





# HOW AALBORG UNIVERSITY CREATES KNOWLEDGE FOR THE WORLD

## **Problem orientation**

Aalborg University's problem-based approach to research and education is strong and well founded. Researchers, lecturers, students and graduates from Aalborg University (AAU) apply their analytical skills as well as a holistic, problem and solution based approach to authentic problems.

## **Collaboration**

AAU conducts research in close collaboration between researchers, students and partners in the business world and in public institutions. The close contact that exists between the University and external organisations is a precondition for our work.

## **Commitment**

AAU reflects the vigour and zeal of its staff and students. AAU is a university for committed staff and students who assume responsibility and make things happen within the University and in the world around us.

## **Change**

AAU creates knowledge that changes the world. Our problem oriented approach to research, education, knowledge dissemination and collaboration makes a difference and creates change.

AALBORG UNIVERSITY 2016

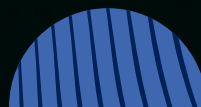
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NILS KROGH: PAGES 4 AND 8

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JØRGEN TRUE: PAGE 38

AS WELL AS FILE PHOTOS







**PER MICHAEL JOHANSEN**  
Rector

# A DRIVING FORCE FOR DEVELOPMENT

**One of the primary tasks of any University is to be a knowledge resource that creates a driving force for development, which in turn creates more knowledge, which then generates more development.**

But the perception of a university as being a mere knowledge factory which conducts research and provides education is too narrow and unambitious. For us as a university the task is also to create momentum and progress.

Knowledge provides insight, and as a university we are responsible for sharing the knowledge we create with the rest of the world. Collaboration is therefore one of our essential key competences. We must offer the knowledge we possess to the world because when societies are developing, knowledge becomes essential. Also, when we collaborate with others, this knowledge generates more and new knowledge. In other words, we become richer in knowledge when we share our knowledge with others.

For people in the modern world, and with the digital opportunities we possess today, it no longer makes sense to perceive societies as mere geographical entities. Because of our professions, interests, relations etc., we all form part of several different societies which cut across physical boundaries and which provide meaning to the content we are actively creating.

For the same reason, it also becomes increasingly meaningless to speak about research areas as isolated entities. When we wish to address the large challenges the world is facing, such as the climate, clean drinking water and energy, the natural sciences, health sciences, social sciences and the humanities become intertwined. They all form part of the solution. This is yet another reason why we attach great importance to collaboration.

Over the past 40 years, AAU has developed from being a regional growth engine to becoming a leading actor in several areas of vital importance to the international community. We are no longer just a driving force for regional development, we are part of the narrative of a global world.

*Welcome to Aalborg University.*

# WHAT DOES AAU STAND FOR?

A number of specific qualities set AAU apart from other universities. It is not the individual distinctive features per se but the combination of these features that makes us strong. Our strategic initiatives therefore focus on strengthening our distinctive features in order to enable AAU to develop into an even stronger version of the unique University we already are.



