Delft Outlook
MAGAZINE OF DELFT UNIVERSITY OF TECHNOLOGY 2013 • 2

Seeing the light

LED: light source of the 21st century

Reactor Institute celebrates anniversary:

Turbulent past, promising future

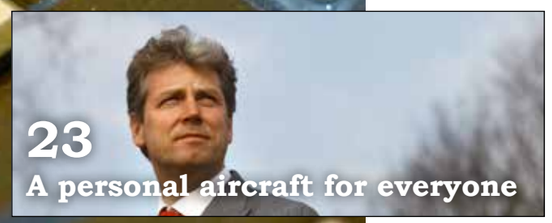
Wiebe Draijer:

'Our knowledge base is incredibly strong'

Jacco Hoekstra:

'A personal aircraft for everyone'

no. 2 2013



Contents

Broad view

It is 25 April 1963. “You never forget the first time for something like that. [There was] euphoria in the air, because nuclear energy was the way of the future”, recalls Professor Emeritus Marcel de Bruin. The Delft Reactor Institute is 50 years old. Despite its respectable age, it is far from being obsolete. A recent injection of 117 million euro is bringing the Delft icon back into the European research circuit. Nuclear energy now makes up only a small part of the new research portfolio. Part-time Dimes Professor Kouchi Zhang is setting his sights across borders as well. “I predict the liberation of light”, he tells us, referring to LED as a source of light for the 21st century. Zhang’s unit is an important academic player in Europe, but his ambitions extend even farther. The LED researchers in Delft are collaborating closely with colleagues in China. This outward focus is exactly what Wiebe Draijer, TU Delft alumnus and President of the Economic and Social Council of the Netherlands (SER), would like to see. “Of all students in Europe, those from the Netherlands are the least likely to go abroad. This is completely inconsistent with our status as a trading nation”. Nevertheless, he has not outgrown the Dutch ‘poldering’ (negotiation). “All major breakthroughs can be traced back to it. Our economy of negotiation is a fundamental strength”. I hope that they like meetings in China.

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Delft in Brief


Photo: Tomas van Dijk

Vacuum gripper

PhD student Durandus Vonck developed a vacuum tool that allows surgeons in keyhole surgery to get a grip on tissue without damaging it.
It all began with the idea of using vacuum for getting a grip on tissue during an operation. Tools that have been in use for that are basically modified pincers, which are prone to damage the tissue if not handled correctly. Amongst other studies, Dr. Eveline Heijnsdijk showed this in a PhD research project (2004) at the faculty of 3mE. The project fell within the research contract with the German laparoscopic instrument builder Karl Storz GmbH. No less than five IDE master students worked on the design of the vacuum pump handle. “The first design looked like a hair blower”, Goossens remembers. “After that, it gradually became more elegant until Storz took over to optimise the design for manufacturing.” Another clever adaptation they introduced was to place the vacuum piston in the tight shaft instead of in the wider handle.

delta.tudelft.nl/26538

Sensitive sensor

Concentrations of carbon dioxide in greenhouses may be monitored by a cheap and small solid-state nano device. A special polymer coating makes an electronic chip sensitive to the greenhouse gas. During his PhD research, Dr. Xiangping Chen set out to develop a new type of solid-state CO_2-sensor that would be fast, sensitive and affordable. Polymers are more often used to add chemical functionality to electronic devices, potentially turning them into electronic noses, taste buds or indeed gas detectors. Chen explains the function of the polymer is twofold: it increases the sensitivity and makes the sensor more specific for CO_2 detection. Prof. Paddy French, who was in Chen’s doctoral committee, says the polymer technology is promising, but that more work is needed to proof that the proposed gas sensor is specifically sensitive to CO_2 and not to whichever other gases may pass.

delta.tudelft.nl/26530


Photo: Tomas van Dijk

Personalized medicines

Cancer treatments should be completely revised, said Prof. Lodewijk Wessels of the section pattern recognition and bioinformatics (EEMCS faculty) during his inaugural speech on the 15th of March. Wessels, who also works at the cancer research institute Antoni van Leeuwenhoek in Amsterdam, envisions a future in which people receive personalized cancer treatments. This is necessary, he believes, because cancers can be the result of a myriad of different genetic mutations and medicines usually only tackle cancers resulting from certain types of mutations.

delta.tudelft.nl/26468

Speed devils

The students of the Human Power Team Delft & Amsterdam presented the design of their new bicycle, the Velox3. With it, they hope to break the world cycling speed record, set at just over 133 kilometres per hour. It will be the third year in a row that the students participate to the cycling races held each autumn in Nevada. In 2011 and 2012, the students won with speeds of almost 130 kilometres per hour. For the first time the students will now use rear traction and they also have new tires. The students expect them to result in fifty per cent less rolling resistance.

delta.tudelft.nl/26466


Photo: Tomas van Dijk

Thousand euro wind turbine


Photo: Tomas van Dijk

"A thousand euros for a complete wind turbine system, that's what I'm aiming for", says Dr. Sam Ani who obtained a PhD in electrical engineering by successfully developing a low-cost generator for developing countries. "This technology can be built locally, it can create employment and it solves the problem of the lack of electricity in rural areas", says Ani. "The benefits are just too much to ignore."

delta.tudelft.nl/26410

Micro-cracks

Students from Aerospace Engineering have reached the second level of the Airbus competition 'Fly Your Idea'. Bram Davids, Philippe Willems and Maarten Debrouwere propose to integrate stress and delamination sensors, made of specially prepared glass fibers, into composite materials for aircraft hulls. An integrated network of these sensors would provide early warning for micro-cracks and delamination. Over 600 student teams from all over the world pitched their ideas in the open first round of the competition.

delta.tudelft.nl/26268


Photo: Tomas van Dijk

Cracks in the wall

Environmental engineer Dr. Giorgia Giardina improved the method for estimating what damages to brick houses can be expected as a result of tunneling activities. Construction companies are required to perform damage predictions on the existing buildings above the track. But the method in use, called LTSM for Limiting Tensile Strain Method, can be made more realistic with Giardina's extensions.

delta.tudelft.nl/26379

Promising holes

Researchers from TU Delft, the FOM Foundation and TU Eindhoven have demonstrated that not just electron spins but also hole spins (the absence of an electron can also have a magnetic moment or so called spin) are good candidates for qubits, the information carriers in quantum computers. They have managed to electrically manipulate the hole spins. The research was published online last week in Nature Nanotechnology (DOI: 10.1038/NNANO.2013.5). The lead author is Dr. Vlad Pribiag of the faculty of Applied Sciences.

delta.tudelft.nl/26323

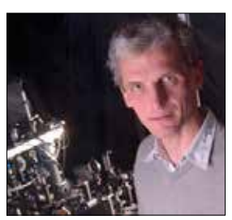
Earthquake in space

The massive earthquake that hit Japan on 11 March 2011 was registered by the GOCE gravity satellite at 270 km's above the Earth's surface. This was announced by ESA. TU-researcher Dr. Eelco Doornbos was involved in the data analysis. It shows large variations up to 15 % in the air density (infra sound waves) about half an hour after the quake hit.

bit.ly/16rE58c

What really matters

Nobel laureate Wolfgang Ketterle from MIT visited his colleagues of the Kavli Institute to talk about the quest for new forms of matter. Ketterle explores new forms of matter in ultra cold gases. He was rewarded the Nobel prize in physics 2001 (together with Eric Cornell and Carl Wieman) for the observation in 1995 of a Bose-Einstein condensate of sodium atoms. "Our scientific goals are the same; to understand and develop novel materials" he explained. "But our methods couldn't be more different. In conventional nano science you work with real materials, materials with the density of this table (he knocks on the table). In the field of ultra-cold atoms we work with atomic gasses which are a billion times more dilute. Yet because they are so cold they behave like matter with a much higher density. In the end however, the kind of materials we realize - conductors, superfluid's, quantum magnets - may follow the same equations. So we follow each others work and there is cross fertilization."



delta.tudelft.nl/26446

Hot water


Photo: Sam Rentmeester

Deep geothermal wells have a large heating potential for the Netherlands, according to experts at DAP's 'Hot Topics' symposium on 11 February. In the Netherlands, a small number of commercial gardeners have taken up geothermal heating for their glass houses. With a failure rate of 10 to 30%, geothermal projects have been luckier than oil and gas explorations, which typically fail in nearly half of the drillings. Experts think that the geothermal potential in the Netherlands has hardly been tapped.

delta.tudelft.nl/26306

Curly curved concrete

Ir. Roel Schipper (CEG) is working on a technique to produce double curved precast concrete panels. This could greatly enhance free form architecture, he believes. The system is a spin-off of a technique, developed earlier by Dr. Karel Vollers of the Architecture faculty to make freely bended glass panels. It works quite simple. Placed above the pistons, that can be adjusted in height using nuts, is a lattice made of thin flexible plywood. On top of that you put a silicone mould filled with concrete. Once the concrete has hardened a little and reached the right shear strength and viscosity you lower the lattice on the pistons thereby creating bended concrete panels, the shape of which you control by adjusting the height of all the vertical stands. "What looks simple on paper is actually very complicated", says Schipper. "Finally by trial and error we found the right recipe."

delta.tudelft.nl/26569


Artist impression: NL Architects


Photo: Sam Rentmeester

Traffic tool

A new traffic model called Fastlane is tested on the A15 harbour motorway. Its forecasting ability should optimize control of serious congestions. Fastlane is developed by three PhD students from the TRAIL research school at the faculty of Civil Engineering and Geosciences.
In traffic flow models, it's all about speed (km/h) and traffic density (vehicles per hour). Fastlane also reckons with passenger car equivalents (pce's) which is a measure for how much a vehicle (truck or car) contributes to the traffic flow. A large truck has therefore a high pce value.In his PhD research dr. Thomas Schreiter has proven that differentiating between cars and trucks ('multi-class DTM') improves the performance of the simulation.

delta.tudelft.nl/26465

Passive builders

Ten years ago, energy-efficient passive houses were introduced in Flanders, Belgium. At the time, these houses without heating were regarded as radical innovations. Now, they form a proofed concept and a successful growing market. In comparison, the Netherlands lags behind. Dr. Erwin Mlenick, who was involved in the Belgian introduction, says that builders should cooperate more in focused networks. At the same time, experiences of end-users who, for example, ask for more influence on ventilation, should be taken seriously. Overall, lack of motivation for innovation in the construction sector seems to be the largest problem.

Photomontage of the reactor being built in the 1950's and the reactor in 2013.

50th anniversary of the research reactor

'Nuclear energy was the way of the future'

It was the hidden jewel of TU Delft, according to the employees of the nuclear reactor. Others protested against it and insisted that it be eliminated. Following a major mid-life crisis, the Delft research reactor is now in better shape than ever before.

