costs are significant.

In the new solution, the freeze-drying process of strawberries will be carried out continuously. Heat will be supplied to the frozen strawberries in a hybrid way, which will shorten the freeze-drying time and, as a result, reduce the energy consumption of the process. Drying will be controlled with the use of intelligent algorithms enabling on-line optimization of product quality parameters and minimization of energy consumption. A prototype freeze-dryer for continuous operation will be constructed and tested. After reaching full technological efficiency, the installation will be used commercially. The results of the project will be implemented by the leader of the consortium - a fruit processing plant, the company Grupa Produktów KLASA.



## TRANS-FREE SWEET

A large part of population is already aware of the importance of a healthy diet in our lives. However, we still have problems with the right choice of food and good quality products, containing the so-called. "good fats". Scientists from the Faculty of Biotechnology and Food Sciences of the Lodz University of Technology have successfully taken up the challenge of implementing zero trans fats in the production of many types of food. New technologies and patents have been developed that enable, among others, producing healthy sweet snacks. As a result of the implementation of 4 investment projects, co-financed from national and European funds, the Institute of Food Technology and Analysis was equipped with modern analytical and technological equipment, thanks to which it was able to take up the challenge of conducting

Prof. Grażyna Budrym, Prof. Dorota Żyżelewicz and dr Joanna Oracz.

research enabling the replacement of trans fats with trans fats in various products. As a result, producers received know-how and they could start production of healthier products, free of trans fats. The research concerned the technology of obtaining food with a reduced content of trans fatty acids or completely devoid of them. In particular, these were dessert and snack products. Consumption of this type of food is constantly increasing, which is why it is so important to offer consumers the most healthy alternative possible. Thanks to the use of technologies developed at the Institute by food producers, "zero trans" snacks containing healthier fat have appeared on the market. The beneficiaries of the research are also consumers who will be able to reach for such products. Technologies developed at Lodz University of Technology have been successfully implemented in WIEPOL and DELTA companies







## INNOVATIVE SWITCH AWARDED IN THE POLISH PRODUCT OF THE FUTURE COMPETITION

Scientists from the TUL Faculty of Electrical, Electronic, Computer and Control Engineering in cooperation with the Electric Equipment Plant "WOLTAN" from Łódź, have developed an innovative circuit breaker, which is intended mainly for use in DC traction systems in Poland and on foreign markets, and in the future in other types of electric urban and mining traction and industrial systems. The switch was awarded in the 24th edition of the Polish Product of the Future competition. The jury of the competition appreciated the innovative aspect of the invention, awarding it a distinction in the category Common product of the future of higher education and science institutions and entrepreneurs. The innovation of the circuit breaker is, among others, its modular design that allows for installation in various places of the vehicle, and a number of special functions, such as recording of measurements of operating parameters, computer control of the circuit breaker status, data archiving and viewing the history of events over a period of 3 years. The following Polish companies are already interested in the circuit breaker: NEWAG S.A., PKP CARGO S.A. and PESA Bydgoszcz S.A.



## CENTER OF INNOVATION AND ENTREPRENEURSHIP

The activity of the university in the field of knowledge transfer and commercialization of innovative technologies is carried out by the TUL Center of Innovation and Entrepreneurship, which has a Quality Management System certificate according to ISO 9001:2015 (as the only university unit in Poland with ISO in the field of knowledge transfer and commercialization of innovative technologies) and the status of an Accredited Innovation Center granted by the Minister of Economic Development and Technology. CIP offers training and consulting services addressed mainly to graduates and young scientists who want to implement their business ideas and set up their own companies. The Center also offers individual consultations with experts who help choose an effective technology commercialization strategy and find a business partner. CIP Technology Transfer Section (STT) conducts comprehensive activities aimed at promoting TUL as a research center that offers innovative technologies of world standards. STT also helps nurture collaboration between the scientific community of the university and industry. In 2021, TUL obtained 98 patents in the Patent Office of the Republic of Poland and 5 patents in foreign patent offices. In 2021, data on 40 of the latest inventions were submitted to the special purpose

vehicle TULVENTURE Sp. z o. o. in order to search for potential buyers, licensees or investors for them. In 2021, there were 8 spin-off companies established to commercialize TUL's research results.



## MODERN LABORATORY OF INTELLIGENT BUILDING MANAGEMENT SYSTEMS

A state-of-the-art Laboratory of Intelligent Building Management Systems has been opened at the Institute of Mechatronics and Information Systems. In one space, a number of the latest cutting-edge ICT solutions from leading companies Bosch, Schneider, SmartSys and Less have been installed.

The laboratory creates unique conditions for conducting research, staff development and education in areas of priority for the economy and the development of science, including areas related to monitoring the vital functions of people.

The laboratory, thanks to the well-thought-out configuration of its systems, will also be a significant support for the work carried out at TUL on the development of integrated mechatronic systems for building intelligent indoor space. Knowledge discovery from multiple databases in the systems installed in the laboratory is a key competence of the future and a source of innovative solutions in the management of intelligent buildings.





## GOAL 10

**10** REDUCED  
INEQUALITIES



**REDUCE INEQUALITY WITHIN  
AND AMONG COUNTRIES**



### **TUL REPRESENTATIVE IN THE COMMITTEE ON EQUAL EDUCATIONAL OPPORTUNITIES AT THE CONFERENCE OF RECTORS OF ACADEMIC SCHOOLS IN POLAND IN THE 2020-2024 TERM**

The Commission for Equal Educational Opportunities at KRASP (CONFERENCE OF RECTORS OF ACADEMIC SCHOOLS IN POLAND) was established on the initiative of Krakow universities in 2016. It is composed of representatives of 15 academic centers, which are leaders in providing educational support to students with disabilities and special educational needs. One of the representatives of the committee is a Lodz University of Technology employee. The Commission deals with setting standards for educational support, as well as reducing inequalities in access to university education. This is done by promoting good practices, sharing knowledge with less advanced universities, as well as by issuing opinions on legal acts and regulations, e.g., documents of the Ministry of Culture and National Heritage on students with disabilities. The Commission also cooperates with the National Centre for Research and Development in developing expert studies and model solutions, e.g., under the "Accessibility Plus" program.



### **EQUALITY REGULATIONS BINDING AT TUL**

Regulations of the internal anti-discrimination policy are in force at Lodz University of Technology:  
<https://p.lodz.pl/pracownik/wspiera/regulamin-antydiskryminacyjny-w-pl>  
They were introduced by Order No. 50/2019 of the Rector of TUL of September 23, 2019, which includes provisions on equality for job offers, hiring, establishing and terminating an employment relationship, terms of employment, promotion, access to training, etc. It states that any form of discrimination, including harassment and sexual harassment, is unacceptable and that hiring is to be carried out using transparent rules for selecting candidates. It regulates the rights to equal remuneration for equal work of the same quality. Equality issues are also regulated by the Labour Regulations in force at TUL:  
<https://p.lodz.pl/pracownik/hr-excellence-research-w-pl/wewnetrzne-akty-normacyjny-pl>  
Paragraph 94 of Section VIII Counteracting Discrimination and Mobbing refers to the Labour Code, in which in art. 113 states that: any discrimination in employment, direct or indirect, in particular on the grounds of sex, age, disability, race, religion, nationality, political beliefs, trade union membership, ethnic origin, denomination, sexual orientation, fixed-term employment or indefinite, full-time or part-time employment – is unacceptable.



## COOPERATION WITH COUNTRIES IN THE SOUTHWEST ASIA REGION

One of the most important activities aimed at reducing inequalities within and between countries is providing equal access to education and offering opportunities for skill development in the poorest regions and countries, which is a prerequisite for economic and social development. The Institute of Electrical Power Engineering at Lodz University of Technology is cooperating with countries in the Southeast Asian region under the eACCESS (EU-Asia Collaboration for aCcessible Education in Smart Power Systems) project, funded under the EU Erasmus-CBHE (Capacity Building in Higher Education) program. The aim of the project is to improve course programs, introduce innovative teaching methods and tools.