**PROBLEMBASED  
LEARNING**

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**COLLABORATION**

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**COMMITMENT**

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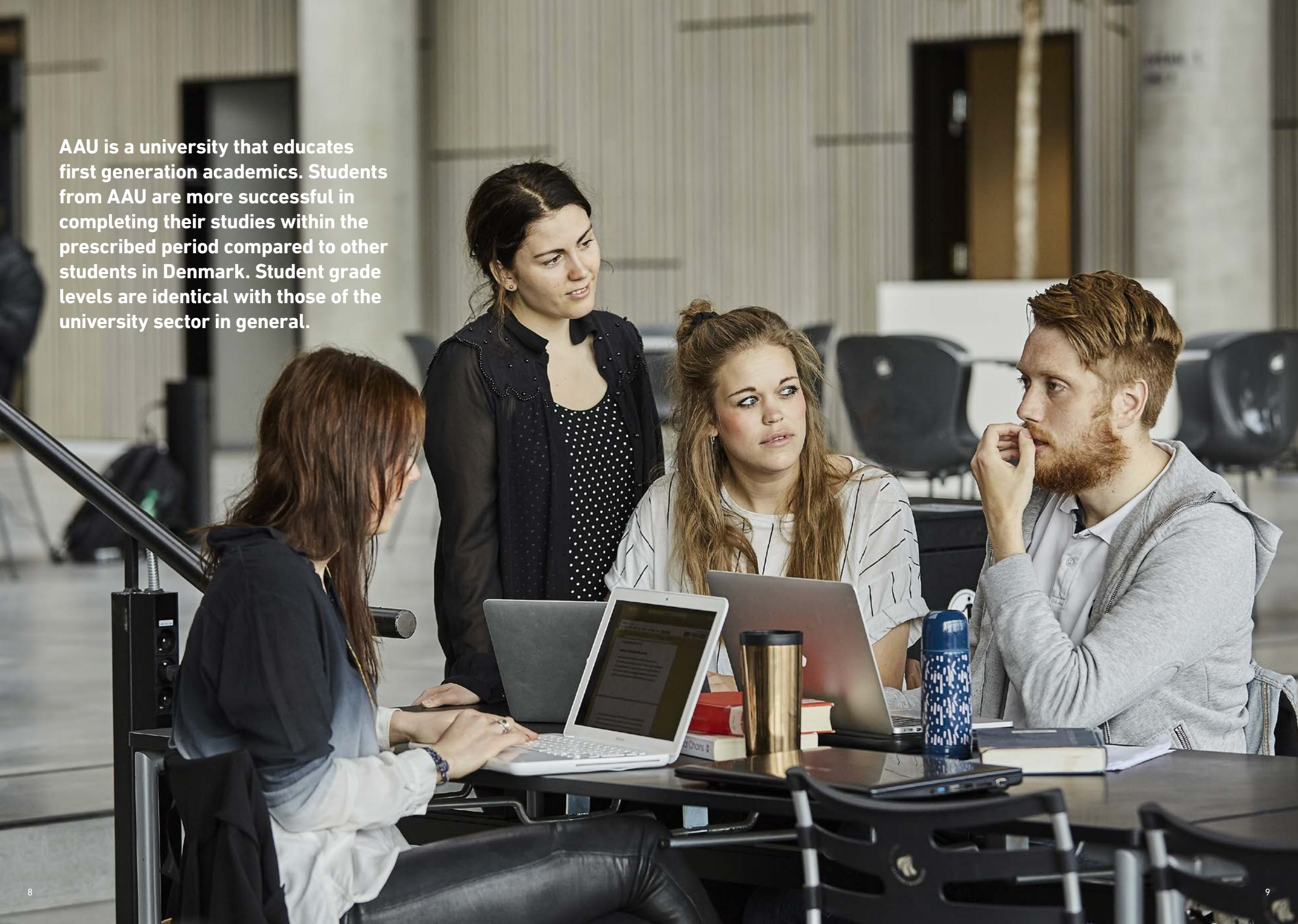


**CHANGE**

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**AAU is a university that educates first generation academics. Students from AAU are more successful in completing their studies within the prescribed period compared to other students in Denmark. Student grade levels are identical with those of the university sector in general.**



# PROBLEM-BASED LEARNING



## THE ANSWER THAT KEEPS ASKING QUESTIONS

**Problem-Based Learning (PBL) is AAU's most important trademark. Through collaboration, project work and supportive teaching, our students acquire a number of competences which are recognised and sought after across the world. In their project work, students always approach an authentic problem, in the sense that their task is or might well be to solve an actual issue.**

60 percent of our graduates find jobs in the private sector. One of the reasons is that our students become familiar with AAU's unique learning methods from day one. This model, which focuses intensively on collaboration and practice-oriented case work, creates graduates for the labour market of the future; they possess the particular competences required by the business world; they are able to work independently while possessing good collaboration skills. They take an analytical approach and are practice-oriented.

Their work is theory-based and solution-oriented. The result is tangible: Graduates from AAU are experienced in solving authentic, professional problems even before they enter the labour market.

PBL, or "the Aalborg Model", is universally applied in all University departments, schools and centres. AAU has its own PBL academy, which is instrumental in ensuring that the PBL model is continuously developed and adapted to modern needs and conditions.

This approach goes hand in hand with AAU's strong position as one of the preferred collaboration partners of the Danish business world. Master's and PhD theses as well as research projects based on business collaboration are examples of close-knit networks and collaboration partnerships. AAU has established such networks and partnerships with enterprises throughout the world to develop the breakthroughs of tomorrow. This is one of the reasons why UNESCO has chosen to place its only Danish chair in PBL at AAU.