Jos Wassink

In the summer of 1957, an exhibition entitled 'The Atom' *(Het Atoom)* was held at Schiphol, with a genuine nuclear reactor as a public attraction. For an admission fee of half a guilder, visitors could view the mysterious blue Cherenkov radiation. Throughout the summer, an estimated 750 thousand people did just that. They saw the light of the new era at the bottom of the water basin. Einstein said that those who could apply nuclear energy to peaceful purposes would open the gate to paradise. The Dutch government purchased this key to paradise from the United States, with the intention of housing the reactor in Delft after the exhibition, under the name *Hoger Onderwijs Reactor* (Higher Education Reactor, HOR for short).

First time

25 April 1963 - After a day of opening festivities, peace was restored in the reactor building. After ordering Chinese, a small team led by ir. Hans Kleijn went to work starting the reactor. He proceeded with great caution, as recalled by Professor Emeritus Hugo van Dam. As a student assistant, his assignment was to calculate when the reactor would become critical. Professor Emeritus Marcel de Bruin was also there as a student. He had brought his camera (the only one on site), because he had no official job.
During the night, fuel rods were added to the reactor, one by one. "If you place enough enriched uranium together, the system becomes critical", explains Van Dam, 50 years later. "The chain reaction maintains itself. If the mass is too small, the process will not begin. If the mass is too large, it will get out of hand". Each time the calculations of the student assistants indicated that another rod was needed, the control rods were lowered, nuclear fission material was added and the control rods were raised cautiously, keeping a firm eye on the measuring instruments.
A neutron source was then placed at the core to keep the fission process going. As long as the reactor is not critical, the reaction will be extinguished if there is no external source of neutrons. Once it has become critical, however, the process keeps itself going. "Then the source can be removed, and the core will keep simmering quietly", explains Van Dam.

'There was euphoria in the air'

That point was reached at four o'clock the next morning. The log reports: "04:00; control rod 49.99%; time-constant positive; reactor is now critical.
"It was up to capacity for only a short time, and then it went out", recalls Brown. Then it was time for a glass of champagne. "I remember that the light had already started to shine through the windows. That was my last snapshot that day".
It was also an unforgettable experience for Van Dam. "You never forget the first time for something like that. Moreover, there was euphoria in the air, because nuclear energy was the way of the future".

"You have visitors"

26 September 1980 - At six o'clock in the morning, the telephone rang in the home of Hugo van Dam, the deputy dean at the Interuniversity Reactor Institute (IRI). Because the dean (Prof. Jan Houtman) was unreachable, the police had called Van Dam with the dry announcement, "You have visitors".
"That said enough", Van Dam tells us. The Anti-Nuclear Movement *(Stop Kernergie)* had already been causing some disturbance, and now hundreds of protesters had infiltrated the reactor site. They had laid planks over the moat and had walked onto the premises. The deputy dean decided to negotiate with them. "Who's in charge here?" he asked. "We're all in charge", came the reply. Van Dam thinks now that it was all purely for show. That aside, he climbed onto a platform and called out three times: "You must vacate the site. Otherwise, we will take action". His announcements were met with jeering laughter.
In conformity with the crisis protocol, Van Dam retreated to an office at the top of the A&E building, which looked out onto the reactor. The Mayor joined the Police Commissioner and representatives from several Ministries.
Meanwhile, the situation was becoming increasingly unpleasant inside the reactor building. Test installations needed attention and liquid nitrogen, and the operators – who should have been relieved at eight o'clock – were becoming restless. It was for this reason that the crisis team decided in afternoon to have the riot police evacuate the site, in the presence of the assembled members of the press.
"That generated bad publicity", recalls Van Dam. The police dragged people away with a new small baton under their chins. In the media, it was soon dubbed the strangling stick. "People perceived it as a harsh evacuation".

Shortage of 'Democracies'

8 June 1977 - Prof. Jan Houtman, an old-school professor who had played a crucial role in the construction of the IRI, resigned as scientific director and declared that the institute was "killing itself with meetings". For >>

'The Oyster programme **has returned the ageing reactor to the European research circuit** *in a revitalised form'*

years, the Interim Institute Council (IIR) had been a source of particular irritation to him, as well as to others. In the wake of the University Management Reform Act of 1970, the IIR held regular meetings with the general board, as well as with the TU Delft board, the academic council, the unions and, preferably, with the State Secretary of Education as well. Given that an active democracy demanded everyone to respond to everything, a tsunami of meeting documents was set in motion that led to meetings that would begin at two o'clock in the afternoon and last until after six, sometimes being resumed the next day. Van Dam, who had served in the Navy for two years, was dismayed by this process of 'democratisation': "We almost had more managers from outside than we had staff inside. The general board had 26 members. It was horrible". After Houtman resigned, Van Dam served as deputy dean for six months, but he'd already "had it up to here", in his own words. It was not until the arrival of Marcel de Bruin as dean that the institute would once again become manageable. People were also tired of the hassle, says Van Dam. The disadvantages of democracy had come to light: because no one was in charge, unsuccessful projects were dying a very slow death. Examples include the cold neutron source and the pulsed neutron gun. These projects were not progressing at all, but nobody dared to say it.
De Bruin brought two special habits with him when he took office as the director in 1988. Each week, he took a walk through the institute and made small talk with everyone. He occasionally took the time to walk or look out the window and quietly reflect on the future of the institute. The strategist De Bruin kept his eye on the mission of the IRI: the reactor receives its value by sharing the facility with other researchers from a wide range of fields. The manager De Bruin was capable of giving people new ideas and making them think that they had thought them up themselves.

A second youth

1 January 2005 - Prof. Tim van der Hagen took office as the director of a company in transition. Two years earlier, a commission chaired by the current Rector, Prof. Karel Luyben, had assessed the IRI and found it wanting. According to Luyben, the institute was too self-absorbed and too rich. This atmosphere was quite familiar to Van der Hagen. "We simply received money and did our own things". Luyben had proposed splitting the IRI into a facility reactor institute (Delft Reactor Institute or RID) and a department (Radiation Science and Technology) within the Faculty of Applied Sciences. Van der Hagen was asked to formulate a vision for the future. He did this in close consultation with De Bruin. When this vision fell into favour with the Executive Board, it was followed by an assignment to draft a business plan and, later, by an appointment as the director of an institute in transition.
The number of jobs had been cut in half, the quality of the research had to be increased and the institute needed to provide more education. A fortunate turn of events made it possible to attract new people for supervisory research positions: Ekkes Brück, Katia Pappas and Freek Beekman trickled inside. This list should also include Bert Wolterbeek, who was already in service. Meanwhile, Van der Hagen was travelling throughout the country, drawing attention to the RID and its new research focus on energy and health. Money was needed – lots of money.
Van der Hagen emphasised that the Delft reactor was the only research facility in the Netherlands producing neutrons. Operating at the international level, however, would require substantial investment. Although the Ministry of Education had already made a commitment in 2005, the funding for the Optimised Yield for Science, Technology and Education of Radiation (Oyster) programme would not became a reality until 2012.

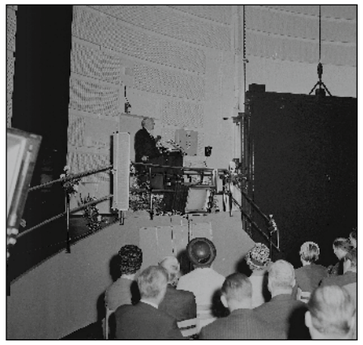
The future: Oyster

The 117 million euro Oyster programme has returned the ageing Delft reactor to the European research circuit in a revitalised form. This is due to the instruments that are being developed in Delft for high-ranking international facilities, combined with the fact that researchers are able to prepare their experiments in Delft. The director of RID, Prof. Bert Wolterbeek, further emphasises the neutron activation study, in which objects are analysed according to the decay radiation that they emit after intensive neutron irradiation. He also emphasises the production of medical isotopes – research and production of new isotopes, as well as the emergency production as a backup for Petten.
The research portfolio of the Oyster programme mentions energy, health, food, chemistry, art history and more. Nuclear energy, for which Einstein had such high expectations, forms only a small part of this portfolio.


Visitors are shown around at the opening in 1963.

See also:
Hugo van Dam and Frida de Jong, Geboeid door straling en strategie. Geschiedenis van het Interfacultair Reactor Instituut te Delft [Fascinated by radiation and strategy: The history of the Inter-faculty Reactor Institute in Delft], Walburg Press, Zutphen, 2003.

1963


1963, 24 April. Prime Minister De Quay opens the Higher Education Reactor (HOR)

1963


1963, 25 April. Reactor (100kW) critical for the first time

1982

1982, 24 May. Anti-Nuclear Movement protests at the gate

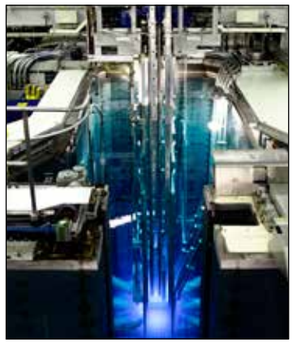
1995


1995, 3 May. Protesting children make a tour of the reactor.

2001


2001, 2 October. Tim van der Hagen drives the first pile for the new office building

2013


2013, 25 April. Higher Education Reactor – 50 years of incident-free operations

1950 | 1960 | 1970 | 1980 | 1990 | 2000 | 2010

1956, 8 May
Prof. Kramers recommends: 100 kW swimming pool reactor at the Delft Institute of Technology
1957, 25 June
Minister issues decree establishing the Delft Reactor Institute
1957, 28 June
Reactor open for public at exhibition entitled 'The Atom' at Schiphol
1958, 11 November
Prof. R. Kroning drives the first pile for the reactor building
1962
Spring storm blows cladding panels from the dome

1963, 24 April
Prime Minister De Quay opens the Higher Education Reactor (HOR)
1963, 25 April
Reactor (100kW) critical for the first time
1965, June
Reactor to 200kW
1966, Sept
Reactor to 500kW
1968
Construction of the cooling tower for expansion to 2MW
1968, June
Opening of 2MW reactor