The development of teaching infrastructure is also a priority, including advanced laboratories dedicated to renewable energy and sustainable development in five partner universities, in countries such as Butan, Nepal and Indonesia. TUL is the coordinator of the project, while European partners from Greece and the UK are providing support in pursuit of its goals. The eACCESS project is a continuation of earlier academic cooperation with partner universities from the Southeast Asian region, initiated under the SmartLink project, which focused on academic exchanges (students, staff, doctoral students) from countries such as Bangladesh, Butan, India and Indonesia.



## SUPPORT FOR BALKAN UNIVERSITIE

Scientists of the TUL Faculty of Electrical, Electronic, Computer and Control Engineering participate in the international Erasmus+ project "VTECH - Accelerating Western Balkans University Modernization by Incorporating Virtual Technologies", which is to support Balkan universities in the use of modern technologies, including virtual (VR) and augmented (AR) reality. By integrating virtual technology into the academic culture of universities, the project aims to improve the quality of education, thus contributing to upskilling and building a digital society in the Western Balkan countries. In March 2022, the project partners visited TUL for the first time. During this visit, workshops were held on the arrangement of virtual and augmented reality environments, user interface design and interaction scenarios, as well as application usability testing.

Balkan universities find the knowledge of partners, including scientists from TUL, who have extensive design and practical experience in the field of technologies connecting the real and digital world, particularly attractive. It is thanks to them that the goals of the project are achieved: building the potential of academic staff in the field of including virtual technologies in the education process and developing teaching methods using ICT technology and tools based on knowledge and experience. There are 11 partners in the consortium, including 8 Balkan universities, and universities from Estonia (University of Tartu) and Slovenia (University of Ljubljana) provide knowledge and know-how in the field of modern forms of education.





## SUPPORT FOR DISABLED PERSONS AT TUL

There is an Office for Persons with Disabilities (BON) at TUL, which provides a very wide range of support for students, doctoral students and employees. In 2021, 145 students with disabilities (including 10 doctoral students) used the services of BON. The university's activities focused on supporting the education of people with disabilities e.g., by providing specialized equipment, organizing additional, supplementary and remedial classes and language courses, one-to-one classes - as part of Individual Organization of Studies (IOS) - or arranging transportation assistance to students who cannot walk. BON also offered workshops and training for students with disabilities developing psychosocial skills, training for employees on accessibility - including safe evacuation of people with disabilities, or psychological support during the pandemic for students and employees. A handbook available in Polish and English was published. In order to equalize educational opportunities for people with various disabilities and to disseminate academic education among groups at risk of social exclusion, the magazine "AION - Academic Handbook for Persons with Disabilities," is published on the TUL website and distributed free of charge to all universities in Poland and other educational institutions. A coordinator for people with disabilities has also been appointed at each TUL faculty.



## INVOLVING PERSONS WITH DISABILITIES IN SPORT ACTIVITIES

TUL Sports Centre facilities are being systematically adapted to the needs of people with disabilities. In the 2021/22 academic year, a new elevator was put into use, a toilet and showers adapted to the needs of people with disabilities, and new ramps were made. Also, the Sports Bay was designed and built as a disabled-friendly facility. The swimming pool is located on ground floor, right at the entrance to the facility from the parking lot. Wheelchair users won't encounter any ramp or obstacle obstructing access to the checkouts and the pool. A spacious, separate changing room is available where a disabled person can comfortably prepare for swimming or other water activities. TUL Sports Bay has joined the Lodz Barrier Free Card. Its holders are offered entry to the swimming pool with a 40 percent discount. A sports section for people with disabilities has been established within the Academic Sports Association (AZS) under the name AZS Integration Sports Section. Its goal is to create suitable conditions allowing students with disabilities to increase their participation in various forms of sports activities.

In October 2021, the first Integrative AZS Weightlifting Championships for persons with disabilities were held in the Sports Bay. The athletes tried to beat their own personal records, and rules were strict. 37 athletes from all over the country took part. Athletes competed in 10 weight categories: 4 women's and 6 men's.



## ACCESSIBLE TUL

Since 2021, Lodz University of Technology has been implementing the Accessible University project, which aims to improve the accessibility of higher education, support organizational changes and improve the competence of staff in the higher education system. The project envisages the implementation of 10 tasks, including the initiation of the Centre of Excellence for Universal Design (CDPU), expanding the services and developing the competencies of the staff of the TUL Office for Persons with Disabilities, eliminating architectural barriers, developing an Interactive Map of the TUL Campus, expanding TUL's educational support offer for persons with disabilities, etc. Activities implemented in the academic year 2021/22 include: launch of educational and career coaching for students with disabilities, appointment of

accessibility coordinators at TUL units, audio description of TUL promotional resources, e.g. the videos published on YouTube, purchasing portable suitcase/telescope ramps, a Braille printer, and other equipment, training for employees (audio description of visual materials, creation and auditing of websites in accordance with WCAG 2.1 standard, training a coaching game instructor supporting people at risk of exclusion). In the 2021/22 academic year, 43 training courses were conducted, attended by a total of 430 TUL employees. The MIGAM sign language interpreter video connection service has also been launched for TUL faculties and centres. The service can be accessed through the TUL website or directly o [https://tlumacz.migam.org/politechnika\\_lodzka](https://tlumacz.migam.org/politechnika_lodzka) (available also in the mobile version). The call can be made from any location seven days a week from 8 a.m. to 8 p.m. In addition, modernization of the TUL website and Wikamp platform has been done, partial renovation of the Faculty of Civil Engineering, Architecture and Environmental Engineering building was carried out, adapting it to the needs of persons with reduced mobility. New equipment has been purchased for 4 laboratories. More information on <https://dostepnosc.p.lodz.pl>



## AIR QUALITY SENSORS

With the funds from the "Idea Box" budget, AIRLY air quality measuring sensors were purchased and installed on TUL campuses. Each user is able to track the measurements thanks to a mobile app for Android and iOS systems, and through an online platform. The purchase of the monitoring system was part of the "Smart Campus" project that has been underway at TUL for several years, and the data collected is used in scientific research. The sensors have supplemented the publicly available map <https://airly.org/map/en/> thanks to which Lodz residents have access to information on the city's air quality.



## ARCHITECTS FROM TUL AT THE WORLD URBAN FORUM

June 2022 marked the 11th World Urban Forum (WUF11), one of the most important events on urban planning, which brought together 20,000 participants from more than 170 countries. The main patron and organizer of the event is UN-Habitat, i.e., the United Nations Human Settlements Program. The Faculty of Civil Engineering, Architecture and Environmental Engineering at TUL, in cooperation with the Society of Polish Urban Planners, organized a panel on urban resilience to climate change: Urban form, Ethics, Aesthetic, and Heritage: an exploration of new urbanities for a resilient future.



## URBAN PLANNERS MET AT TUL

A consortium of three universities: Lodz University of Technology, the University of Lodz and Krakow University of Technology, organized the 29th ISUF 2022 Congress - International Seminar on Urban Form. The theme for the debates and meetings at the congress was spatial redevelopment and revitalization - a multidisciplinary perspective. Some of the debates were held in the Alchemium building of TUL.

The International Seminar on Urban Form is an international organization of architects, urban designers and geographers interested in issues related to urban morphology. Each year, the congress brings together several hundred researchers from around the world. This year's proposed topics addressed issues of urban structure transformation and revitalization from a multidisciplinary perspective.



# GOAL 11

**11 SUSTAINABLE CITIES AND COMMUNITIES**



**MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE**



## LODZ UNIVERSITY OF TECHNOLOGY TAKES GOOD CARE OF MONUMENTS

In the mid-19th century, Lodz factory owners took steps to establish a Polytechnic Institute in Lodz. They donated land and buildings for this purpose. When Lodz University of Technology was founded a century later, its headquarters were established precisely on the sites of former factories, while industrial buildings, villas and residences were adapted to the university's needs. There are 14 historic buildings on the TUL campus, and the university's authorities make sure that they remain in the best possible condition and are a permanent feature of the landscape on the campus, where modernity is intertwined with the tradition of post-factory Lodz. The Rectorate of Lodz University of Technology is situated in the Reinhold Richter Villa, whose construction was completed in 1904. The villa is a combination of different styles: gothic, mannerist and art nouveau. Inside the building there are many decorative elements in the style of antiquity and Renaissance. The Dean's Office of the Faculty of Process Engineering and Environmental Protection is housed in Oskar Schweikert's neo-Renaissance villa built in 1888, while the Dean's Office of the Faculty of Technical Physics, Computer Science and Applied Mathematics has its seat in a residential building built in the 2nd half of the 19th century and purchased in 1893 by Friedrich Wilhelm Schweikert.