## AAU STUDENTS LAUNCH OBSERVATION SATELLITES WITH ESA

Students at the AAU have launched several satellites, e.g. AAUSAT4, which will contribute to enhancing the monitoring of water-borne traffic near Greenland. Monitoring is relevant in detecting pollution from vessels. This work was initiated with this satellite's predecessor AAUSAT3, and will be followed up with AAUSAT5 in collaboration with the Danish astronaut who took part in the Iriss mission in 2015.

AAUSAT4 is a so-called CubeSat measuring 10x10x11 cm. It is able to receive signals from vessels in the areas it flies over and to send the information it receives to control stations on Earth. During the past two years, students from the technical sciences have been involved in the project.

The satellites have been launched as part of the training programme Fly Your Satellite! managed by the European Space Agency ESA.



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**Within engineering, AAU ranks  
as number 21 of 250 universities  
in the world.**

SOURCE: RANKING LIST COMPILED BY US NEWS WORLD IN 2015



**In 2014, AAU accounted for 14 percent of total national BFI points, even though the University's activities only amount to 10 percent.**

SOURCE: THE DANISH BIBLIOMETRIC RESEARCH INDICATOR (BFI)

## **AAU INVESTS DKK 48 MILLION IN RESEARCH TALENTS**

AAU's talent management programme forms part of the University's strategy for the years 2016-2021, which includes an increase in talent development initiatives within research. Initially, 18 young AAU researchers will benefit from the funding allocated under this programme.

The talent management programme is directed towards AAU's own research talents and is expected to be repeated in 2017 and 2018. The programme must ensure that the University's promising young research talents develop into strong, skilled researchers and research managers.





# COLLABORATION



## WHEN ONE PLUS ONE EQUALS THREE

**AAU perceives itself not only as a university in Denmark, but as a university in the world. This is reflected in all our activities, but particularly in our collaboration with companies and organisations around the world.**

Our basic position at AAU is that we can learn from the world, and the world can learn from us. This is why, since the foundation of the University, we have strived to create a strong collaboration culture which is embedded in all our activities. We cooperate with partners from the business world, other universities and the society around us. And we are internationally known as an open university where the doors separating us from the rest of the world open both ways.

Many examples may be mentioned. One technique in the wind turbine industry has been labelled the bucket foundation; this reduces the financial costs of installing a wind turbine, creates additional jobs and is more protective of the environment. Another example is 5G mobile technology, which ensures much better signal reception. Or a partnership with a major car manufacturer on the creation of more user friendly cars.



## REVOLUTIONARY INVENTION WILL ENSURE SUBSTANTIAL COST REDUCTIONS FOR THE WIND INDUSTRY

A professor from AAU and the company Universal Foundation are the forces behind a revolutionary invention, The Bucket Foundation, which will result in substantial reductions in the costs of production and establishment of offshore wind turbine foundations. At the same time, the invention will create new jobs and be more protective of the environment than existing solutions.

Studies have shown that the bucket foundation may reduce the price of foundations in an offshore wind farm by up to 30 percent, and that the invention will be applicable in 80-90 percent of all wind farms in Northern Europe.

The technology makes it possible to install and dismantle the foundation using a combined jet and suction technique; this means that noise pollution affecting marine life is kept to an absolute minimum and that the entire foundation can be removed and reused. The first foundations have been installed, and the company is working to optimise the solution for mass production in a project supported by the Danish National Advanced Technology Foundation and others.

#2

**AAU is second in Denmark as  
regards collaboration with industry.**

SOURCE: LEIDEN RANKING, 2015



## NO MORE ROAMING ABOUT THE LIVING ROOM TO CATCH THE MOBILE SIGNAL

We all depend on our mobile phone's voice and data connections. High quality mobile connections are therefore becoming increasingly important.

In a new project, AAU, Intel Denmark and Wispry Denmark collaborate on taking mobile telephone antennas into a new era – in order to meet future expectations to mobile networks.

In the future, mobile telephone signals must be directed precisely towards the spots with the best reception. For this to happen, many small antennas must be developed and combined in order to control signal directions. This paradigm shift in mobile communication is referred to as 5G.



## VOLVO'S USER EXPERIENCE COMPETENCE CENTER AT AAU IN COPENHAGEN

Volvo has placed its User Experience Competence Center (UXCC) at the AAU campus in Copenhagen. UXCC works with Volvo's research and product development in the infotainment systems and HMI (Human Machine Interface) used in all Volvo's car models.

