Delft Outlook
MAGAZINE OF DELFT UNIVERSITY OF TECHNOLOGY 2013 • 5

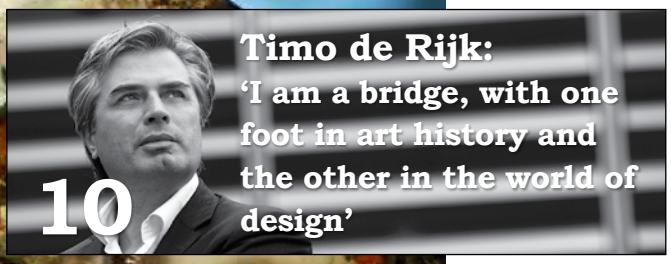
Profit from heat
ORC-technology takes care of the pennies

Timo de Rijk
'As a researcher, interpretation is what matters'

Gold for Nuna
Solar car fastest yet again

Painting by numbers
Printing paintings in 3D

no. 5
2013



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Building bridges

"Leiden University studies the workings of culture, while TU Delft aims to create new things. These are fundamentally different approaches. I am a bridge between those two worlds." Art historian Timo de Rijk is the new Professor of Design, Culture and Society in Delft and Leiden. "Most products have a cultural component. [...] Designers can take this into account."
Will the technique that TU Delft and Canon-Océ developed for making relief reproductions of paintings bridge the gap between research in technology and art history? Joris Dik can see it already: printing successive stages of the painting in 3D, revealing the creation of a work of art. But Michel van de Laar, restorer at the Rijksmuseum has other ideas. "I'm not sure what kind of added value the 3D technique is going to provide."
Delft Outlook has been building bridges between you and TU Delft for years. But all bridges need regular maintenance and this is why Delft Outlook is being given a makeover. From 2014 on, we will be appearing four times a year, in a slightly thicker format than the current issue. With more science, more background features and more news about what is happening at the University. We look forward to seeing you again in the spring on this shiny new bridge.

Frank Nuijens, Editor-in-Chief, Delft Outlook

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Hydrologists discover DNA

The myriad uses of DNA are endless. It is life's own code, you can use it to combat shoplifting and it can even help evaluate the water flows of huge river systems such as the Rhine or Danube river basins. The latter is argued by Dr Thom Bogaard (CEG) and Dr Jan Willem Foppen from the research institute Unesco-IHE. They released small fragments of DNA (80 base pairs) in various streams in the Benelux. They then found the DNA in samples that they took downstream. Because even minimum quantities of DNA are traceable using the latest DNA analysis techniques, this method is a prime candidate for upscaling.

delta.tudelft.nl/27328

Medical mechanics

Students often see the course in medical device prototyping to be the most practical part of their biomedical engineering programme at 3mE. At the end of June, students presented their prototypes at the MedTech West event. These included a plastic artificial hand with independently movable fingers that can be used without gloves, a gel cushion for an ultrasound device and a device for helping surgeons to perform heel operations. The photo shows the lightweight "Open Fit" fitting for underarm prostheses developed by Tonke de Jong and Claire van Mil (second and third from the left), chosen as the best design by those attending the event.

delta.tudelft.nl/26919

Photo: Tomas van Dijk

The "Open Fit" prosthesis fitting was judged the best design.

Survival of the fattest

A major threat to the cultivation of oil-producing algae is contamination by other types of algae that produce less oil. Biotechnologists at TU Delft have developed and patented a cultivation method that can circumvent this problem. Their algae only receive the nutrients they need for cell division at night. This means that only the algae that have built up sufficient fat reserves during the day are actually capable of division. A case of survival of the fattest, in other words. The company Algae Food & Fuel intends to upscale the Delft technology and establish a production line for algae oil.

delta.tudelft.nl/27400

Two world-class publications

Seismologist Dr Läslo Evers (CEG) has just had two articles published in Science and Nature – in the very same week, no less. When a meteor exploded above Russia on 15 February, he wasted no time. After watching the news report, he logged into the closest seismic monitoring station in Kazakhstan. In Science, he and his colleagues reconstructed the shock waves caused by the exploding meteor. In Nature, he and another group of researchers calculated that this kind of meteor reaches the Earth on average once every forty years and not every hundred years as had originally been thought.