## BP. MICHAŁ KLEPACZ PARK

Since 2017, the park, located in the center of Lodz, has been owned by TUL, so it has been incorporated into one of the University's campuses. The area of the park is 3.3 hectares. It remains a generally accessible public space, which is eagerly used by Lodz residents. Numerous trees, natural monuments and shrubs grow in the park, and Siberian squills bloom beautifully in early spring.

In the park, trees are well maintained, new plants are systematically added, new species of trees and shrubs appear. All this has a positive impact on the natural qualities and aesthetics of the park, which is listed in the register of monuments. During the 20th edition of the Feast of Trees, the oak called "Fabrykant" (Factory Owner) growing in Bp. Klepacz Park took first place in the Tree of the Year Contest, with as many as 5559 online votes.

Every spring, the tree attracts crowds of strollers to the park, especially when "Fabrykant" is submerged in a sea of blue flowers - Glory of the Snow and Siberian squills. The trunk of the "Fabricant" measures 4.52 meters in circumference, while the span of the crown is more than 30 meters in diameter. In February 2023 "Fabrykant" will represent Poland in the international poll for the European Tree of the Year.





## ACOUSTIC CLIMATE MANAGEMENT IN URBAN SPACE

The problem of noise in urban spaces is one of environmental hazards and is treated as pollution. The concentration of noise in urban areas is most often related to economic activity which generates industrial noise, or to transport, which is responsible for traffic noise. Due to the prevalence and density of roads, it is traffic noise that has the greatest impact and significantly affects the state of the natural environment and people's quality of life. Researchers from the Faculty of Organization and Management of TUL have a solution to this problem. The aim of one of their studies is to monitor, control and manage noise in urban spaces using health indicators to designate quiet areas. Research conducted at the Faculty includes benchmarking of cities using health indicator methods in acoustic maps, performing acoustic surveys at reference points, or preparing IT tools in the development and visualization of acoustic maps. The research also encompasses developing a strategy for managing urban space to minimize noise from various sources.



## ENVIRONMENTAL ASPECTS OF SUSTAINABLE DEVELOPMENT IN SPATIAL URBAN PLANNING

The dynamic process of urban development entails many problems related to environmental degradation, climate change and the need to provide comfortable living conditions for residents. Research conducted at the Faculty of Civil Engineering, Architecture and Environmental Engineering aims to develop a methodology for assessing the impact of selected housing structures on aerodynamic and thermal conditions, establish relationships between the type of buildings and microclimate conditions, define local zones for Lodz, and develop GIS-based cartographic methods in the form of urban climate maps for selected areas of Lodz. In response to climate warming and the phenomenon of the Urban Heat Island, being a consequence of the increase in average air temperature, in the number of hot days and in air pollution, the Faculty has also undertaken research to determine the peculiarities of the Greater Metropolitan Zone of Lodz, taking into account its diverse urban forms. The aim of the research is to provide information on the quality of the urban environment and to select areas requiring adaptation strategies. The next step is effectiveness analysis and selection of optimal adaptation solutions.

Implemented solutions will lead to beneficial changes in environmental parameters, including lowering temperature, improving air quality and space aesthetics, and enhancing human thermal comfort. Cooperation at the university-city institutions level will contribute to undertaking planning activities that increase the city's resilience to current and anticipated future extreme events.



## EDUCATION FOR SUSTAINABLE URBAN DEVELOPMENT

TUL offers many majors educating future engineers and masters who are aware of challenges associated with rapid urbanization of areas as well as planners who effectively manage urban resources. Among them, it is worth mentioning Architecture, Bioeconomy and Sustainable Bioeconomy, Biotechnology, Civil Engineering, Chemistry of Building Materials, Energy Systems in the Built Environment, Environmental Engineering, Environmental Engineering in Civil Construction, Urban Revitalization, Urban Planning, and Transport.



## UNIVERSITY BICYCLES

The International Faculty of Engineering (IFE) at Lodz University of Technology has taken care of the needs of foreign students. Wanting to make it easier for them to function and stay in Poland, the IFE donated bicycles purchased by TUL to the ESNEYE student organization. Thanks to this initiative, exchange students can freely commute to the university, explore the city, and at the same time lead and promote a healthy lifestyle.



## TUL STUDENTS AWARDED BY THE MINISTER OF DEVELOPMENT AND TECHNOLOGY

Researchers and students at TUL are awarded for their individual and group achievements in support of regional development, and for their impact on the ecosystem. In the 2021/22 academic year, the Minister of Development and Technology awarded two works in a competition for papers in the fields of architecture and civil engineering, planning, area development and housing, including the master's thesis A maximis ad minima. Revitalization of a small city on the example of Wieluń, the author of which took up the subject of protecting and shaping the city's cultural landscape. Implementation recommendations, which can support municipal authorities and planners in the process of preparing and developing a planning document, give this work special value.



## A PATENT FOR BIODEGRADABLE FOIL FROM TUL

A team of researchers from the Faculty of Biotechnology and Food Sciences at TUL has developed an innovative technology for obtaining durable biodegradable foil based on starch. Although this foil base material has many advantages (including being compostable), at the same time it easily absorbs water and can be weakened during use. Additionally, it is subject to aging, making it more susceptible to tearing. Researchers from TUL have managed to largely overcome these drawbacks by introducing an additive to the starch foil, which is an organic acid found in many grains. This leads to a reduction in water absorption, gas permeability and susceptibility to rupture of the foil made from such modified starch. Chicory root extract was added to the starch foil to give it antibacterial properties.

In the form of thin foil, this material can be used to produce pouches, sachets, tray wrappers for packaging food or cosmetics that are mainly solid. Trays or disposable dishes can also be extruded from the designed material. The final stage of technological works is being carried out at the machinery park of the Institute of New Chemical Syntheses in Puławy, where further technological trials are planned.

Researchers from TUL are one step away from offering finished foil on a roll, which will enable a transition to industrial use of the material. The technology has been filed for a patent.



## VEGAN LEATHER

As part of a PBL project at the IFE, students majoring in Industrial Biotechnology have developed a material that is vegan leather. The project using apple waste may appeal to all environmental enthusiasts. Apple leather is very strong, durable and, most importantly, fully biodegradable. It also contains no environmentally harmful substances. In addition, the material can be easily dyed, which makes it attractive for the production of consumer goods. Producing eco-leather from fruit doesn't generate much cost either, so the students' idea seems really innovative, but at this stage it still needs a few improvements. The material is not waterproof, which limits the possibilities of its application, but the team intends to continue the work and thus improve the invention. In October 2021, the TUL students talked about their invention in the program Dzień dobry TV.

# GOAL 12

## ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS

12 RESPONSIBLE CONSUMPTION AND PRODUCTION







## COSMETICS OF THE FUTURE

Cosmetics obtained on the basis of natural raw materials, devoid of any synthetic "enhancers" are in great demand today. At the Institute of Natural Resources and Cosmetics of TUL, research is being conducted on new components of cosmetic masses obtained from vegetable oils after ozonolysis. The starting point for the research work is olive oil and rapeseed oil, among others. Each of these biomaterials is a reservoir of potentially valuable chemical compounds. Treatment which consists in introducing ozone into the vegetable oil allows to further expand the range of these compounds. After treatment, an oil-based cosmetic product has a more pleasant scent, is noticeably less allergenic, and provides better hydration when spread on the body. Ozonated vegetable oil shows anti-aging, regenerative and antibacterial properties. The final product prepared on its basis is ozone-free and environmentally friendly.