1969, 13 May
Transition of the RID to the Inter-university Reactor Institute (IRI)
1969
Permit for capacity of 3MW
1979, 28 March
Nuclear accident at Three Mile Island near Harrisburg, Pennsylvania (USA)
1980
Prof. Jan Houtman takes office as Dean
1980, 26 Sept
Reactor is occupied in protest against the new construction
1981, 6 April
Delft Institute of Technology Board rejects relocation of IRI
1981, 29 May
Construction of new control room completed
1982, 24 May
Anti-Nuclear Movement protests at the gate
1986, 26 April
Nuclear disaster at Chernobyl, Ukraine
1987, 16 April
New protest; reactor building covered in graffiti
1987, 1 Sept
IRI returns to TU Delft and is now 'Inter-faculty'
1988, Sept
Prof. Marcel de Bruin becomes Director of the IRI
1995, 3 May
Protesting children make a tour of the reactor
1996, 1 May
Prof. Ad Verkooijen becomes Director of the IRI
1997
IRI receives lower enriched uranium (19.75%)
1998, June
Opening of new experimental hall
2001, Sept
Veltman Commission recommends closing the reactor within four years
2001, 2 Oct
Tim van der Hagen drives the first pile for the new office building
2004, 20 April
Final report of the Luyben Commission concerning the future of the IRI
2004, 23 Nov
Executive Board approves IRI business plan. This plan contains the essential ingredients for the OYSTER programme.
2005, 1 Jan
Prof. Tim van der Hagen becomes Director of the RID
2005, 1 Jan
IRI is split into RID and the Department of RRR in the Faculty of Applied Sciences
2009, 11 May
RID becomes a research partner of the IAEA
2010, 23 Sept
TU Delft/RID announces ability to produce medical isotopes if necessary
2011, 11 Mar
Nuclear disaster in Fukushima, Japan
2011, 22 Mar
Ministry of Economic Affairs requires stress test at TU Delft reactor
2012, 20 Jan
Government allocates 38 million euro to implement the Oyster programme
2012, 12 May
NOS news: Delft reactor suitable for medical isotopes
2012, 30 June
Interim report on stress test: RID reactor is safe
2012, 1 July
Prof. Bert Wolterbeek becomes Director of the RID
2013, 25 Apr
Higher Education Reactor – 50 years of incident-free operations

‘All major breakthroughs can be traced back to ‘poldering’

Since September 2012, TU Delft alumnus Wiebe Draijer has been the president of the Social and Economic Council of the Netherlands, a key advisory body of the government. The fact that he had to take a major cut in pay does not bother him. “It’s good to make a contribution to the public domain”.

Jos Wassink

Lecture Hall 2 in the Faculty of Mechanical, Maritime and Materials Engineering (3mE) was packed full on Saturday 23 March. It was not filled with students, but with former students. It was the Alumni Day, and one of the speakers was the former student of mechanical engineering Wiebe Draijer (47). Since September 2012, he has been the president of the Economic and Social Council of the Netherlands (SER), the advisory body that saw its influence dwindle considerably under the Rutte I administration, but which is now once again a full-fledged partner in considering the impact of government plans.

He told his listeners about his career and his current work. “My career looks like an accumulation of coincidences. I wanted to be a journalist, but a journalist told me that I would be better off learning a trade. Then I started to think deductively. The mechanical engineering programme was the best option – and, by the way, my father had done the same thing”. [Laughter from the audience.]

When Draijer was 17 years old, he saw an advertisement for a technology editor in the *NRC Handelsblad* newspaper, and he went ahead and applied. “Someone in the newsroom thought: ‘This guy has guts. Let’s invite him’. I was hired. During the first two years of my programme, I was primarily focused on this side job. Then I had a class with the recently deceased professor Okko Bosgra. That’s when the light came on. I was instantly hooked on control technology. Bosgra was at the forefront of an entirely new development in control technology. It was immensely inspiring”.

Draijer conducted his graduation project in Philips Natlab. It earned him two patent applications for CD-player components. “I had contributed something. That was gratifying, but I was sitting in a room alone, working from half past seven in the morning until half past ten in the evening. That wasn’t what I wanted”.

Draijer planned his next career move, but fate had something else in store for him. “I was determined to pursue a PhD in Sweden. I was already there, but my plans went awry because of the financing from the Netherlands”. Draijer did not throw in the towel. In 1990, he became an organisational consultant at McKinsey, where he managed several large-scale mergers and acquisitions, which he still does not wish to mention by name.

Solve social issues

Draijer climbed up the ladder, eventually becoming the director for the Benelux. Even then, he felt that he should be making a contribution to society. Twelve years ago, before this sense of duty would make him decide to assume the presidency of SER, he started the website 21minuten.nl. With this site, Draijer hoped to turn democracy ‘on its head’. “The idea was that anyone could solve major social issues. People are very good at making comprehensive assessments about difficult policy choices, if only they are aware of causes and effects. Already in the earliest phases of 21minuten.nl, people proved to be willing to give up the mortgage-interest deduction”.

When Draijer was asked to become the president of SER, he did not have to think about it for long. He recounted with a laugh: “I had to check at home to see if they would be okay with me taking a considerable cut in my pay”. Each year, Draijer earns about € 140 thousand - hundreds of thousands less than he had earned at McKinsey. After thinking about it for half an hour, he agreed. “It’s good to make a contribution to the public domain”.

Draijer’s substantive story had a hopeful ring to it. Any critical notes were framed in terms of opportunities. Sharp words do not suit the president of a purebred ‘polder’ organ. He is a firm believer in ‘poldering’ (negotiation). “All of the major breakthroughs can be traced back to it. Our economy of negotiation is a fundamental strength. It takes a while, but we are ultimately twice as fast as other countries. For example, take the retirement age. Just about every country is considering raising the retirement age. It has been discussed in the Netherlands for a long time as well. Meanwhile, the actual retirement age here is rising more rapidly than anywhere else: by six months per year”.

Draijer noted that the polder model requires maintenance. “We have too many institutions and too little connection. We still need to connect with the individual Dutch citizen. I can be part of the solution to that problem”.

He told the audience something else about Dutch industry. “Our industrial sector is a strong knowledge competitor. You can think what you like about the international takeovers of Dutch companies, but they illustrate one thing very clearly: we have knowledge that others want and that we have apparently not utilised or marketed. I mean it. Our knowledge base is incredibly strong. Any failure to exploit it fully is due to a lack of will or support in the form of good policy”.

Bold

As an example, Draijer referred to the barriers that companies in the Netherlands encounter when initiating sustainable projects. “It’s pathetic. Take Siemens, for example. After nine years, they finally received a permit for an offshore wind farm. By that time, the company had stopped manufacturing the turbines that were mentioned in the proposal. They had to start the entire application process all over again. Good policy could be >>

Photos: Sam Rentmeester

‘The dropout rate amongst boys is embarrassingly high. This is due to the feminisation of education’

of great benefit to us. The Netherlands has always been bold enough to reach beyond its own power. That has brought us a long way".
After his lecture, alumni had the opportunity to ask Draijer questions. One participant wanted to know what he thought would have to happen in order to increase the low value that is attached to technological education programmes and to remedy the worker shortage in the technological professions.
The president of SER changed the subject without missing a beat. "The high-tech industry needs 80 thousand people, and we have a shortage of 150 thousand technicians. We should work to make it more attractive and to improve the connection with the labour market. We should bring education and employment closer together. At the same time, a silent disease has emerged and taken on epidemiological proportions. The dropout rate amongst boys is embarrassingly high. This is due to the feminisation of education. It's great that girls are performing better, but we also need to pay more attention to practical forms of education, which are generally better suited for boys".
When asked why he thinks that many major infrastructure projects are so slow to get off the ground, Draijer was once again prepared with an analysis.
"This is due to public participation procedures and the lack of commitment on the part of individuals. For example, wind farms encounter a great deal of resistance. Let people participate. Make it 'our park'. Provide a better explanation of why things are necessary, and simplify procedures where necessary. Nevertheless, participation should not disappear completely; it serves an important function. We are in particular need of consistency in policy. This is difficult, however, given all of the changing of the guard in The Hague".
After the lecture, the former students broke up and headed out onto the campus. Draijer grabbed a sandwich wrapped in cellophane, left over from the lunch that had been served earlier in the afternoon.

You said that we need more technologically oriented people. But many engineers are opting for occupations outside of technology. You did as well.
"Right. It took a while before my father accepted my switch to McKinsey. You shouldn't have me pushing the buttons, but I will always remain close to the industry. For now, I'm happy to be in the public sector. In America, it's very common for people from the private sector to work in the public sector for a few years. It's extremely enriching. The people at SER are unusually motivated and confident in the economy of negotiation. They absolutely do not conform to the image that the commercial sector has of them. They work extremely hard".

How has your education benefited you?
"I work with eight economists to conduct an analysis of what is wrong with the Netherlands and how we can solve it. I can't make any substantive statements in this regard. As an alumnus of TU Delft, however, I maintain my position by asking logical questions and using my common sense. I can bring myself up to speed on topics very quickly".

If you had been able to complete your PhD, you would have been a professor by now.
"Perhaps, but things turned out differently. Many of my choices arose because people gave me opportunities, like Professor Bosgra and the NRC Handelsblad editor. This pattern has repeated itself time and time again".

SER investigates how choices are made. Which lessons can we learn from this?
"We're looking at students with immigrant parents in relation to the vocational trade economy. It's fascinating to see how choices are made. In many cases, they seem to be motivated by parents, based on outdated information. Discussion about job opportunities is needed. This doesn't happen enough. Although we must obviously retain freedom of choice with regard to educational programmes, the motivation is often no deeper than a surfboard".

How do you see today's students?
"Of all students in Europe, those from the Netherlands are the least likely to go abroad. This is completely inconsistent with our status as a trading nation. If you ask them why they don't go abroad, you learn that they're very comfortable here. They need to get out into the world. My oldest son has just started a programme in mechanical engineering at a university of applied sciences. I think he needs to go abroad. We cannot maintain our prosperity without continuing to be an extremely open economy".

In the coming years, SER will be collaborating on major themes, including labour-market reform, housing, healthcare and sustainability. You've come at a good time.
"I see a lot of opportunities. Our government is coming to us, and the trade unions are back at the negotiating table. We should stimulate this as much as possible; it's a gratifying job. The major energy agreement that we're working on offers a fresh perspective on a broadly supported plan for a sustainable Netherlands. Or look at the labour market. How can we arrange it to make it work better? Doing that will involve considering more than just dismissal legislation. We should explore how we can offer people incentives without undermining their sense of security. This is less pertinent with younger generations. They are more likely to follow their own paths, and they know that permanent contracts for life are not the way of the future. We are also working to develop recommendations for healthcare with regard to prevention, employment in the healthcare sector and incentives for improvement. Unfortunately, I can't say any more about this, as the negotiations are still underway".

That's how it works in the polder. <<

Who is Wiebe Draijer?

Wiebe Draijer was born in Enschede on 27 August 1965. In 1989, he completed his degree in control technology. When his plans to pursue a PhD in Sweden failed, he made his move to the McKinsey consultancy firm in 1990. In 2004, he became the director of McKinsey Netherlands. Two years later, he was boss of McKinsey Benelux. In September 2012, he became the president of SER. Draijer is married and has four children.