More specifically, UXCC focuses on user experience, concepts or services combining several elements such as sound, navigation, driver information, entertainment systems, car sensors and data connectivity in cars. The Center conducts user surveys to discover what car owners are asking for and experiencing in their cars.

AAU teaches and conducts research within many fields that overlap with UXCC's work tasks. The collaborative potential is indeed one of the reasons why Volvo has decided to place this section on our campus.

# COMMITMENT



## COMMITMENT CREATES RESULTS

**No collaboration without commitment. AAU is committed to educating graduates needed by society. And to conducting research which will make a valuable difference for other people. Our targets are progress and change.**

AAU's working method is project-based and problem-based learning. The University's targeted focus on group work and collaboration with other universities, enterprises and organisations has enabled us to develop a unique culture characterised by commitment. When AAU students and researchers feel that their efforts generate valuable results, this enhances their commitment immensely.

One of the results achieved through the commitment to working with authentic problems is that research is conducted into the replacement of medical drugs by music to affect the wellbeing of people suffering from dementia and their ability to communicate with their surroundings. Other researchers are committed to finding ways of clearing up space junk so as to prevent active satellites from being destroyed by the space junk.





## FOR PEOPLE SUFFERING FROM DEMENTIA, MUSIC MAY BE A REAL ALTERNATIVE TO MEDICINE

People suffering from dementia, their relatives and carers may experience great benefits from music used as a therapeutic tool. This is evident from research conducted by the Department of Communication and Psychology at AAU. Our musical memory is retained longer than our linguistic memory; this is why music can be used for several different beneficial purposes:

**Music may draw a person suffering from dementia into a situation and create a sense of presence; it may have a unifying effect and create a feeling of community.**

Music can even have a calming effect on people suffering from dementia, externalising behaviour problems or problems of anxiety.

In some cases, music therapy is therefore an alternative to medicine. A research team will now examine how music therapy may enhance mutual non-verbal communication between carers and people suffering from dementia.

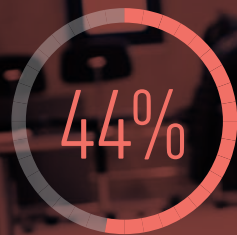


## STUDENTS NUDGE ROUTINES

Companies that welcome collaboration with AAU students must accept "odd" questions. In return they will get a fresh look at their processes and products, critical views on fixed routines and input that may serve to optimise their solutions.

Student analyses and suggestions may result in resource savings, for instance. This was experienced by TeeJet Technologies, a supplier of spray technology to the farming industry. Students have assisted the company in improving their production flow and have impressed TeeJet Technologies by their commitment to this work.

The company also found the actual collaboration fruitful, in that processes that had become natural to the company were being questioned. At the same time, they point out that the greatest benefit from collaboration is gained when the company itself plays an active part and gives the students access to the data and information they need.



**44 % of all master's theses at AAU are written in collaboration with a company.**

## COMMITMENT

## INVENTION FROM AAU ESBJERG TO CLEAR UP SPACE JUNK

End-of-life satellites and other space junk left in orbit represent a rapidly growing problem and have attracted international political attention, because the space junk poses a threat to communication and national security.

Space junk is a threat to the future use of space because of the danger of collisions between active satellites and disused ones abandoned in space.

Researchers from AAU Esbjerg have invented a simple self-expansive construction for clearing up some of this space junk in the future. The invention is based on a basic principle known from pop-up tents, folding frisbees and the screens used by photographers. It is an ultra-compact, simple and energy-neutral solution that can be used as a wind brake for end-of-life satellites in space.



# CHANGE



## MAKING AN IMPACT ON THE WORLD

**At AAU we contribute to solving tomorrow's greatest challenges. These may be life threatening or debilitating diseases, digital crime or drinking water contaminated by pesticides.**

Research makes a direct or indirect impact. New knowledge contributes to new solutions. We experience this in our everyday lives, even if the names of a researcher or university are not directly mentioned. Sometimes, however, it is generally known that research has played a decisive role. Whether we contribute with answers to small or very large problems, we are happy to share what we know and are capable of doing.

A vital question is that of drinking water contaminated by pesticides. An AAU project is studying whether live bacteria might help purify water. In line with the conversion to more environmentally friendly energy technologies, AAU's research in power electronics has become crucial to ensuring that society can convert maximum amounts of energy from renewables into electricity. We are also exploring how several international research laboratories might pool their efforts to discover the effect of certain molecules on cancer and other serious diseases.