The work carried out at the Institute confirms that ozonated vegetable oil can be successfully incorporated into the composition of a cosmetic mass, and its sensory and functional contribution will favour the overall characteristics of the finished preparation. It is on the basis of such experimental substances that cosmetics of the future will be created, thanks to which the industry will stop using preservatives such as parabens or formaldehyde derivatives. The problem of searching for promising ingredients for the production of cosmetic masses is being systematically developed within the framework of the Institute's work. The use of ozone is one of a variety of tools available to scientists. In 2021, progress in this field was expanded to include an entirely new area of research that entails using natural modification processes involving microorganisms.



## SUSTAINABLE PUBLIC PROCUREMENT

Researchers from the Institute of Marketing and Sustainable Development are implementing the project: "Sustainability and Procurement in International, European and National Systems - SAPIENS Network," funded under the EU's Horizon 2020 Marie Curie Skłodowska program. The project constitutes the world's largest interdisciplinary doctoral program combining aspects of sustainable development and procurement. The project represents the world's largest interdisciplinary doctoral program combining sustainability and procurement issues. Economists, lawyers and engineers have joined forces to implement sustainable development principles in public procurement practice. In 2022, the Faculty of Organization and Management hosted the so-called Advance Training Course (ATC) on sustainable supply chain issues. Nearly 70 participants from around the world attended the event both onsite and online. The first day was dedicated to tools allowing for more sustainable supply chain management, such as standards, life cycle analyses and eco-labelling. The role of the product itself and product design was also discussed. The second day was dedicated to social issues such as human rights in supply chain management.



## BIOPOLYMER-BASED SENSORY PACKAGING

Researchers from the Faculty of Materials Technology and Textile Design are working on an innovative product in the form of biodegradable foil that contains a printed-on sensor of temperature change from negative to positive in an irreversible way. The use of this type of product in frozen food packaging will make it possible to objectively determine whether a thawing and refreezing step occurred after freezing in further transportation processes or during storage. In addition, the research is intended to develop biodegradable foil that can be used on products subjected to deep-freezing. The main product of the project will be innovative packaging that actively and intelligently monitors the quality of frozen food. Thus, the innovation will also directly and indirectly influence and be incorporated into supply cycle management, storage, optimization of distribution chains, storage and reduction of food losses (at each stage of the production-transport-store-consumer chain).



## GREENTEX – SUSTAINABLE TEXTILES

Today, the textile and apparel industry is the second largest industry that burdens the environment - right after the fuel industry. The GreenTEX (Sustainable Design and Process in Textiles for Higher Education) project responds to the related needs of modern education and the labour market by addressing the area of sustainable textiles. As part of the project, innovative solutions and courses of action will be developed, so that in the future the textile and apparel industry will become less carcinogenic, and the user will be able to obtain a safe high-quality product. The materials prepared will not only include specific solutions but will also demonstrate a whole range of possibilities of sustainable actions that can be used in education and business. TUL is working on the project in cooperation with universities from the Czech Republic (Technická Univerzita in Liberec), Portugal (Universidade De Aveiro), Croatia (Sveuciliste in Zagreb) and Lithuania (Kauno Technologijos Universitetas).



## WASTE MANAGEMENT

Relevant regulations have been adopted at TUL, obliging all TUL organizational units to observe certain principles of waste management, and in particular the hierarchy of actions applicable to waste management, consisting in: preventing waste generation; minimizing the amount of waste produced; ensuring recovery of waste compliant with environmental protection principles; ensuring environmentally compliant disposal of waste whose generation could not be prevented or which could not be recovered; selective collection of waste at the place of its generation, and its classification in accordance with the waste catalogue binding under the regulations.

The University conducts selective waste collection in accordance with the law and out of concern for the planet. In each building, in publicly accessible areas, there are points equipped with containers for selective collection of waste: paper, glass, metals and plastics, bio, and leftover after segregation. Waste is transferred to pergolas located on the Campuses, where waste is placed in appropriate marked containers. In addition, caps for charity and batteries are also collected at some locations. A "Manual for Handling Hazardous Waste, Including Chemical Waste at TUL" has also been developed.

It contains provisions on, among other things, detailed handling of chemical waste, a description of the organizational structure of a hazardous waste collection and storage system, the principles of operation of a chemical waste collection and elimination system, etc. Individual organizational units of TUL have their own plenipotentiaries for hazardous waste management.



## BIODEGRADABLE PACKAGING FROM USED TIRES

Every year, millions of tons of rubber waste, including tires, end their lives and become a huge environmental challenge. Disposing of end-of-life tires is an environmental and economic problem due to their volume and durability. A team of scientists from the Faculty of Biotechnology and Food Sciences and the Centre for Papermaking and Printing at TUL has developed a method to partially recycle a used tire and create biodegradable packaging that is completely impervious to air. The team has not stopped at further improving the functionality of the composite and is working on reducing its hydrophilicity. The researchers are also testing ways to combine bacterial cellulose with plant cellulose.



## RAISING SOCIAL AWARENESS OF SUSTAINABLE DEVELOPMENT

Aim 12 includes such tasks as "providing access to relevant information and raising awareness among all people around the world regarding sustainability and lifestyle in harmony with nature", and "encouraging companies to implement sustainability practices and include information on this topic in their periodic reports." In response to so-defined tasks, TUL publishes information on this topic on its website, and it launched a tab dedicated to sustainability on its website in the academic year 2021/22: <https://p.lodz.pl/uczelnia/zrownowazony-rozwoj> (in Polish and English). The university also publishes reports on its efforts to meet the Sustainable Development Goals on its website, encouraging other universities and businesses to follow suit. In 2021, a new series of live meetings called #EKOlogicznie z PŁ (#ECOLOGically with TUL) was premiered. Every two weeks, scientists from TUL shared their knowledge on topics related to ecology, advised on how to be a conscious consumer, and hinted at decisions worth making while caring for the environment. A total of 10 episodes were published (e.g. #EKOlogicznie z PŁ - Eco-shopping, or #EKOlogicznie z PŁ - Photovoltaics for a Layman), which were viewed by 1,710 people on the YouTube channel, with 59.2 thousand viewers on Facebook.



# GOAL 13

**13** CLIMATE ACTION

**TAKE URGENT ACTION  
TO COMBAT CLIMATE CHANGE  
AND ITS IMPACTS**



## FROM SWITZERLAND TO TUL - EXHIBITION ON CLEANTECH TECHNOLOGY

Lodz University of Technology, together with Embassy of Switzerland in Poland, was the organiser of the exhibition 'CLEANTECH - technology for a green future.' This unique mobile presentation presented innovative technological solutions developed by Swiss researchers and entrepreneurs in areas such as water management, agriculture, electromobility, recycling and energy. It was attended by the staff and students of TUL, for whom the event was an inspiration to collaborate on a sustainable future. The exhibition was accompanied by two seminars: 'The importance of new technologies in sustainable development' and a student seminar on sustainability projects.



## RACE-TO-ZERO CAMPAIGN

TUL, as one of two Polish universities, has joined the Race-to-Zero initiative, which is carried out in collaboration with the EAUC (the Alliance for Sustainability Leadership in Education), Second Nature and the United Nations Environment Programme (UNEP). The aim of the initiative is to develop a plan and take action to halve greenhouse gases by 2030. There are 1118 universities in total from around the world participating in the initiative



## ELECTRONIC DOCUMENTATION MANAGEMENT

In 2021 Lodz University of Technology signed an agreement with the State Treasury - Podlasie Voivodeship Office in Bialystok and Warsaw School of Economics - for the free use of the Electronic Documentation Management System (EZD PUW). A test version of the system was prepared and launched by the appointed team for EZD implementation at TUL. Ultimately, paper correspondence will be replaced by electronic communication.