Ode to chalk

Tonie Mudde is a writer and science journalist for de Volkskrant. He studied aerospace engineering at TU Delft from 1996-2002.

At 34 years of age, I am still too young to be conservative. Nevertheless, when educational reforms are looming on the horizon, I frequently catch myself holding on to very traditional views.
In August, ten Steve Jobs schools will open in the Netherlands. Books do not exist in these schools; everyone works on an iPad. Teachers are called coaches. These coaches give as few classroom lessons as possible, supporting individual students in their virtual adventures.
In my time – this is Grandpa speaking – the nicest and most instructive lessons were those given by teachers who could tell a good story to the class. This was the case throughout primary school and secondary school, as well as at the university.
From TU Delft, I remember the mechanics lectures of Ernst Kouwe – a man who entered an arena of hundreds of students armed with nothing more than a blunt piece of chalk.
To explain how you had to rely on angular accelerations, he catapulted himself across the room on a rotating office chair. After that, the chalk raced across the board.
You could hear a pin drop during those lectures. Thanks to Kouwe, the success rate for this notorious stumbling-block subject shot up by several tens of per cents, even though the difficulty of the exams remained the same.
Perfectly in keeping with his own style, he thought that anyone could learn how to teach like he did. In a 1996 interview in Delta, he stated, "To me, the notion that 'you've either got what it takes to be a teacher or you don't' doesn't make sense. For example, I used to fail all of my speaking assignments. But I started small, with tutoring, and I just grew into it slowly."
Another notable quotation in response to the massive performance improvements in the students at the time: "The funny thing is that no one here asked, 'Hey! How did he manage to do that? How can we transfer that to other subjects?
At TU Delft, systems thinking is particularly strong. People are constantly looking for methods that even the biggest idiot can apply, but that doesn't work."
I think that this hits the nail on the head: educational reforms too often involve changes in the system – better equipment, better teaching methods, a mathematics app with motion graphics and built-in chat functionality – even though there is only one thing that really matters: who is standing at the front of the classroom?
My former mechanics lecturer Ernst Kouwe is remarkably invisible on the internet: no LinkedIn, no more hits in the TU Delft staff directory. I hope he is still in a classroom somewhere. Chalk in hand.

Photo: Sam Rentmeester

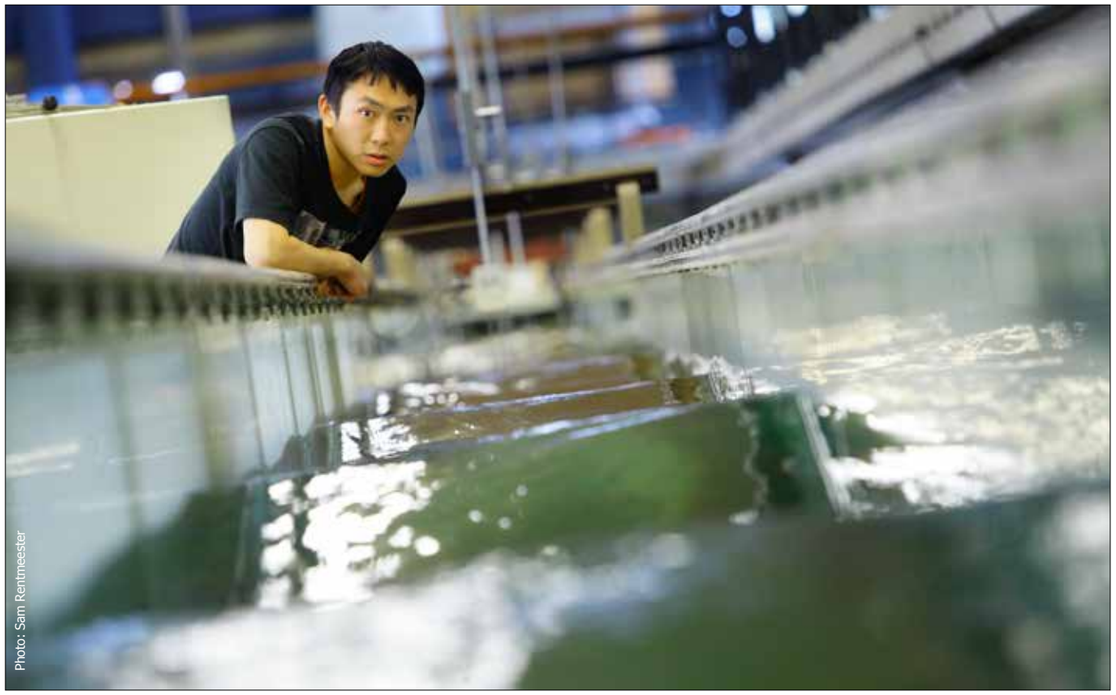


Photo: Sam Rentmeester

PhD candidate Zhan Hu can be found among the wave tanks in the otherwise empty hall of the Stevin III water laboratory in the Faculty of Civil Engineering and Geociences. He is investigating the influence of vegetation on wave dissipation. Coastal vegetation may prove to be an important means of mitigating the effects of rising sea levels and increasing storms resulting from climate change.

The propeller is back. Its energy efficiency has brought the propeller back into research. Since the beginning of this year, a new test installation for propeller research has been available in the Open Jet Tunnel (OJF) of the Faculty of Aerospace Engineering, created by employees of the Demo workshop. The study, conducted within the framework of the European Esposa research programme on the energy-efficient propulsion of small planes, involves measuring the influence of the wing (not pictured) on the propeller that is mounted on it. It is driven by an air motor with a capacity of 100 hp.

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Photo: Sam Rentmeester

The liberation of light

For more than a century, light has come from glass shell. But it won't for much longer, believes Prof. GQ (Kouchi) Zhang. "Light emitting diodes are going to liberate light."

Tomas van Dijk

A member of staff at Philips sweeps her finger over the screen of her smartphone. All the rectangular lighting elements with gas-discharge lamps high in the ceiling of the truck assembly hall suddenly rotate a quarter turn, and LEDs (light emitting diodes) take their place. It's like the rotating number plates on a James Bond car.
We are in one of the many demonstration areas for lighting at the Philips Light division in Eindhoven. The hostess from the electronics company is demonstrating the advantages of LEDs to a group of a dozen PhD students from Delft. According to Philips, the LED is the light source of the 21st century. LEDs are energy-saving, you can dim them, they have a life of twenty thousand hours and they are small, so they can be worked into all manner of materials.

'By 2020, three-quarters of all bulbs will be LEDs'

Not much needs to be explained to the young researchers. They are all involved in LED-related research in close collaboration with Philips. The visit is an interesting outing for them.
The PhD students' supervisor is Prof. Kouchi Zhang, who has been part-time professor at the Delft Institute of Microsystems and Nanoelectronics (Dimes) for two years. Zhang, who also works for Philips, is a Messiah of the new light. "By 2020, three-quarters of all bulbs will be LEDs", he says.

Photos: Sam Rentmeester

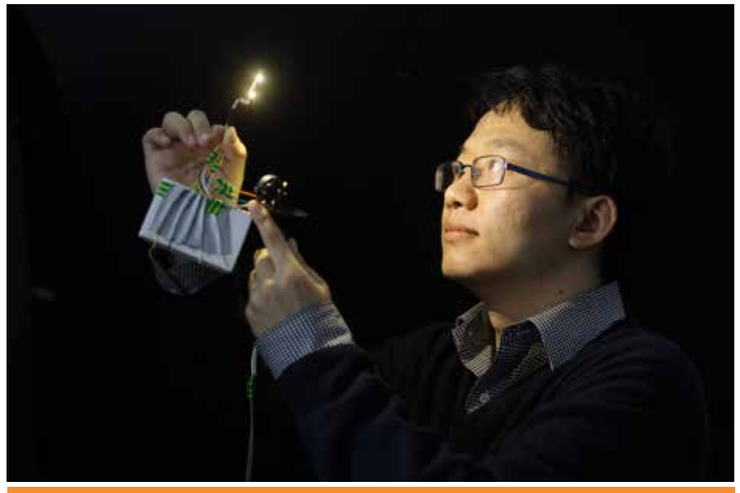
PhD student Sima Tarashioon focuses on the electronics of the bulb.

Will they all be LED bulbs that you have to screw into a socket? Zhang hopes not. "I predict the liberation of light. Retrofit is actually very stupid. If you power LEDs with batteries – and we're getting better and better at that, because they're becoming increasingly energy-efficient - then you no longer need any of the infrastructure with wires and sockets."

Efficient

LEDs are nothing at all like incandescent bulbs, energy-saving bulbs, gas-discharge lamps or fluorescent tubes. They are chips that work like a solar cell in reverse.
The semiconductor materials in solar cells absorb photons and current begins to flow, but in LEDs, flows of electrons through the semiconductor materials result in photons being emitted. And they currently produce 150 lumen per watt, ten times more efficient than an incandescent bulb.
The fact that LEDs are chips means that all sorts of electronics and sensors can be connected to them. What about LEDs fitted into window panes, to measure how much sunlight is shining into a room and provide light when it gets dark outside? Or LEDs with temperature and smoke sensors that mark out the safest escape route when there is a fire?
All these things could be possible, claims Zhang's colleague, Dr Henk van Zeijl. "Ever since Edison invented electric light, it has been imprisoned inside glass. Until shortly after the Second World War, electronic functions were realised with glass; glass radio tubes. When transistors made it possible to make electronics without glass, this brought about a revolution. Something similar is now happening with lighting."
The research of the Delft PhD students focuses on many different aspects relating to electronics and sensors for LEDs. But the housing for the chip – which to a large extent determines the colour of the light – and techniques for preventing the bulb from overheating are >>

PhD student René Poelma researches the elastic properties of silicons.

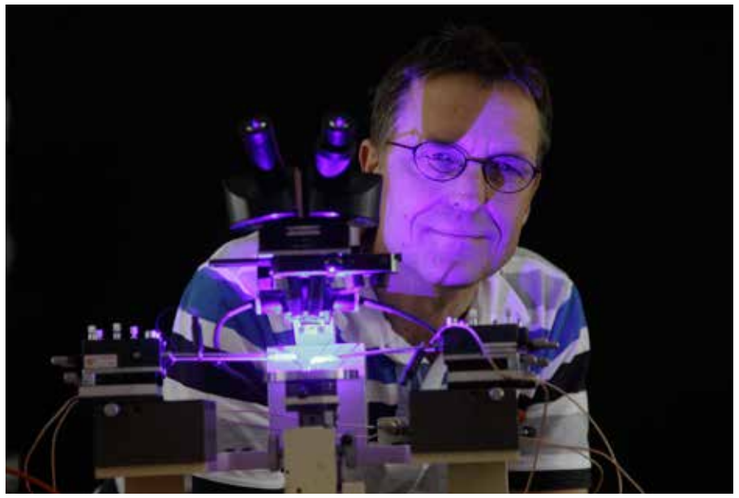


Msc Huaiyu Ye has developed a cooling system that uses cooling fluid.