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Photo: Nature/Andrea Carvey, Mark Boslough & Brad Carvey

The meteor raging through the atmosphere in 3D.

Now you see (Qub)it

Quantum particles have the unique property of being able to exist in multiple states at the same time, but according to the principles of quantum mechanics they lose that property as soon as they are measured. Scientists from the Kavli Institute for Nanosciences published an article in October's edition of Nature about what they call a feedback control method to enable measurement while still maintaining a quantum state: "Deterministic entanglement of superconducting qubits by parity measurement and feedback". The result is extremely important for the development of quantum computers, which can solve complex problems much faster than supercomputers.

delta.tudelft.nl/27323

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Since you asked on Fred Kavli

Noise measurements in a modern daycare centre.

Noisy adult daycare centres

People with intellectual disabilities who spend their time in adult daycare centres do not always have an pleasant time there. Although many of them may also be hard of hearing, the rooms tend to be very noisy. The hard walls and services required for hygiene reasons are a major factor in this. Dr Konca Saher was awarded her PhD in architecture for developing practical guidelines to improve the acoustics in these centres. What was missing was noise absorption. Saher calculated the average absorption and correlated this with the acoustic experience. In her thesis, she developed her findings into a spreadsheet that architects can use to determine how much noise absorption is required to achieve specific acoustics.

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Hydraulic wind turbine

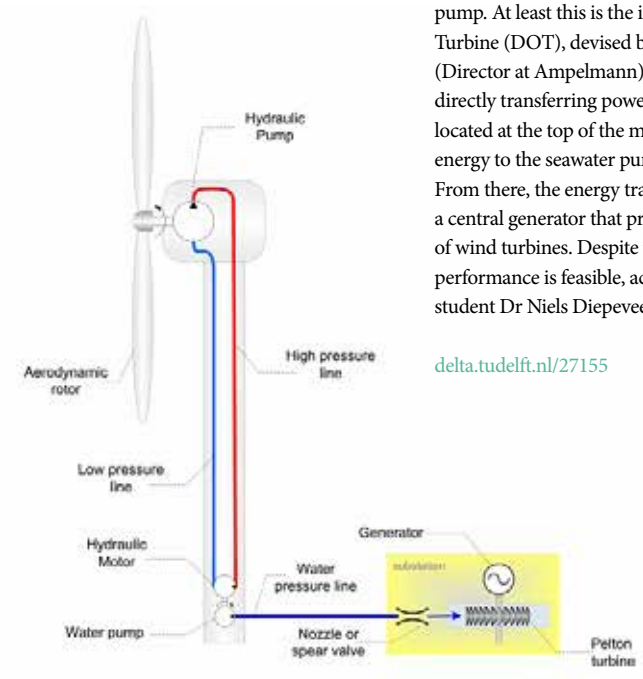

Illustration: Niels Diepeveen

In the next generation of offshore wind turbines, the fragile transmission will be replaced by a hydraulic pump. At least this is the idea behind the Delft Offshore Turbine (DOT), devised by Dr Jan van der Tempel (Director at Ampelmann). The concept involves the rotor directly transferring power to operate a hydraulic pump located at the top of the mast. An oil pipe transports the energy to the seawater pump at the bottom of the mast. From there, the energy travels through seawater pipes to a central generator that produces energy for a number of wind turbines. Despite the three conversions, 80% performance is feasible, according to calculations by PhD student Dr Niels Diepeveen.