## HOME WIND TURBINE

Lodz University of Technology, in a consortium with business partners from Poland and Turkey, will develop a backyard wind turbine capable of cooperation and integration with other Renewable Energy Sources. The consortium, in which TUL is the leader, includes two Polish companies: Enerwis and Ergos related to energy, and a Turkish start-up Devcitech, developer of the Enlil smart turbine. As part of the project, TUL will design a generator and test a prototype turbine under urban conditions. The starting point for the research is the Turkish Enlil wind turbine, and the aim is to develop an innovative and highly efficient wind turbine with a vertical axis of rotation. The turbine will be suitable for urban and suburban applications, generating energy not only from natural wind, but also from wind generated by vehicle traffic, for example. Ergos will develop the control and automation systems tailored to the needs of the machine under development, and Enerwis will be responsible for ensuring that the developed prototype meets the requirements of the renewable energy market and for working with external partners.



## TUL RESEARCHERS AT THE THIRD FORUM OF BUSINESS AND SUSTAINABLE DEVELOPMENT - LODZ 2022

TUL was a content partner of the Third Business and Sustainable Development Forum - Lodz 2022, an event organised by the Lodz Voivodeship. Discussions and lectures focused, among other things, on building and promoting an innovative economy with sustainable development principles. The programme of the event included panel discussions, talks with specialists representing various industries, speeches by experts and a debate in the area of transformation and the challenges it entails. The wide spectrum of topics made it possible for the Forum to look at the challenges of the modern economy from various perspectives that set the desired directions for the development of the region and companies. As part of the Forum, TUL researchers led two panel discussions: 'Challenges in the area of carbon footprint reduction in organisations' and 'Technologies of Tomorrow - a TUL debate: RES + Intelligent Energy Management + Energy Independence?'



## INNOVATIVE RESEARCH TO REDUCE CARBON DIOXIDE EMISSIONS

Climate change resulting from global warming is one of the greatest challenges facing science today, so it is fundamental to reduce greenhouse gas emissions, primarily carbon dioxide. Researchers from the Faculty of Process and Environmental Engineering at TUL are coming up with an answer to this problem. A Polish-Czech team of researchers is working on optimising a modern technology for capturing carbon dioxide from flue gases discharged into the atmosphere.

The research is being conducted in RPB (Rotating Packed Bed) reactors which make it possible to achieve a higher efficiency of the absorption process thanks to the use of centrifugal force. The innovation of the project lies in the fact that this type of reactor is currently very rarely used in industry. The project will develop numerical CFD (Computational Fluid Dynamics) process design methods, the validation of which in individual areas of the RPB reactor will be the task of the project partners.





## TUL CO-CREATES A GREEN REVOLUTION IN INDUSTRY

TUL researchers participate in the European FLEXIndustries consortium, which brings together 36 European institutions. Experts from the Faculty of Mechanical Engineering at TUL and the company K-FLEX Łódź - Uniejów are among the members from Poland. As part of the Horizon Europe project, more than €17 million will be allocated for solutions supporting smart energy transformation in large industrial plants. The project will result in the development of demonstration installations in large industrial plants producing insulation materials, steel, cement, paper, biofuels, as well as from the automotive and pharmaceutical industries. Over a period of four years, the consortium partners will implement intelligent systems to ensure reduced energy consumption, use of renewable energy sources, recovery of waste heat and reduction of CO<sub>2</sub> emissions. Each of the demonstration plants will be equipped with advanced monitoring systems to adapt to changing operating conditions. It is estimated that the project could directly save 154 GWh of electricity and €6.0 million each year. Participants in the consortium hope that the good practices developed in the project will pave the way for similar transformations in other European industrial plants.



## CIRCULAR ECONOMY OF THE SUGAR COMPANY

Researchers from the Department of Environmental Biotechnology at TUL together with the National Sugar Company, have received PLN 19 million from the National Centre for Research and Development to develop an innovative process for drying pulp using waste heat and obtaining functional feed components, as part of the circular economy of sugar factories. The focus is on developing a new way of drying wet pulp, which is the residue of sugar beet after sugar extraction.

An innovative belt dryer will be designed and built, using the excess heat that accompanies sugar production. The role of the TUL researchers is to develop bio-components to enrich the dried pulp used for feed purposes. Measurable effects from the implementation of the technology developed by TUL researchers will include: the provision of a product with a lower level of contamination and an improvement in roughage parameters, through the introduction of bio-components enriched in protein and other nutrients in the production process. An important aspect of the project is the efficient use of products from domestic GMO-free crops.

The AGROTECH project fits in very well with the policy of sustainable development. Thanks to the innovative technology, there will be a reduction in CO<sub>2</sub> emissions and other compounds into the atmosphere, as well as a reduction in the use of fossil fuels. The project is scheduled to run for 32 months. The innovative technology will be implemented at Krasnystaw sugar factory and will enable the management of waste heat from the sugar and pulp production process.





## BALTIC UNIVERSITY PROGRAMME (BUP)

The Baltic University Programme (BUP) is an international academic network established in 1991, whose participants are universities in the countries of the Baltic Sea Region. Today it is one of the largest university networks in the world with nearly 90 member institutions. The aim of the BUP is to support universities in spreading knowledge on universally understood economic, ecological, and social sustainability in the Baltic Sea Region. The programme is based on cooperation between universities, but also other social institutions, e.g. local authorities and organisations working for sustainable development in the region. The Baltic University Programme is an interdisciplinary programme bringing together all types of universities - humanities and technical, pedagogical, and economic universities, agricultural and medical universities. It is coordinated at international level by the BUP Secretariat at Uppsala University (Sweden). In Poland, the national Baltic University Centre is located at Lodz University of Technology.

The Baltic University Programme focuses on sustainable development, environmental protection, and democracy in the Baltic Sea Region.

The following types of courses are organised within the programme:

- Environmental Science of the Baltic Sea Basin,
- Baltic Sea Environment,
- Baltic Sea Region - Culture, Politics, Society,
- Baltic peoples,
- Sustainable Development of the Baltic Sea Region,
- Sustainable Water Management,
- Sustainable Social Development and Town Planning.

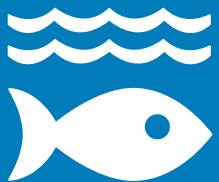
The programme offers university-level courses for both undergraduates and masters students, as well as lifelong learning for teachers and professionals. For more information: <https://www.balticuniv.uu.se>

One of BUP's annual events is a training course for PhD students. In 2021/22 academic year, it was hosted by TUL. The aim of this event is to provide PhD students with the opportunity to discuss scientific issues with a particular focus on sustainable development in an interdisciplinary, international, multicultural, and regional context. The training enables participants to learn about the scientific work of other researchers and to look at their own work through the eyes of other event participants, both their colleagues and invited experts. The training for PhD students held at TUL resulted in a Book of Abstracts containing 14 presentations from the event.

# GOAL 14

**CONSERVE AND SUSTAINABLY  
USE THE OCEANS, SEAS  
AND MARINE RESOURCES  
FOR SUSTAINABLE DEVELOPMENT**

**14** LIFE  
BELOW WATER





## BIRD HOUSES AND INSECT HOUSES

For more than five years, the TUL community has been able to have a real impact on the quality of the workplace and its surroundings through successive editions of the IDEA BOX initiative, in which students and employees can participate. Proposals that they submit are often strictly related to the environment and a significant part of the projects are pro-environmental in nature. Among the ideas implemented in previous editions were, for example, a floral meadow (for bees, butterflies and other insects), houses for hedgehogs (an endangered species in Poland, remaining under strict protection) or mini apiaries. Among the winners of the last edition of the IDEA BOX, were the projects Ptasi kampus- swift boxes on the wall of the Institute of Architecture and Urban Planning, and houses for insects in Klepacz Park.

Swifts are very useful birds that help get rid of mosquitoes and flies (one feeding young pair of swifts kills up to 20, 000 mosquitoes a day). They are very clean birds- they remove their droppings from the nest, so they do not dirty the building façade. Swifts have lived in Polish cities for a long time, but unfortunately, renovations and thermal modernizations of buildings have significantly reduced the number of places where they can live. As part of the project, nesting boxes will be purchased and installed on campus on the building tops. Following in the footsteps of the winning projects from the previous edition i.e. hedgehog houses and a flower meadow, in order to emphasize the university's care for the surrounding ecosystem, it was proposed to set up several insect houses in Klepacz Park. Blooming flowers, trees, shrubs are a lure for pollinating insects, so it is good to invite them for a longer period of time by providing friendly houses where they can find shelter and breed.