How does a light emitting diode work?

A chip the size of a grain of sand lies on the desk of Dr Henk van Zeijl at Dimes. That's all it is.
"When I pass current through it, you mustn't look directly into the LED," he explains. "The light is so bright that it would blind you."
In the chip's semiconductor material there are freely moving electrons and electron holes. When a current is passed through the material, the electrons move through the material until they come to a hole that they can fill. When the electron drops from a high energy state to the lower energy state of the electron hole, light is emitted.
Van Zeijl: "Think of the electrons as water, and the difference between the energy level of a moving electron and that of an electron that has just filled a hole as the height of a waterfall. The height determines the colour of the light that is emitted. For every ten buckets of water that flow down the waterfall, eight or nine are converted into light. The internal efficiency is therefore as much as eighty to ninety per cent."
However, part of that light does not leave the chip; it is absorbed again soon after, reducing the efficiency further, to around thirty to forty per cent. But the expectation is that chips will become much more efficient.
LEDs have been used in electronics since the 1960s. For decades, the chips emitted only weak red light. Since the 1990s, following much experimentation with alloys, clear blue LEDs have been made using the semiconductor materials gallium nitride and indium gallium nitride. These blue LEDS can be combined with green and red LEDs to produce white light. But white light is usually created by coating the blue LED with phosphors (these are usually rare earth metals) that turn the blue light that is emitted into white light.

‘LEDs are chips that work like a solar cell in reverse’



Dr Henk van Zeijl (Dimes).

Prof. Kouchi Zhang: “Retrofit is actually very stupid.”

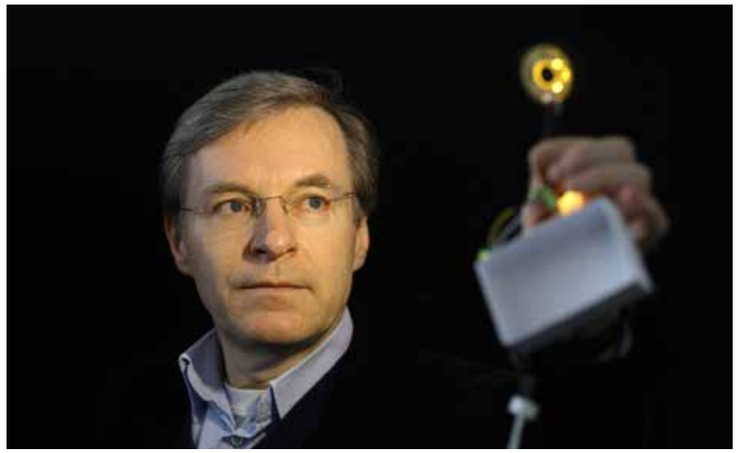
also important subjects for research. (See box ‘A selection from the LED research at Delft.’)

Player

With a total of fifteen PhD students and post-docs, Zhang says his group is one of the major academic players in Europe. But if you search in the scientific literature using the keywords ‘light emitting diode’, you’ll find many other research groups elsewhere in Europe (e.g. Germany, Switzerland and France) that are publishing much more on the subject. And Eindhoven University of Technology is scoring well too in that respect.
Is the Dimes group really such an important player? “What we’re doing is micro-electronics and lighting systems integration,” responds Zhang. “That’s what our research focuses on, not on the chip itself. You’ll see that we lead the field in Europe in that respect. And many of our articles still haven’t been publishes yet, because the group was only established a few years ago.”
Prof. Paul Urbach of the Optics research group at the Faculty of Applied Sciences thinks that TU Delft is a major academic player in Europe in the field of LED research. He regularly has students and PhD candidates who are conducting research into LEDs, usually in collaboration with Philips. “With Philips just around the corner, it’s logical that we’re so big in this field,” he says.
Zhang wants to extend his group in the coming years, and work more closely with colleagues from Applied Sciences (including Prof. Urbach), 3mE and Architecture. He wants to work with them to set up a Centre for Solid State Lighting (another name for LEDs).

A long way to go

The group of visitors in Eindhoven has now reached a dark research area where researchers are testing whether lamps shine evenly in all directions. Despite all the fascinating possibilities, Philips’ efforts, as far as the consumer market is concerned, remain largely focused for the time being on LED bulbs that can be screwed into a socket. One such bulb - the L bulb - was recently tested here.
Philips developed the L bulb to replace the sixty- watt incandescent bulb. In 2011 it won the company ten million dollars (the Bright Tomorrow Lighting Prize), a prize awarded by the U.S. Department of Energy. The LED bulb consumes ten watts and should last for twenty thousand hours.
PhD student René Poelma has a similar LED bulb at home, he says. “It gives very fine light. Very diffuse. You can’t tell that it’s an LED bulb rather than an incandescent bulb.”
Yet Poelma doubts whether we are on the eve of an LED revolution. “Personally, I wouldn’t have bought the bulb. I think it’s still too expensive. In my view there’s a long way to go before they’re interesting to consumers.”
The award-winning Philips bulb still costs sixty euros. But according to Zhang, there are already high-quality LED bulbs on sale for much less than this. And very rapid advances are being made. “In China you can already buy a good bulb for ten euros.” <<



Prof. Paul Urbach: “TU Delft is a major academic player in Europe.”

Together with China

The Delft LED researchers are working in close collaboration with fellow researchers in China. TU Delft has had a research branch in Beijing since 2011. The branch has seven PhD students who are supervised from Delft, and the plan is to increase this number to ten in the course of this year. The collaboration works in both directions. For several months now, Dimes has housed an office of the Chinese State Key Laboratorium (SKL).
The collaboration seems to be a sensible move. With a view to saving energy, China earmarked 22 billion yuan (2.8 billion euros) in 2011 for the promotion of green lighting, primarily LED lighting.

A selection from the LED research at Delft

LED bulbs could soon last for a hundred thousand hours, believes PhD student Sima Tarashioon. To achieve this we need to know what the life is of all the components of a bulb, and how they affect each other. Her work focuses on the electronics of the bulb. Her field is known as ‘the physics of failure’.
PhD student René Poelma is interested in the elastic properties of silicons. LEDs are produced on a wafer, to which silicon lenses are attached one by one, by hand. If all the lenses could be attached at the same time, the cost saving would be huge. But the lenses would have to release easily from the mould above. Poelma’s research is geared to finding the optimum conditions for this.

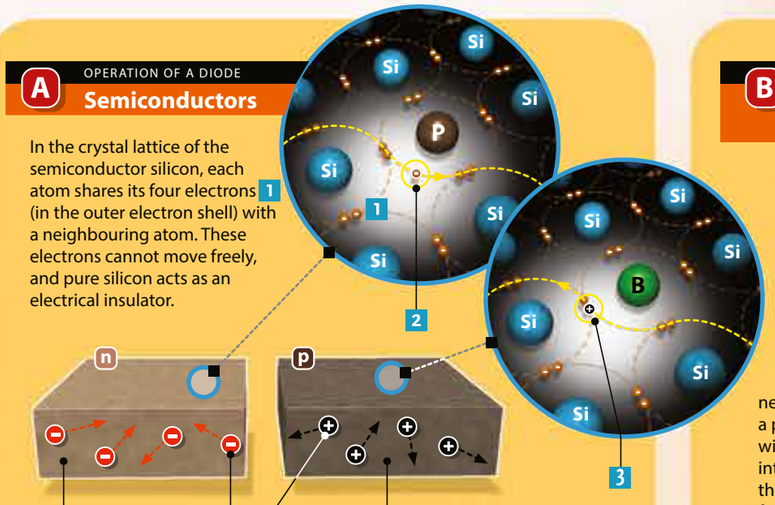
Heat

The heat is the limiting factor in the life of LEDs. Most LEDs have a passive cooling system: small metal structures that dissipate the heat. Msc Huaiyu Ye has developed a cooling system that uses cooling fluid. A few millilitres of water per second flow past the LED through a very small circular tube. This is enough to keep the temperature of the LED at a constant one hundred degrees Celsius.This happens automatically. Due to the phase transition of the water, from liquid to gas and back again, the water flows by itself. As long as the light is on, of course.
Philips wants to produce LED bulbs that look like miniature retrofit halogen bulbs. The major challenge is to ensure that the LEDs produce enough light without overheating. There is no space in the bulb for cooling systems. Pan Liu is making foldable chips to hold LEDs. Five LEDs linked to form an L shape can be folded into an open cube that emits light on all sides. The open structure allows the heat that is created to dissipate.

How does a LED lamp work?

A OPERATION OF A DIODE
Semiconductors

In the crystal lattice of the semiconductor silicon, each atom shares its four electrons 1 (in the outer electron shell) with a neighbouring atom. These electrons cannot move freely, and pure silicon acts as an electrical insulator.



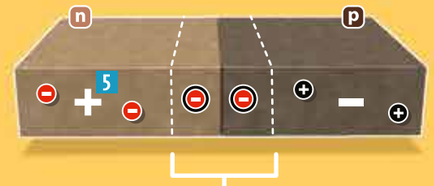
N-type silicon
When phosphorus atoms (five electrons in the outer shell) are added to the silicon lattice, the fifth electron 2 remains unbound and can move freely throughout the lattice. This n-type silicon has a surplus of negatively charged free charge carriers. N-type silicon acts as an electrical conductor.

P-type silicon
The addition of boron atoms (three electrons) to silicon creates a deficiency of electrons (i.e. a surplus of positive holes 3). This increases conduction, as electrons in p-type silicon can jump between holes. P-type silicon is an electrical conductor as well.

B OPERATION OF A DIODE
Separation of electrons and holes

1. A diode consists of a layer of n-type silicon and a layer of p-type silicon. At the interface of the two layers, free electrons flow from the n-type silicon to the p-type silicon, where they are immediately bound in a positive hole. This creates a zone without free charge carriers: the depletion region 4 .

2. The layer of n-type silicon is electrically neutral. As electrons diffuse to the p-type layer, a positive charge emerges in the n-type layer 5 , with a negative charge in the p-type layer. This internal electric field arises spontaneously around the p–n junction, blocking the further diffusion of free charge carriers. This keeps the free charge carriers, electrons and holes separated.