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**AAU ranks number  
31 among the world's  
universities under the  
age of 50.**

SOURCE: THE TIMES HIGHER EDUCATION  
150 UNDER 50, 2016



## **GROUNDBREAKING METHOD OF REMOVING PESTICIDES FROM WATER**

Ensuring the supply of clean drinking water is among the biggest challenges of the international community. In many parts of the world, ground water has been contaminated by pesticides which will not automatically disappear. Once a water drilling has been contaminated by pesticides, it is difficult to purify the water by using existing methods.

The Department of Chemistry and Bioscience has developed an extremely simple method which will remove pesticides from water; this makes it possible to restore contaminated drillings by filtering most of the water through a membrane which removes the pesticides.

Pesticides can then be removed from the residual water by way of oxidation; in this process, pesticides are eliminated using electricity. However, this is relatively expensive, and residuals may occur in the shape of undesired non-organic substances. The MEMBIO project is therefore exploring methods to develop financially and environmentally sustainable technologies for using live bacteria for the removal of pesticides from the residual water.



## AAU SETS NEW STANDARDS FOR THE USE OF RENEWABLE ENERGY

Over the past 20 years, AAU has achieved unique research results within power electronics. Power electronics explores methods of controlling and converting electric power. The results achieved by AAU now place us among the leading universities in the world within this field.

In society we find many examples of energy conversion in which power electronics is absolutely essential.

This applies, for instance, to power from wind turbines and solar cells, which must be effectively connected to the electricity grid, and to computers, engines and other appliances in which power must be adapted to the load. In fact, it is estimated that around 70-80 per cent of our total electricity consumption is being converted by power electronics. Power electronics is therefore absolutely essential to the entire energy field.

At AAU, researchers are working intensely to develop these technologies even further. This takes place in close cooperation with a number of industries whose appliances and components need to be improved in terms of power consumption and durability as well as in power production from sustainable energy sources such as wind turbines and solar cells. The University's contribution to the pursuit of energy efficiency improvements is found in small electrical appliances as well as in huge engines in giant offshore wind turbines.

#6

**AU ranks as number six in the world within the research fields of electronics and electronic engineering.**

SOURCE: QS BY SUBJECTS, QUOTATION AND H-INDEX



## NEW ARCTIC CENTRE ENHANCES IMPORTANT RESEARCH

AAU has for many years collaborated closely with Greenland on education, research and knowledge sharing. This has taken place through the Centre for Innovation and Research in Culture and Learning in the Arctic (CIRCLA), which has been conducting research within the fields of humanities and social sciences. This collaboration has recently been expanded by yet another research centre, AAU Arctic, which cuts across the University's departments and also its research disciplines.

AAU Arctic conducts research in climate changes, the adaptation of animals and plants to extreme environments, biology in general as well as the health of the population in Greenland. Moreover, it explores cultural heritage, fisheries, the sustainability of mining, tourism etc.

This work strengthens our collaboration with Greenland and with other Danish Arctic research environments; however, it is even more important that research in these topics is carried out for the benefit of Greenland as well as for the rest of the world.



## AAU'S LEGAL EXPERTS PROVIDE CONSULTANCY TO INTERNATIONAL AUTHORITIES ON CYBERCRIME

International Economic Crime and Cybercrime Research Centre (IECC) conducts research and provides consultancy on cross-border economic crime and cybercrime. The Centre is a member of Europol's Academic Advisory Network and is the first Nordic centre to work with cybercrime in a broad sense.

**The research field is relatively young but has attracted increasing attention in recent years. This has coincided with the ever increasing demands of the digitisation of society on our handling of cybercrime, and not least on the ways in which we protect ourselves against this.**

The legal system must follow suit, but the laws that govern society were not designed for the modern digital reality. Some of the most important tools to combat cybercrime are surveillance and the registration of data, and it is in everyone's interest that the police and others have the best possible conditions for investigating digital crime and making sure that we are not transgressing individual rights to privacy.

## NEW OPTIONS FOR THE TREATMENT OF LIFE THREATENING CANCERS

Analyses have resulted in the revolutionary discovery that the human genome is much more complex than previously assumed. A large part of our DNA is read by tens of thousands of so-called non-protein coding RNA or ncRNA molecules, which regulate many important biological processes in the cell. Moreover, it turns out that defects in the activity of ncRNA molecules may be linked to the development of a large number of diseases. This is not only of interest to basic research, but is expected to form the basis for the development of new targeted therapies for the treatment of many life threatening diseases.