# GOAL 15

15 LIFE ON LAND



PROTECT, RESTORE AND PROMOTE SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS, SUSTAINABLY MANAGE FORESTS, COMBAT DESERTIFICATION





## USE OF PLANET BIOMASS FOR PRODUCTION OF CHEMICAL COMPOUND

One of the main threats to our civilization is the depletion of fossil fuels and the increase of environmental pollution. A way to prevent it is to use renewable raw materials such as plant biomass for the production of chemical compounds. Selective catalysts are needed here, and it is on them that the scientists from TUL are working on now. Research is conducted in cooperation with partners from France (University in Strasbourg, Ecole Normale Superiere in Lyon), Germany (University in Aachen), Japan (Shibaura Institute of Technology). The stable common metal-based catalysts developed in the project enable efficient conversion of biomass and obtaining chemical compounds with a wide range of industrial applications. The new catalyst synthesis method focuses on the use of sunlight.



## STUDIES ON METAL MIGRATION IN SOILS

Soil is an element of the environment where contaminants remain much longer than in water or atmosphere. To reduce its degradation means to control the level of contaminants. A risk to the biosphere is the presence in the soil of mobile metal forms that migrate easily and are assimilated by the plants. Metals of anthropogenic origin tend to be more easily mobile and pose a greater threat to living organisms as compared to metals of natural origin. The scientists from the Institute of General and Ecological Chemistry, TUL, studied the quality of soils in Lodz and adjacent regions. They used the statistical methods, as well as unit and aggregate indices and thus identified sites subject to strong anthropopression. The results of the study make it possible to identify sites particularly vulnerable to pollution, also historical pollution. The results also provide the source data necessary for compiling geochemical maps to show the quality of soils. The results of agricultural soil analysis are used by institutions responsible for environmental protection, as well as agricultural consulting. They help ensure food safety.



## FROM THE INSIDE OF THE PLANT TO SERVE THE ENVIRONMENT

One of the main goals of biotechnology with respect to environment protection is to use biological processes to effectively clean up the environment. Bioremediation technology is of greatest importance. It means that the degradative activity of microorganisms to convert toxic organic compounds into less toxic or completely harmless components, such as carbon dioxide and water, is used. Researchers from the Department of Biotechnology and Food Science, TUL, are implementing the BIOREM project 'Modern technology for bioremediation of soil contaminated with creosote oil on the site of the Sleeper Treatment Plant S.A.in Koźmin financed by NCBR under the Regional Science and Research Agendas. Its purpose is to develop a modern technology for bioremediation of soil contaminated with creosote oil on the site of the Sleeper Treatment Plant. Creosote oil is a product of distillation of coal tar, used to impregnate wood. It is classified as environmentally inert, and its disposal is considered as very complicated. The team of researchers from the Department of Biotechnology and Food Science has an extensive experience in developing microbial and enzymatic biopreparations effective in removing hydrocarbons, as well as optimizing and implementing bioremediation technologies on an industrial scale.

One of the team's tasks is to select microorganisms effective in degrading the components of the creosote oil. The project is being carried out in a consortium that includes the Institute of Wood Technology, Poznan(leader), the Technical University of Poznan, TUL and Sleeper Treatment Plant S.A. in Koźmin Wielkopolski.



## TUL ALSO CLEANS UP THE WORLD

Employees and students of TUL actively engaged in environmental activities, this time as part of the celebration of the International Earth Day. The university eco-team consisted of several people, both employees and students who worked to collect waste. Altogether over twenty bags of various types of garbage were collected, including bottles, hairdryers, plastic pipes of considerable dimensions. The organizer of the action Galante sprzątanie as part of the International Earth Day was the Department of Ecology and Climate of the city of Lodz.





## ECO-PREPARATIONS TO IMPROVE SOIL QUALITY

The scientists and students from TUL are regularly awarded by the Council for the Higher Education and Science under the Lodz Mayor's Office for achievements that promote the development of Lodz with the statues 'Lodz Eureka'. In the academic year 2021/22 the award in the technology category went to the interdisciplinary team of scientists from TUL for their innovative use of sugar factory waste to produce feed protein and eco-preparations to improve the soil quality. The team closely cooperates with the sugar factory Dobrzelin, which is one of the largest sugar processing plants in the northern part of Lodz province. Over the sugar campaign months of September-January the plant processes 520,000ton of sugar beets, which brings with it a number of technological problems related to the environmental protection. The scientists have developed a new technology for recovering soil, the so-called float blot, received in the process of cleaning and washing beets, so that this soil can be used by farmers to improve the soil quality. Physico-chemical studies of the elemental composition of silt, carried out by scientists, have shown a high content of organic compounds, which makes it an excellent material to enrich soils with valuable fertilizing substances for plants. The National Union of Sugar Beet Growers has declared its willingness to take back this reclaimed earth and use it as a natural material to improve the soil quality.

The scientists think that the theory they developed is groundbreaking. Its applications may bring considerable savings in a year. The advantages of this technology have been noticed and appreciated by the Management Board of the National Sugar Company and it was recommended for the industrial use.



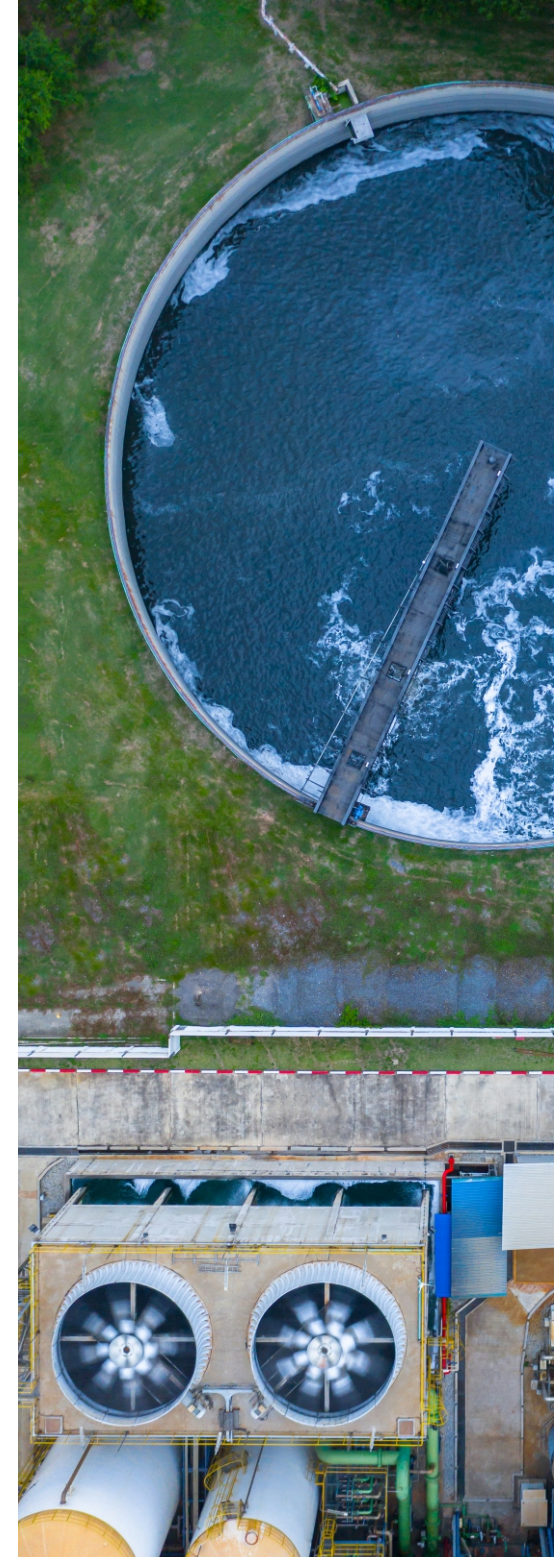
## STUDENT EDUCATION

The university educates students in the field of architecture, where they participate in classes like Pro-ecological architecture and Landscape architecture (I cycle studies), and Landscape and Environment (II cycle studies). The subjects are aimed at students who in the future will be responsible for planning, design and implementation of landscape architecture objects, like woods, gardens, parks, boulevards and nature reserves.