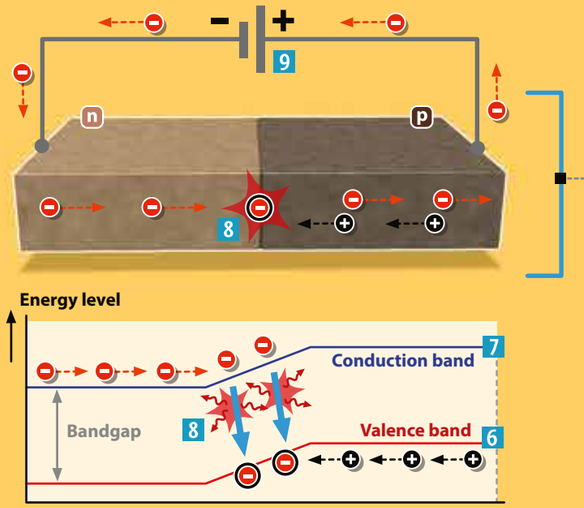
C OPERATION OF A DIODE
Current flows in one direction

1. If the diode is connected to a battery, an excess of electrons occurs on the n-type side, thus creating a negative voltage.

2. Once this external voltage exceeds the internal electric field, electrons will cross over to the p-type material (and holes in the opposite direction). At that point, an electric current flows through the diode.

3. **Diode emits light**
The holes in the p-type layer are at a lower energy level (the valence band 6) than are the free electrons (the conduction band 7) in the n-type layer. At the n–p interface, the free electrons recombine with the holes, and the energy difference is released as either light 8 (the electron emits a photon) or heat.

4. If the battery is connected in the opposite way, the positive pole attracts the electrodes on the n-type side away from the p–n junction (the negative pole attracts holes). This enlarges the depletion region and makes it non-conductive. A diode thus allows current to flow in one direction and not in the other direction.

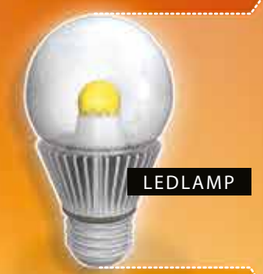


Battery contributes to light formation
The battery 9 gives the electrons additional potential energy (up to the size of the bandgap) before they enter the n-type layer (the energy of these electrons is in the valence band). During the recombination, this energy is converted into light.

LED: visible light

All diodes emit light when current flows through them in the forward direction. A silicon diode emits infrared light that is not visible to the human eye. A light-emitting diode (LED) is a diode in which the crystal material emits light that it is visible. The colour of the light is determined by the energy that an electron emits as it recombines (the bandgap). As the bandgap increases, the energy (and thus the frequency) of a photon increases, and the light becomes more bluish.

LED efficiency
A complete LED (e.g. including electrical contacts and fluorescent lens) has an efficiency of approximately 40%.



Crystal efficiency 10
Up to 70% of the energy that goes into the crystal is emitted in the form of photons. The rest is converted into heat.

Glass globe
The outer glass bubble ensures maximum diffusion of light.

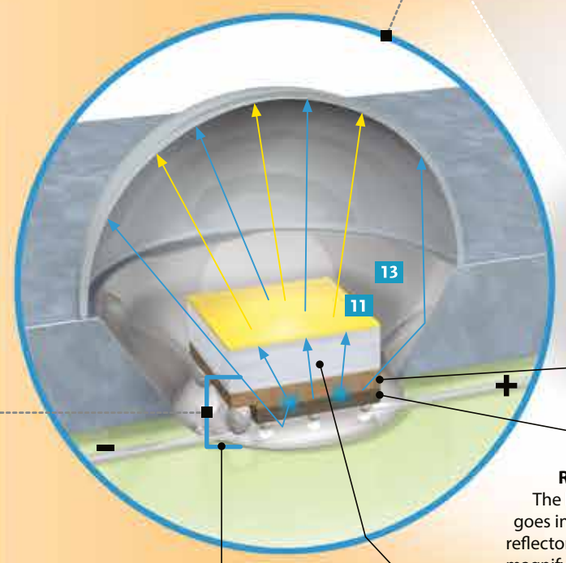
Colour filter
The inner bubble emits light with a warmer tint.

25 W bulb
Light output
375 lumens
Purchase: € 11.25 (25 x € 0.45)
Rated lamp life:
25 x 1 000 hours (= 25 x 3 months, 10 hours/day)
Power costs: € 131.25
(25 W x 25 000 h x € 0.21/kWh)
Total costs
€ 142.50

Ledlamp 2 W
Light output
300 lumens
Purchase: 1 x € 10.00
Rated lamp life:
25 000 hours (= 7 years, 10 hours/day)
Power costs: € 10.50
2 W x 25 000 h x € 0.21/kWh
Totale costs
€ 20.50

Cooling
Heat decreases the efficiency and longevity of the LED. A cooling system is therefore essential. The crystals are mounted on an aluminium cone, which acts as a passive cooling system. The cooling fins conduct the heat through natural convection. A heat sink makes LED lamps larger and heavier than light bulbs are.

Electronics
The hollow metal cone can accommodate power electronics. Because LEDs always need basic electronics, it is easy (and inexpensive) to add functionalities (e.g. to allow the remote regulation of intensity, colour and operation of the LED through digital media).



Reflector 13
The light in the crystal goes in all directions. A silver reflector is needed in order to magnify the light yield.

Semiconductor crystal gallium nitride
The semiconductor gallium nitride (GaN) has a large band gap (3.5 eV) and emits blue light. This crystal is but a tiny part within the complete LED lamp.

Sapphire
Gallium nitride is evaporated from the gas phase on the glass-like sapphire. The gallium nitride layer is soldered to a circuit board, along with connection contacts.

White light
Each LED emits one colour of light. White light is created by combining red, blue and green LEDs with each other. The efficiency of converting electrical energy to green light is low, while the efficiency of converting to blue light is high. In many cases, therefore, only blue LEDs are used. A transparent lens is positioned above the LED 11 , such that it is partially covered by a fluorescent layer 12 . This layer absorbs a blue photon (high energy) and subsequently transmits the energy in the form of a photon with lower energy (e.g. yellow). Users perceive the combination of blue and yellow light as white light. This conversion from high energy to low energy results in the loss of energy through heat.

Propositions

Affirmative action is fair.
Femke van Wageningen-Kessels, transport engineer

Affirmative action is unjust.
Thomas Schreiter, civil engineer

There is no scientific basis for the discussion whether affirmative action is fair or unjust.
Yufei Yuan, transport engineer

'Building with nature' is not complete without 'Demolishing with nature'.
Menno Eelkema, civil engineer

Evolution is smarter than stupid.
Kourosh Honarmand Ebrahimi, biotechnological engineer

The fact that a slowed down economic growth is perceived as a recession is perplexing: every engineer recognises that continuous growth is an unsustainable affair and hence the current economic model is not sound.
Gijs van der Veen, systems and control engineer

The monopoly position held by the high tech sector is a discordant note in the current globalization process.
Jiaming Tan, electrical engineer

Proposition

"Initiatives to attract women to STEM (science, technology, engineering, and mathematics) should focus on teachers and parents instead of on women."
Félienne Hermans, IT-expert

Defence

"Recently, I was talking to high school girls about my profession for the Dutch Spiegelbeeld program, a database with female role models who work in technology, and they told me that often their parents actively discourage them to choose technical. Not to actively discourage, but they just say things like: 'Are you sure you would like that?' or 'Are you sure this is for you?' and that makes girls question their choice. At the age where kids have to choose what courses they will take (in the Netherlands, this is at age 15) girls are especially vulnerable for critique and want to fit in, whereas boys still have more of an I don't care attitude."

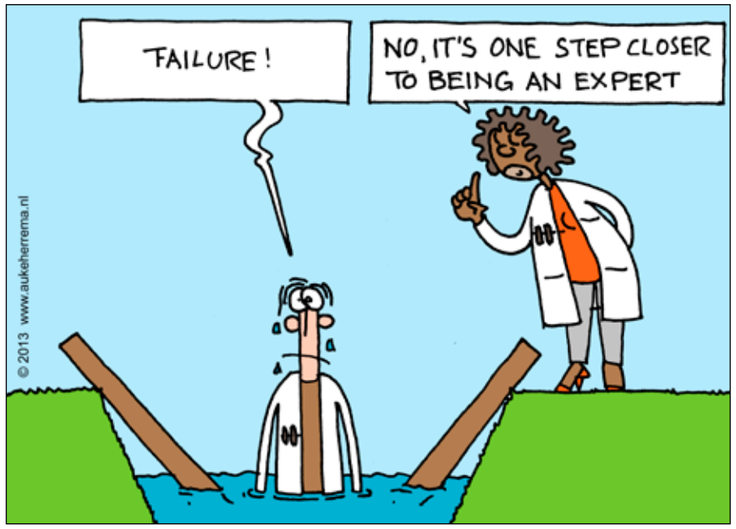
Soundbites

"When you drink water, you actually take in a cocktail of medicines in very low concentrations".
Prof. Hans van Dijk, Professor Emeritus of Drinking Water, in Algemeen Dagblad.

"Most computer criminals use automated tools for hacking. It therefore does not matter whether you have a larger or a small webshop – if the software is not patched, the criminals will extract your data automatically".
Prof. Michel van Eeten, Professor of Internet Safety, in NRC Handelsblad

"Ideally, every passenger should spend a short time in a local train in Belgium and in a delayed British train before expressing an opinion about the express train between Amsterdam and The Hague. Then they would realise just how fortunate they are with the Dutch rail system".
Public transport expert Dr Wijnand Veeneman, in Trouw

"In 1982, times were hard, just as they are now. At that time, I was earning money bar-tending, and I was writing for Vrij Nederland. I eventually made it, with a little patience and hope. Times are exceptionally hard in this sector – there's no denying it – but we must find our own opportunities. Let's not start mourning together".
Prof. Thijs Asselbergs, also owner of Architectuurcentrale Thijs Asselbergs in Het Parool



'Don't be afraid of making mistakes. A person who made all the mistakes in his field, would be called 'an expert' in that field.'

Liang Zhang, materials engineer

Personal aircraft

A personal aircraft for everyone. Prof. Jacco Hoekstra, Professor of Communication, Navigation and Surveillance/Air Traffic Management and Dean of the Faculty of Aerospace Engineering until 15 April, thinks that he will witness "the new era of individual air transport" in his lifetime. "I'm not that old yet", he laughs.