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Massive interest for moocs

More than 78,000 people signed up for the first TU Delft moocs (Massive Open Online Courses): one on "solar energy" and an "introduction to water treatment". Moocs offer free online access to TU Delft knowledge to anyone, wherever they are in the world, without the need for prior qualifications or an admission test. The courses last ten weeks, students are given homework, can consult with fellow students and complete the course with a certificate. Moocs are a major innovation in education. They contribute to TU Delft's international reputation, reach out to large numbers of people across the world and offer alumni the opportunity of lifelong learning.

ocw.tudelft.nl

Wet nanopore

Until recently, molecule-sized holes in graphene would become blocked by DNA chains. Thanks to a coating that makes the carbon surface of grapheme hydrophilic (attractive to water), long organic molecules can now slip smoothly through. This is important for the plans of bionanoscience staff to use nanopores to read the basic sequence of a whole DNA string in one go. Dr Grégory Schneider and colleagues have developed a molecular coating (from pyrene ethylene glycol) that makes graphene hydrophilic and therefore repel organic molecules, doing so without affecting the special electric properties of the graphene. They announced this in Nature on 15 October.

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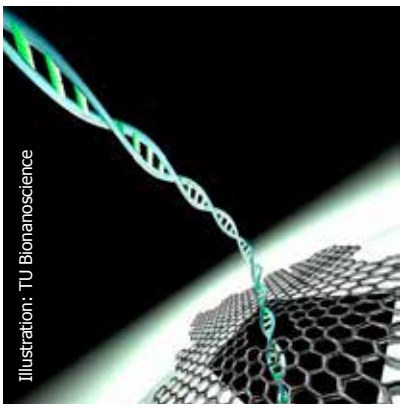

DNA now slides smoothly through graphene.

H.E.L.P.

Delft Aerospace Engineering students tried their luck in the aircraft design competition run by the AIAA (American Institute of Aeronautica and Astronautics). Students from Delft secured the first three positions in the student competition. Raphael Klein created the winning design with his light-weight H.E.L.P. (High Endurance Lightweight Program). He was able to prove that his design met the highly taxing requirements. The aircraft must be able to cruise at a height of 22 km for 20 hours and cannot not weigh more than 3,400 kg. Klein's design was awarded extra points because it can fit into a container when folded. Only when his lecturers started congratulating him did Klein realise how important the competition was.

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The light weighted drome can be folded into a container.

A record in gamma resolution

Prof. Pieter Dorenbos with the new detector.

With the new gamma detector developed by Prof. Pieter Dorenbos and staff in radiation, science and technology (Applied Sciences), it is easier to trace (illegal) radioactive materials at airports and scrapyards. The identification of radioactive isotopes is done using a kind of fingerprint in the gamma radiation spectrum. This means it is important to have a detector that can combine sensitivity with a high energy resolution. Dorenbos's team achieved this by developing scintillation material that also provides a linear response for low gamma energies, unlike existing detectors. The results of this STW-funded programme are being put to use by glass and detector manufacturer Saint-Gobain.

delta.tudelft.nl/27243

Silver prosthesis

Infections in prosthetic joints can cause no end of misery. The prosthesis must be removed, the injury allowed to heal and a new prosthetic joint then fitted. Materials scientist Dr Bogdan Stefan Necula believes he has developed a technique that can prevent this kind of predicament for titanium prostheses. On top of the titanium, he adds a layer of silver nanoparticles. The silver atoms kill bacteria. The technique looks promising but follow-up studies will need to show whether the silver also leaves the surrounding tissue unaffected in the long term. Necula was awarded his PhD at 3mE last November.

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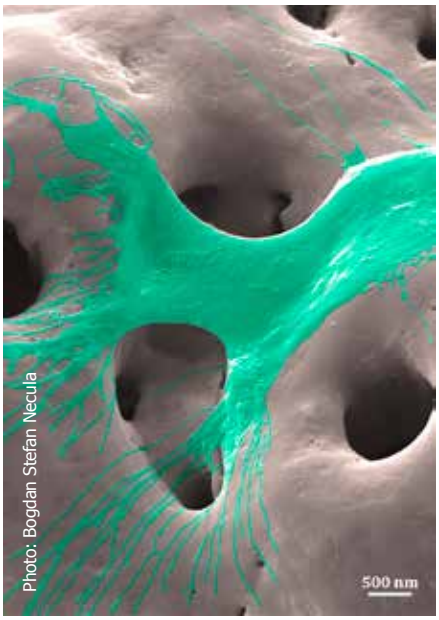

A bone cell growing on a titanium prosthesis, seen using an electron microscope.