## MINIMALIZATION OF POLLUTANT EMISSIONS TO THE AQUATIC ENVIRONMENT

The Faculty of Civil Engineering, Architecture and Environmental Engineering together with the Group Sewage Treatment Plant S.A. carry out research aimed at developing monitoring and early system warning for the sewage treatment plant to minimize the emission of pollutants from the urban area. The system will be based on measurement data of the precipitation and flows in the sewage network and online measurements of the wastewater composition. The IT system will forecast the flow, concentrations and loads of pollutants at the inlet to the treatment to early warning against the inflow of toxic substances and hydraulic overload during rainfall. The system will enable optimal process control and in consequence sustainable management of the plant. The main recipients of the project's work will be the municipal companies responsible for the collection, transport and treatment of municipal sewage. The project will be a significant innovation in the sewage disposal and treatment system with considerable progress towards its fully sustainable operation for the protection of the environment and optimization of related expenditure.





## GOAL 16

**16** PEACE, JUSTICE  
AND STRONG  
INSTITUTIONS



**PROMOTE PEACEFUL AND INCLUSIVE SOCIETIES FOR SUSTAINABLE DEVELOPMENT, PROVIDE ACCESS TO JUSTICE FOR ALL**



### **EDUCATION FOR RESPECT OF HUMAN RIGHTS AND DIVERSITY**

TUL is fully aware of the need to protect fundamental freedoms in accordance with international agreements and to promote non-discriminatory law. In its curricula, it includes issues that help raise student awareness. Project classes Diversity Management in the Interdisciplinary Doctoral School of TUL present the social aspects of diversity as one of the key challenges in modern organizations. The classes enable the development of problem-solving skills arising from diversity. Attitudes free from stereotypes, racial, ethnic, national, religious or gender prejudice are developed in students as part of the intercultural Management and diversity management module implemented as part of the management course, second-cycle studies. Project classes Human Rights and Technology, which are also held in the Interdisciplinary Doctoral School, TUL, and the module Management and human rights implemented as part of the subject Ethical and social aspects of management in the digital world in the Management course, second-cycle studies, present and develop issues relating to human rights as viewed in different contexts in the modern world.

In the classes, the international human legal framework with reference to the fundamental principles like equality, non-discrimination, freedom, honesty and dignity found in agreements and international conventions, is reviewed.



### **DEMOCRATIC REPRESENTATION OF THE UNIVERSITY**

Rector elections are held every four years. The election is made by the University College of Electors that consists of 112 people who represent all groups of employees, students and doctoral students of TUL. Candidates for the post of rector can be submitted by the TUL Council and any member of the university community with a right to vote. Inclusive, participative and representative process of decision taking is assured by the University Senate which consists of all representatives of academic community- academic teachers, administrative employees, doctoral students and students.



## MAN-BUSINESS-TECHNOLOGIES

Open Scientific Seminars 'Man- Business-Technologies' are held under the auspices of the Faculty of Organization and Management, TUL. During the lectures, topics related to the holistic view of society, economy and technology and their relationships are discussed. Among the most important topics are:

- the universal aspect of technology and the human condition
- the impact of the Enlightenment vision of progress and the economic vision of the free market economy on contemporary social reality
- relations between science, ideology and politics, i.e. political responsibility of scientists
- the society of risk and safety- questioning scientific expertise
- responsibility and moral consequences of economic and technological development

Analyzed concepts and symbols describe contemporary civilization. To participate in the seminars outstanding guests are invited and present their findings. There are also open meetings and discussions, held for the TUL employees, doctoral students and students. In the academic year 2021/22 five meetings of this kind were held



## GOOD ACADEMIC PRACTICE COMMITTEE

The good practice committee, set up at the university, formulates opinions and conclusions in cases of violation of good academic practice. These refer specially to conduct that violates the duties of an academic teacher, nepotism, abuse of power, activities competitive to those that represent the university, also lack of respect for individual property, the use of non-substantive criteria in job evaluation, discrimination, undermining authority and scientific competence, incidents with signs of corruption, conflict opposing sides when mediating between academic teachers.



## DECLARATION OF SOCIAL RESPONSIBILITY IN TUL

TUL, as one of the of the first universities in Poland, has become a signatory to the university's Declaration of Social Responsibility, which is the initiative of the Ministry of Development and Investment together with the Ministry of Science and Higher Education. Signing of the Declaration is a voluntary commitment of the university to promote the idea of sustainable development and social responsibility in educational programmes, research, management and organizational solutions. Its goal is to build broad public awareness of the role universities have in shaping the conditions for the sustainable, social and economic country development.- The Declaration emphasizes the role of the university as a place to form and transfer knowledge and the need to nurture academic values.

The importance of ethical principles and the need to spread the idea of equality, respect and protection of human rights in relation to the entire academic community and its environment is most crucial.

The Declaration includes twelve principles relating to different aspects of university functions, its didactic activity, research, internal organization and dialogue with others interested. Within the framework of each principle, expectations were formulated for the signatory university to develop a particular area in the spirit of respect for social solidarity and the environment. TUL participation in this initiative expresses its commitment to the 'Third Mission'- i.e. forming and nurturing academic values to actively work for the society in various areas.





## STUDENTS' PARTICIPATION IN UNIVERSITY MANAGEMENT

The student self-government has a wide range of rights as guaranteed by the provisions of act. These include participation in the distribution of funds for the student affairs, the exercise of legislative power, improvement of education programmes and carrying out activities in the field of accommodation and cultural issues. The student self-government is the sole representative of all students of any university. The doctoral students' self-government has a similar mandate; its role and rights, however, relate to matters relating to doctoral students only. For its part, the university provides the conditions necessary for the functioning of student self-government, including the infrastructure and financial resources at the disposal of the student self-government as part of its activities.

At the university, apart from the central student self-government there also function faculty divisions. Students and doctoral candidates' representatives are members of the university collegial bodies; hence no important decisions can be made without their consultation. The President of the student self-government is a member of the University Council, which is the university's collegial body. The voice of students is important when they create and improve educational programmes. In some faculties the student representatives are included in the teams monitoring didactic activities. The student self-government of TUL has a strong representation on the national level, including the PKA student expertise, who transfer their experience, good practice and interesting formal and legal solutions to the university.



## AID TO UKRAINE

The TUL community is deeply disturbed by the ongoing war in Ukraine. The university is taking a number of measures to provide adequate support to Ukrainian students, and in order to coordinate its activities the university has launched a special site on which it presents information to support people affected by the war (<http://p.lodz.pl/uczelnia/lodzka-politechnika-dlya-uraini-pl-dla-ukrainy>). The university launched a special information and recruitment point to offer aid and support to students, doctoral students and academic teachers and administrative employees who come from the Ukrainian universities, but also to those students who stayed in Poland before the outbreak of the war. Academic Trust Centre provides free psychological help. The university organizes intensive Polish language courses for those who want to continue their studies in Poland and also courses and workshops to facilitate entry into the academic system at Polish universities. TUL also joined a donation collection, organized by the City Hall of Lodz. The university community offered such basic products as: painkillers, first-aid kits, thermoses, thermal mugs, batteries, powerbanks and long-term food. (the full list can be found on the Lodz City Hall website). The donations for Ukraine were collected at some points in different areas of the university campus and delivered collectively to the City Hall.