Hoekstra thinks that people will use their personal aircraft primarily for intracontinental flights. "But who knows? Maybe even farther. People are already driving a day and a half to Spain. In the same time, you could fly 7 000 kilometres to North America, at a speed of about 500 kph. You stop for lunch in Iceland, spend the night in Greenland and continue on to New York the next day".
Hoekstra compares the current air-transit system to public transport. "The difference is that it involves only one type of trains, and not yet any form of individual transport. That bothers me. There's no reason why a personal aircraft should be any more expensive than a car is. It's a matter of mass production".
But what about the environment? If everyone were to fly individually, we would ultimately be using more energy. "On the other hand, we'd be able to fly much more slowly for the same trip from door to door".
Moreover, the current energy shortage might be only temporary. According to Hoekstra, we need to kick our addiction to oil one way or the other. In his view of the future, we could conceivably make large-scale use of solar energy while improving methods for storing hydrogen, making it possible for aircraft to use this for fuel as well. Alternatively, batteries might become much lighter. Hoekstra notes that the exact way in which this will occur is anybody's guess.
"Some people are saying that biodiesel is the solution, but not enough of it is available". It is also open to debate whether this would solve the climate problem. "That would depend on the time needed for the CO_2 to return from the stratosphere to sea level, as well as on the effect of contrails".
Hoekstra predicts that larger aircraft are particularly likely to suffer during the transition to sustainable energy sources, due to their heavy dependency on oil. "Aircraft manufacturers do not seem to be preparing themselves for this development quickly enough. It takes decades to develop aircraft. We must therefore already be conceiving of planes that can keep flying even when the oil runs out. We are not doing this enough. The problem is that nobody knows which way it will go: electric, hydrogen, biofuels or synthetic fuels".
The positive side of the crisis is that it is making smaller planes more attractive. Because they travel more slowly, they can be more easily flown with electricity. They are thus less addicted to oil. Hoekstra continues, "We are already seeing electric variants of sport planes. Small private planes are going to become much more important if we have to fly on electricity". (TvD)


Photo: Sam Rentmeester

Robotic fish

A school of robotic fish that quickly swim to the bottom and chart oil fields using seismic sensors. Shell hopes to use this method to reduce the length of measuring missions from twelve to six weeks.

The current method of charting oil and gas fields involves ships dragging a carpet along the seabed with long cables equipped with sensors. This method requires a great deal of time. The ships must sail slowly in order to obtain sharp images. Shell expects that their small underwater robots will do the job faster.
"Working with swarms of small robots is a trend in robotics. These robots often have specific tasks, and they are less expensive and complex to make than are advanced robots that can perform many tasks. Moreover, it is not as bad when a relatively inexpensive robot fish is damaged", explains PhD student Tim Vercruyssen (3mE). His research focuses on new fins for underwater robots. After being launched from a ship, the robot fish operate in a smart manner, using acoustic signalling with sonar to swim to a specific location on the bottom. Once there, the sensors detach from the underwater robots and secure themselves to the seabed. Then the measuring begins. Sound waves fired from the ship with compressed air cause seismic waves that travel to the seabed. The reflected seismic pulses contain information about oil or gas fields. This information is stored in the memory built into the tiny fish. Once sufficient data have been gathered, the robot fish swim back to the ship. "All of the robot fish in various locations form a network that can chart the surface with great precision", continues Vercruyssen. Obtaining a good image requires many fish. "With the current method, the cables sometimes contain as many as 20 000 sensors. This is because we need two samples for each wave length, in order to ensure that we have a good image of the surface. This means that thousands of these fish would not be enough for a measurement mission. I'm inclined to think in terms of tens of thousands", explains Dr Guy Drijkoningen (Civil Engineering and Geosciences). Drijkoningen is enthusiastic about the tiny fish. "As soon as it's cheaper than the current method, it's better". According to Go Science, the British company that is developing the fish, the robots will reduce the costs of measurement missions by half.
The geophysicist also expects that the fish will be used to monitor oil and gas fields. "At present, seismic stations are placed on the seabed for this purpose. These stations measure movements in three directions and indicate how full the field still is. Every six months, a ship sails over them and collects this information. A field measuring 10 x 10km requires about 14 000 of these stations. The robot fish could do this as well", asserts Drijkoningen.
In order to make the fish as inexpensive as possible, researchers should focus primarily on efficiency, as Vercruyssen knows. "For example, robots that are less efficient need larger batteries in order to perform the same tasks. This makes them larger, it causes more friction and they require more propulsion power". Shell has tested the fish in the Netherlands and Great Britain, and they plan to test them in the Gulf of Mexico this year. (RV)

After Delft

Name: Sander Bokkinga (41)

City: Rotterdam

Marital status: Married, one son

Occupation: Artitectus Universalis

Work status: Full-time

Salary: Depends upon the project; not a 'horn of plenty'

With a major nod to Leonardo da Vinci, Sander Bokkinga refers to himself as an Artitectus Universalis. As a 'free fellow', he circulates between art, design, architecture and sculpture. After graduating in architecture in 1997, he established the architectural firm 2 23 8 with two fellow students, but he soon realised that he was not willing to build dormers.

When an attractive contract fell through, he became an urban planning assistant in the project firm Leidsche Rijn. Building for the distant future was also not for him. He tried an architectural firm once again, but afterwards, he was certain: no rules.

For about a year, Bokkinga was a handyman in the new Luxor Theater in Rotterdam, giving tours to ... architects. What was his true passion? As a child, he wanted to be a fashion designer. He eventually looked for something "creative academic", ultimately choosing architecture.

Halfway through his studies, he changed course. He received a freelance contract for a garden house in The Hague and built it with his own hands. He continued with rabbit hutches, vegetable gardens, trunks and barbecues. To earn a living, he took a job as an urban planner in Haarlemmermeer.

'I truly do what I like to do, and that keeps changing'

In 2005, he started making birdhouses out of bricks, in order to help "the sparrow with its housing problem". His inner engineer designed a hand press, which a factory has since used to make 2 000 houses in the bok.vogelstenen series.

He created a 'sitting fork' – a shortened pitchfork in a bale of hay as an alternative form of outdoor furniture – and a beach shovel as the backrest for a beach chair. In 2007, he quit his job. He reserved a place in the Salon in Milan – a major interior furniture exposition – and displayed his collection for three consecutive years, just as his overview exhibition this year. "It's starting to land".

Bokkinga has exhibited in London, Copenhagen and Seattle. His trademark has become furniture made from garden hoses, which is now displayed in Plart, the Museum of Plastic Art in Naples. After Milan, he started sculpting and building scale models. "I truly do what I like to do, and that keeps changing".

The crowning feat would be a contract for a design hotel in London: 175 dressboys and, in the foyer, "a hunting lodge for retired hunters who long to return to the forest". He is also carrying out a project for Stroom in The Hague involving "sculptures – in this case, for schools, and thus architecture". "The circle is reasonably complete". (CvU)


Photo: Sam Rentmeester

The Firm

3D gap


Photo: Sam Rentmeester

"A 3D printer for everyone". This could be the motto of the young company Leapfrog. The printers, designed by third-year TU Delft student Maarten Logtenberg, are affordable and fit on any desk.

Sometimes, entrepreneurship seems very easy. For example, consider the Leapfrog company, which was founded in early 2012 by TU Delft alumnus Martijn Otten (offshore engineering) and third-year student Maarten Logtenberg (mechanical engineering). Logtenberg single-handedly built a 3D printer that can print plastic objects quickly and inexpensively. The first was targeted towards the commercial sector. Annual sales have already reached € 4 million.

As a teenager, Logtenberg was already assembling CNC milling cutters. In Delft, he initially had no time for this hobby, but his fingers started itching when he saw 3D printers made of wood and plastic. "I thought, 'I can do it better.'"

Otten heard about Logtenberg's plans. They decided to take a chance together. "Three months later, we had our first printer, made of aluminium. Martijn's father invested in us and offered us accommodations at his company, AV Flexologic in Alphen aan den Rijn. We've since repaid him, and now we are on our own. Within a year, we'd like to have our own building in Amsterdam".

The first type of 3D printer that Logtenberg built is standing in the hall of AV Flexologic. Alongside this Creatr is the prototype for the professional 3D printer that Leapfrog will be bringing to the market next summer, the Xeed. The Creatr, which can be connected to a computer or laptop, sells for € 1 250. The Xeed costs € 5 460 and can receive print jobs via WiFi.

The Xeed is already being sold, and the Creatr continues to do well. The shipment of 70 units that is scheduled to be delivered tomorrow in large wooden crates from the East European producer is already sold out.

Logtenberg and Otten now have seven employees and two vacancies. "I hope that in five years everyone will have a 3D printer on their desk".

The possibilities that this offers still sound futuristic. Hobbyists, architects, designers and dentists are currently the most common purchasers of 3D printers. With a few euros' worth of plastic and energy, they can create a scale model or a mould for a dental prosthesis within an hour. In the future, Logtenberg predicts that consumers will buy designs on the internet and print them out in colours of their own choice with one push of a button.

According to Logtenberg, the variety of basic materials that can be printed will increase. "Rubber-like materials and metals are being investigated. We also print with biodegradable corn-based plastic".

Logtenberg also notes that 3D printing provides many environmental benefits. "Products don't need to be shipped, and there is almost no waste". He thus has good reason to say: "This could become huge". (SB)

www.lpfrg.nl

In Person

Asphalt expert Prof. **Erik Schlangen** (Civil Engineering and Geosciences) has made the prestigious website www.ted.com with his story about asphalt that repairs itself through heating. Only one per cent of all global TEDx lectures receive this honour.

The Supervisory Board has appointed **Anka Mulder** as Vice President for Education and Operations. She succeeds drs. Paul Rullmann, who retired on 1 April. Mulder had been Director of Education and Student Affairs (E&SA) at TU Delft since 2004. She is also President of the international OpenCourseWare Consortium. Since 1 July 2011, she had held the position of Secretary General in addition to her duties as Director of E&SA.

Prof. **Theo Toonen** has been re-appointed as Dean of the Faculty of Technology, Policy and Management (TPM) until 1 March 2016. Toonen has been Dean of TPM since 1 March 2008. His previous position was Professor of Public Administration and Dean of the Faculty of Social Sciences at Leiden University.

Dr **Gert Jan Scheurwater** succeeds Hester Bijl as Secretary General. Scheurwater will also remain as Strategic Development Director. Until early this year, he had been the acting director of the Administrative Support department. Under his leadership, Legal Affairs was expanded into the separate department of Legal services, and the Valorisation Centre was transferred to the University Corporate Office.

The Chinese Government Award for Outstanding Self-Financed Students Abroad has been awarded to the PhD student **Hao Chen** (Aerospace Engineering). Chen received the award for his research on the local redistribution of alloying elements during a solid phase transformation in steel.

Maurice Quant, a student of TPM, received the Public Award offered as part of the Shell Bachelor Master Prize. He received € 1 000 for his Bachelor's thesis on tradable energy quotas. The award is intended for students at universities of technology whose theses offer solutions for sustainable technology.

Effective 15 April, Prof. **Hester Bijl** is the new Dean of the Faculty of Aerospace Engineering (AE). Bijl studied Applied Mathematics at TU Delft and English. She earned a PhD in computational fluid dynamics. She was appointed Antoni van Leeuwenhoek Professor in 2006. Bijl succeeds Prof. Jacco Hoekstra.