The Center for RNA Medicine is an integral part of the Department of Clinical Medicine located at the AAU CPH campus close to Denmark's leading pharmaceutical companies. The research team of the Center has built up extensive experience within ncRNA research and the development of RNA targeted pharmaceuticals. The Center is leading a new research programme whose aim is to integrate the key competences of several internationally recognised research laboratories in a joint effort to combat life threatening diseases.

The project will explore the role played by ncRNA molecules in the development of cancer and other life threatening diseases and subsequently transfer the results to preclinical research with a view to develop new pharmaceuticals for the treatment of these fatal diseases.





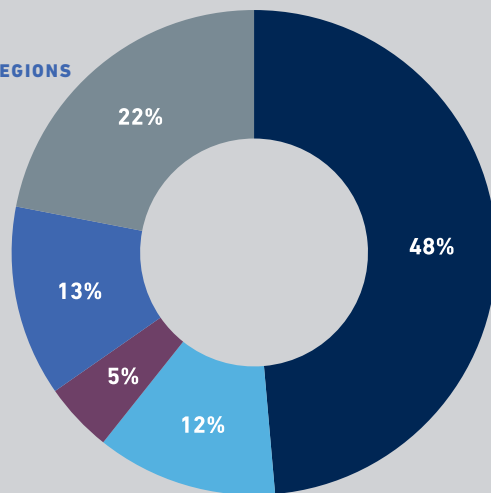
In spite of its young age, AAU has established itself as a recognised international research institution. In 2014, AAU accounted for 14 % of total national BFI points, even though the University's activities only amount to 10 percent of all activities in the sector.

## FACTS ABOUT AAU

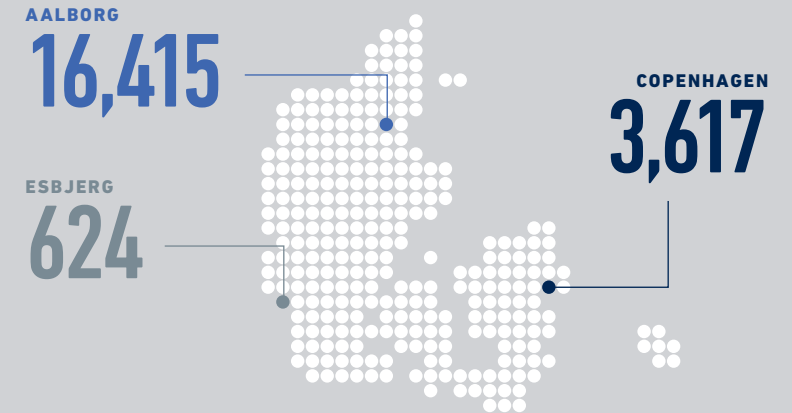
From 2010 to 2014 AAU saw an 81 percent increase in the acquisition of external research funding. This is reflected in the establishment of a prestigious national Centre of Excellence in 2014, as well as in our successful acquisition of EU funding from the new EU Research and Innovation framework programme Horizon2020. In recent years, AAU has also been successful in acquiring research scholarships from the European Research Council in the shape of the much sought after ERC Advanced Grants.