## ANTI-CORRUPTION POLICY IN TUL

The issue of ethical conduct in academic employee ethos is crucial. Counteracting corruption and corruption-generating processes is of vital importance for the employees in the public sector. TUL, as a public finance sector unit, takes initiatives and actions to prevent corruption processes. A tab for this issue has been prepared on the internal Wikamp platform, in which documents and online courses in this field are available: 'Social effects of corruption' and 'Corruption in public administration' developed by the Central Anti-Corruption Bureau. An anti-corruption policy has been implemented at TUL in 2017, and the university undertakes to apply standards of impartial and transparent scientific and economic activity. Supervision over the implementation of these principles was entrusted to the Committee for Good Academic Practice.





## TUL AMONG INNOVATIVE EUROPEAN UNIVERSITIES

At the end of 2021, TUL became a member of a European consortium of innovative universities and joined the elite network of the European Consortium of Innovative Universities (ECIU). ECIU is the first European university where students, teachers and scientists work together with regions, cities and enterprises to solve real problems that require a specific European and, at the same time, multidisciplinary approach. The goal of the ECIU University is to create an open and inclusive platform for students, teachers and scientists to solve real social challenges, such as those resulting from the implementation of the Sustainable Development Goals. The most important ECIU values that are reflected in scientific research, education and innovation are, in addition to academic quality, entrepreneurial mindset and an open ecosystem, also values directly related to the implementation of sustainable development goals - impact on society and stability in the future. ECIU members are, apart from TUL, Aalborg University (Denmark), Dublin City University (Ireland), Hamburg University of Technology (Germany), Groupe INSA (France), Kaunas University of Technology (Lithuania), Linköping University (Sweden), Tampere University (Finland), Tecnológico de Monterrey (Mexico), Universitat Autònoma de Barcelona (Spain),

Universidade de Aveiro (Portugal), University of Stavanger (Norway), University of Twente (Netherlands).



## THE GREAT ORCHESTRA OF CHRISTMAS CHARITY

Lodz University of Technology traditionally played in the orchestra conducted by Jurek Owsiak. The headquarters of the Great Orchestra of Christmas Charity of Lodz University of Technology collected a record amount of PLN 310,000 during the 30th final. That's about 10,000. PLN more than in the previous year. This year, 310 people were involved in the activities at Lodz University of Technology. Volunteers starting with schoolchildren, students up to the Rector's authorities - 180 people - were collecting contributions at various locations in Lodz. As in previous years, students from the Public Secondary School of Lodz University of Technology were involved in the fundraiser. The 30th final of the Great Orchestra of Christmas Charity was held under the slogan: "Przejrzyj na oczy." To ensure the highest standards of diagnosis and treatment of vision in children.

# GOAL 17

**STRENGTHEN THE MEANS OF IMPLEMENTATION AND REVITALIZE THE GLOBAL PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT**

**17 PARTNERSHIPS FOR THE GOALS**





## PROJECT BIO-PLASTICS EUROPE

It is estimated that on average around 30% of plastic waste in the world is unmanaged and ends up directly in waters and soils. So far, more attention has been paid to water pollution with plastics. Perhaps for the simple reason that the waste is better visible there. Meanwhile, the concentration of microplastics in the soil in some parts of the world is as high as several thousand particles per kilogram of dry soil. Researchers from the Faculty of Civil Engineering, Architecture and Environmental Engineering of TUL under the "Bioplastics Europe" project are researching innovative plastics obtained from renewable raw materials (bio-based plastics) produced by TUL partners in this project.

These materials will be assessed in terms of their phytotoxicity, toxicity to soil fauna and in terms of their impact on a model soil ecosystem operating on a laboratory scale. The results of the research can be used by plastics producers. Bio-plastics Europe focuses on sustainable strategies and solutions for bioplastics to support the EU-Plastic strategy and promote a circular economy. The aim of the project is not only to conduct research, but also to raise public awareness. The project is carried out in a consortium, Lodz University of Technology is one of its 22 partners



## GREEN TECHNOLOGIES FOR THE CIRCULAR ECONOMY

Scientists from the Faculty of Mechanical Engineering and the Faculty of Chemistry of Lodz University of Technology take part in the FRONTSH1P project, the budget of which is EUR 19 million, and the list of consortium members includes 34 institutions from Poland, Italy, Greece, Portugal, Spain, the Netherlands, Belgium, Germany, and Switzerland. As part of this project, companies and research centers are working on "green" technologies for the circular economy. The first working meeting of the partners took place on November 17, 2021, in the Sports Bay at TUL. The aim of the project is to create regional closed process loops in the spirit of the circular economy. This will allow for the management of various types of waste: wooden packaging, food, organic agricultural and municipal waste, sewage, plastic and rubber waste.

As a result, huge amounts of waste and pollution, which are currently an unwanted "product" of industrial processes, will be utilized, and the region and Lodz will be cleaner and healthier.

TUL will participate in the development of one of the four new technologies improved as part of the project. TUL will also co-create a technology that uses CO<sub>2</sub> to foam materials used in thermal insulation. The result will be insulation with better thermal properties, lower cost of implementation and - most importantly - containing carbon dioxide particles, which will not be released into the atmosphere. It is expected that as a result of the project, carbon dioxide emissions in the Lodz Voivodeship may decrease by 2%-3%, 100,000 square meters will be cleaned. cubic meters of water per day, the amount of wood recovered will be the equivalent of 180,000. furniture per year, and the recovered heat will amount to 3,240 MWh per year.





## MAZOVIAN HYDROGEN VALLEY

Twenty-five entities, including TUL, signed a letter of intent regarding the creation of the Mazovian Hydrogen Valley. The project leader is PKN Orlen, which will be responsible for defining the goals of the Valley and preparing a strategy for its operation. The priority objective of this project is to develop technologies for the production of green hydrogen from renewable energy sources. The integration of business with the world of science will make it possible to implement large-scale hydrogen investments, contributing to the development of the domestic industry and increasing the competitiveness of the Polish economy. The signatories of the agreement will work on innovative technologies that allow the use of hydrogen in, among others, in transport, energy, municipal economy and agriculture. The Mazovian Hydrogen Valley will be based on four pillars. The construction of the hydrogen value chain in the Mazovian region was adopted as the main one, as exemplified by the first hydrogen projects planned to be implemented by PKN Orlen, e.g., hydrogen hubs in Płock and Ostrołęka, a prototype hydrogen locomotive and hydrogen refueling stations. The other pillars are the implementation of research and development projects, the creation of systemic solutions for the training of specialized staff and conducting activities to support regulatory processes.



## COOPERATION WITH DUTCH UNIVERSITIES

Sustainable Development has become one of the priorities for most universities in the world. The effectiveness of activities in this area requires cooperation between various scientific disciplines, various entities (universities, business, non-governmental and government organizations) and various countries. One example of such cooperation is the project "Sustainable, social design", initiated by the Embassy of the Netherlands in Poland and DutchCulture as part of the country's international cultural policy. The partners in the project are, apart from TUL, SWPS University and the Polish-Japanese Academy of Information Technology, Royal Academy, The Hague and Design Academy Eindhoven. The central theme of the project is sustainable design, which is of interest to the universities invited to cooperate.



## SUSTAINABLE EDUCATION AND LEARNING

TUL is a member of the ESSSR (European School of Sustainability Science and Research), which is an inter-university consortium composed of members who share an interest in science and issues related to sustainable development. It is a key organization that fills the gap in the coordination of teaching and research in the field of sustainable development sciences in European universities. The fruit of cooperation with HAW HAMBURG is the submission of a project under the Horizon 2035 programme

The aim of the project is to exchange ideas, knowledge, experiences and best practices from the perspective of various scientific disciplines and countries. In September 2022, a study visit of partners from Dutch universities to Poland took place. The guests visited the School of Form of the SWPS University, the Polish-Japanese Academy of Information Technology and the Faculty of Organization and Management of TUL. They appreciated the potential for sustainable design provided by the research equipment gathered in the EQUAL (Ergonomic Quality, Usability & Accessibility) laboratory. Thanks to it, during their short visit, the guests could look at the world through the eyes of the elderly and those suffering from Parkinson's disease. Another potential area of cooperation that was discussed is the design of packaging considering the principles of sustainable development.





POLITECHNIKA

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