Prof. **Paulien Herder** was appointed Chair of the Delft Energy Initiative. Herder studied chemical engineering at TU Delft before completing a PhD here as well. Since 2009, she has been Professor of Engineering Systems Design in Energy & Industry within the Faculty of TPM. Herder is also Director of Research for the faculty, and she is the Academic Co-director of Next Generation Infrastructures.

Architecture alumnus **Rogier Alblas** won the NOS design competition for a portrait of Queen Beatrix with his design '75 cent'. Alblas used 10 000 coffee cups to create three 180 x 180cm portraits. The jury, which consisted of Jan des Bouvrie, Sacha de Boer and Marieke Spliethoff, selected his work from more than 2 250 entries. "Queen Beatrix is an icon and has very distinctive facial features. I created three portraits, two of which are based on the postage stamp (Peter Struyken, 1981), with the other based on the portrait by Carla Rodenberg". Along with 64 other works selected from the competition, Alblas' design will be displayed alongside ten well-known portraits of the queen created by artists including Andy Warhol, Marte Röling and Jeroen Henneman, for a total of 75 works of art (one for each year in the age of the queen). The exhibition will be on display until 22 May at Palace Het Loo in Apeldoorn.

Back in the classroom

Working in business after graduation and eventually returning to the lecture hall. Cyril Rothkrantz and Janine van de Linde chose to enrol in the Master's degree programme in Science Education.

It has been seven years since Rothkrantz completed his degree in mathematics. He once considered entering the teacher-training programme, but immediately after completing his studies, he was offered a job in business.
For six years, he enjoyed working as a logistics consultant at TNO. This was followed by a similar position at a small company. This was when it started to bother him. "When it turned out that my contract would not be renewed, I decided to enrol in the full-time teacher training programme".
During the short time that she was working in the commercial world, Van de Linde realised that it was not the place for her. She missed challenge and cooperation. Within a year after completing her degree, she enrolled in the teacher training programme. "I had started in chemistry at TU Delft and finished in energy science at Utrecht. I had to take two modules in chemistry for the teacher training programme. I was dreading it at first, but it was not as bad as I had expected. At first, it felt a bit odd to be back in the lecture hall, studying and completing assignments. I also had to get used to not earning any money. Fortunately, I was able to start combining work with internship activities during my second internship. That way, I had at least some income".

Educational
In the summer of 2012, Rothkrantz and Van de Linde completed their Master's degree in Science Education. They both look back on an educational year. "The contact with other students was particularly pleasant", notes Rothkrantz. "I also considered the flexibility and current expertise within TU Delft as positive features". Van de Linde: "We were able to take the skills we had acquired and apply them directly in the classroom. How do you prepare tests? How do you assess your students? How do you prepare assignments and answer sheets? How do you cope with difficult students? All of these questions were answered during the programme". According to those in Van de Linde's social circle, she has become a happier person since she switched to education. "I'm teaching several tracks in secondary education and I'm working many more hours than before. But I really like what I'm doing. No two days are the same".

Rothkrantz is also teaching at the secondary level, in the junior secondary, general academic and pre-university tracks. At first, he found it a challenge to motivate students and to impart knowledge at their level. He makes good use of his experience in business. "I provide examples from practice, in order to show my students how they can apply the theory later". (PW)


Photo: Sam Rentmeester

Cyril Rothkrantz: "The contact with other students was particularly pleasant."


Photo: Sam Rentmeester

Janine van de Linde: "At first, it felt a bit odd to be back in the lecture hall.

Summer festival

On Friday 31 May, the university will be holding its eighth Summer Festival. The campus will be transformed into a festival site, with a range of performers, music, art, science and entertainment. Four stages will offer performances by famous and upcoming bands, including Handsome Poets, Miss Montreal and Traumahelikopter. Alumni of TU Delft are welcome for a meet and greet (from 15:00 hrs). From 17:00 hrs you have access to the festival venue. Costs: € 15.00
www.alumni.tudelft.nl


Photo: Zomerfestival

TU Delft Alumni Chapters started

Delft alumni are dispersed all over the world. In several locations, TU Delft Alumni Chapters are active. They meet about twice a year for lectures, company visits and/or networking drinks. On 22 February, the TU Delft Alumni Chapter London was established. The first meeting was a success, with 40 Delft alumni in attendance. The Chapter in Athens has been around longer. In late February, a highly successful meeting was held, in which the alumni spoke with about 100 interested secondary students. In March, the Idea League (a partnership between RWTH Aachen, ParisTech, ETH Zurich and TU Delft) held a meeting in Paris for alumni of these four high-ranking universities. LinkedIn Group Delft University of Technology Alumni and **www.alumni.tudelft.nl.**

Five projects receive the UfD-Imtech Bachelor Grant


Photo: Vera Kreuwels

Award winning bachelors rereived € 2 000.

On 21 March, the Delft University Fund (UfD) and Royal Imtech N.V. awarded the sixth UfD-Imtech Bachelor Grants for leading research at the undergraduate level.

Students whose projects reflect daring, a multidisciplinary approach, community involvement, practical application and a fresh look at technological issues were eligible for a prize of € 2 000. Of the 27 entries, five Bachelor's projects received the award.
'Plastics in the Ocean: Resistance analysis of plankton nets (Weerstandsanalyse Planktonnetten); Christiaan den Hertog, Edwin de Hoog, Twan van Leeuwen and Guido Mul, 3mE
'Characterisation of the superconducting transition in disordered NbN films', Lars Schonenberg, Applied Sciences
'The medication file: Medication safety for the elderly (Het medicatie dossier: medicatieveiligheid bij ouderen)', Loes Pluymen, IDE
'UAVForge Challenge', Jurjen de Groot, J. Bouman, D. Castelein, H. Eikelboom, S. Hulsman, R. Knoops, L. Kuijken, M. Milis, S. Schallig, S. Wijdeveld, AE
'Water defence (De Waterweer)', Sandra de Vries and Marloes Wittebrood, CEG
Do you think that it is important to support students with special, excellent or socially relevant projects? Become a 'Friend of TU Delft' and do your part to encourage the further development of students at TU Delft.

www.universiteitsfonds.tudelft.nl.

EEMCS, the movie

'EWI, de film' offers a glimpse into the Faculty of Electrical Engineering, Mathematics and Computer Science. The film presents Bachelor's and Master's students building rockets (Dare), robots (Eva), satellite and solar cars (Nuna), race cars (Forze, DUT racing) and motorcycles (NovaBike); researchers and PhD students manufacturing chips and sensors (Dimes); and alumni establishing companies within YesDelft, including EternalSun, CleVR, Clinical Graphics, Aanmelder.nl and Binkies.
www.ewi.tudelft.nl/actueel/ewi-de-film

Agenda

21 May	UfD Presentation – IHC Teamwork Prize
22, 23 May	IDE Masterclass: New Product Marketing
24 May	IDE Positive Design Day, Pieter Desmet
24-26 May	EIWEIW: Senior student/Alumni weekend 'Stay Connected'
30 May	Alumni Chapter Brussels
31 May	Catalysis Engineering, 7th Reunion
31 May	Summer Festival
26, 27 June	IDE Masterclass: Design for Emotion
11 October	Alumni Event 2013

Engineer of the Year: Pieter Kool

The jury describes the Engineer of the Year, Pieter Kool, as an atypical engineer. At first glance, they consider the IDE alumnus and 3D-design art director at G-Star as more of an artist than an engineer. He is capable of translating knowledge and skills from the complex world of engineering to the world of fashion, in addition to demonstrating the beauty and function of pure technology within an inspiring environment.
According to the jury report, Kool has a clear vision, a high level of authenticity and communication skills that bring people together. In collaboration with Technische Weekblad and Building Careers, the Royal Institute of Engineers in the Netherlands (KIVI NIRIA) awards the annual Engineer of the Year prize to a distinguished engineer, based on such criteria as personality, entrepreneurship and capacity for innovation. As Engineer of the Year, Pieter Kool will be the 'Ambassador of Technology' for an entire year.

Photo: RI Keus

Colofon

Alumni portal
www.alumniportal.tudelft.nl
Changes of address
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Stichting UfD, mentioning "Friends"
universiteitsfonds.tudelft.nl

Vragen of suggesties?
Alumnibureau@tudelft.nl
Telefoon (015) 2789111

who & where

Delft University of Technology has eight faculties, each of which is engaged in education and research in one or more disciplines. The University was founded in 1842 by King William II. With 13,000 students, 2,800 scientific staff members and 2,000 technical and administrative employees, it is the largest university of technology in The Netherlands.

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Multidisciplinary Centres

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Biotechnological Sciences Delft Leiden (bsdl)
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Centre for International Co-operation and Appropriate Technology (cicat)
Mekelweg 2
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Centre for Transportation Engineering
Stevinweg 1
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Telephone +31 15 278 6634

Dutch Institute of Systems & Control (DISC)
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Telephone +31 15 278 7884

Koiter Institute Delft (Institute for Engineering Mechanics)
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Netherlands Institute for Metals Research (NIMR)
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Wind Energy Research Group
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Reactor Institute Delft
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OTB Research Institute for Housing, Urban and Mobility Studies
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Advanced School for Computing & Imaging
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Trail Research School
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Central Library

Delft University of Technology Library (dutl) supplies information and provides services, particularly in the area of the technical sciences.
It comprises a central library and twelve sub-faculty libraries housed at the respective sub-faculties and institutes.
The dutl is intended for students and staff at the Delft University of Technology. However, as the task of the library is to provide scientific and technical information at a national level, its facilities are also available to the general public. As well as all areas of technology and natural sciences, the library also contains a general collection in the social sciences, economics etc.
This relates not only to books or periodicals, but also to standards, reports, reference works and congress proceedings.
Literature not in the collection or not on hand can be obtained through Delft University's Central Library from other libraries in the Netherlands or abroad.

For further information:
Delft University Central Library
Prometheusplein 1
p.o. box 98
nl-2600 MG Delft
Telephone +31 15 278 5678

Delft University Press
IOS Press
Nieuwe Hemweg 6B
nl-1013 bg Amsterdam
www.iospress.nl
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Fax +31 20 620 34 19
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Information

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p.o. box 5
nl-2600 AA Delft
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Information on facilities for foreign students:
Student Advisory Office
Jaffalaan 9a
nl-2628 BX Delft
Telephone +31 15 278 4670

Liaison between business and research:
Liaison Office
Mekelweg 2
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Information on research fellowships:
Mrs. M.Y.M. Spiekerman-Middelplaats
Stevinweg 1
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General information on university education in the Netherlands:
Min. of Education, Science & Culture
Central Information Dpt.
p.o. box 16375
nl-2500 BJ Den Haag
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(Post Graduate) Courses

Delft TopTech
(vocational courses)
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www.delft-toptech.nl

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