### EXTERNAL FUNDING FOR RESEARCH PROJECTS

- GOVERNMENT FUNDS
- PRIVATE FUNDS
- MUNICIPALITIES AND REGIONS
- EU
- OTHER NATIONS



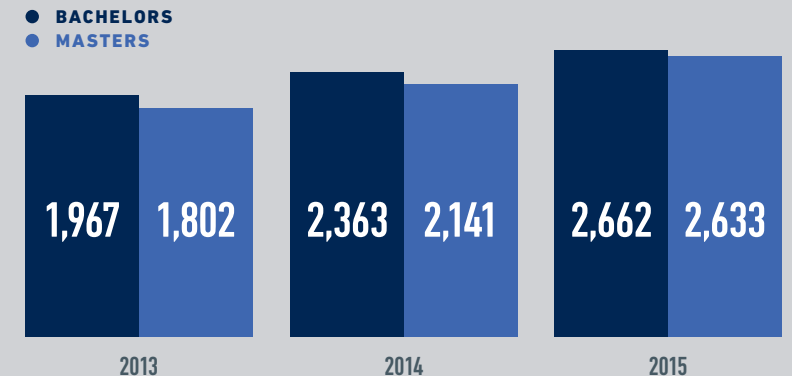
### STUDENT NUMBERS 2015



### INTERNATIONAL STUDENT NUMBERS 2015



### NUMBER OF GRADUATES





## **AAU IMPACTS THE DANISH BUILDING INDUSTRY**

Buildings are the framework of our daily lives; therefore it is important that they are safe and healthy. But it is also important that we construct and maintain our buildings in ways that have the lowest possible negative effect on our economy and natural resources. AAU collaborates with the public sector, the building sector and the building users to meet these complex needs. A key task is to provide research based consultancy on the basis of building regulations. The Danish Building Research Institute (SBI), which has formed part of AAU since 2007, was established to perform this task.

This collaboration not only creates good legislation, but also innovation in the sector. An example is the energy consumption of buildings; SBI has supplied research based consultancy to the public sector as to how energy consumption in buildings may be reduced. The introduction of low-energy classes in building regulations has resulted in extensive innovation in the building sector, and today, the cost effective alternative of low-energy housing is available to consumers.

AAU's impact on the world in 2015:

**12 pending patents**

**90 pending inventions**

**77 license, sales and options agreements**

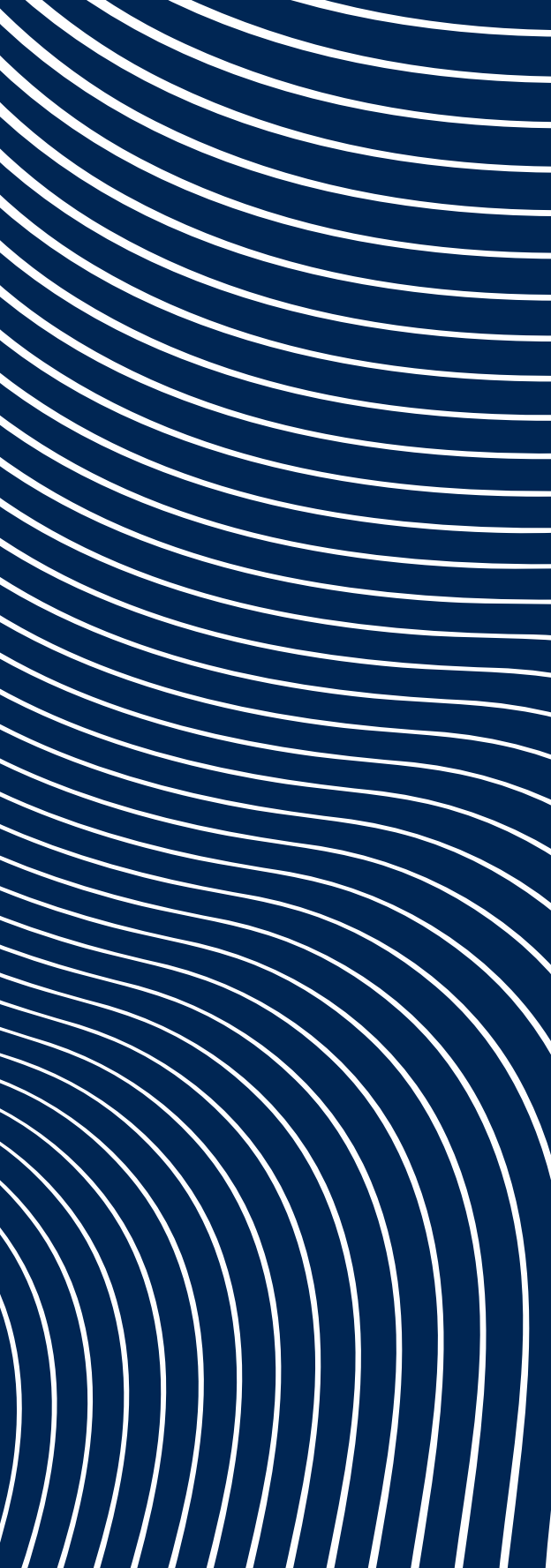
**457 teaching and information publications**

**5,407 research publications**

**947 PhD students, 216 PhD degrees**

**2,633 master's graduates**





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