Wind disruption caused by buildings on campus.

Wind warning

Ironically, the traffic sign warning cyclists of treacherous winds around the EEMCS building was destroyed by the wind in the first storm of the season (28 October). For Dr Sasa Kenjeres from the Burgers centre for fluid dynamics, the storm came at just the right moment: he had just published an article (Journal of Wind Engineering and Industrial Aerodynamics) revealing a method that can be used to measure wind strengths at street level in urban environments. Despite its simplicity, the average Navier-Stokes calculation effectively matches other measurements and can run on a standard PC. Kenjeres recommends that more trees be planted around EEMCS and the Mekelpark. This will significantly reduce problems with wind.

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Photos: Sam Rentmeester

Michel van de Laar in his studio.

Between art and kitsch

The technique which the TU Delft and Canon-Océ developed for making relief reproductions of paintings received extensive news coverage in late September. Art experts frowned on it.

Jos Wassink

"Feel free to touch it", said rector Karel Luyben. In September, a life-size reproduction of Rembrandt's painting The Syndics suddenly appeared in his office. The art historian and materials scientist Prof. Joris Dik (3mE) had offered the copy to the Executive Board as a demonstration of a recently developed technique that involves printing not only the colours, but also the thickness of the paint. It must be said: at first glance, the copy looks shockingly real. It makes you want to feel the beads of paint. Usually this is not allowed, but now it is.

Two days later, Joris Dik appeared on Pauw & Witteman with another copy. There as well, people were fascinated to view an almost life-like Rembrandt.

The Rijksmuseum's art experts thought that they were a little too fascinated. "It's a shame that the 3D technique has drawn so much attention away from the XRF technique", said senior curator Michel Herkenrath (Rijksmuseum) afterwards. He was referring to the X-ray-fluorescence technique developed by Joris Dik and Prof. Koen Jansens (University of Antwerp), which makes it possible to create extremely sharp images of underlying layers of paint (and their pigments). "This technique is of enormous importance for us", states van de Laar. "I'm not sure what the 3D technique can add."

Depth

A solution looking for a problem – that is what the relief-printing technique developed by Canon-Océ could originally have been called. It involved the discovery that plastic could be applied with a high level of precision using a printhead, and then cured under UV light. Prof. Jo Geraedts (IDE and Océ) contacted Joris Dik, because he thought that the reproduction of paintings could be a promising application and because Dik had good connections with the museum art world. What was missing was a scanner that could provide information on depth.

Undergraduate student Tim Zaman (3mE) took on the challenge for his graduation project. He was supervised by the robot-vision expert Prof. Pieter Jonker (EEMCS) and the artificial-intelligence specialist Dr Boris Lenseigne (3mE).

"Depth in a plane can be translated into a movement which is different for each eye", explains Zaman, with regard to the principle on which his topographical scanner is based. To the left eye, a point emerging right in front of the nose will appear to move to the left, while the right eye will perceive it as moving to the right. Because points are difficult to identify in a level surface, however, Zaman projected various grid patterns over it. The shadows of these patterns were picked up by two cameras that registered the painting at 45° angles. The depth information was retrieved from the combination of these images.

It takes two minutes to scan 40 million points within an area of 10 cm by 17 cm, and it takes about 15 minutes to reconstruct them into x, y and z coordinates. The painting The Jewish Bride required 240 shots and two weeks in order to piece the points together and calculate the coordinates. The reproduction has a flat resolution of 50 micrometres and a depth resolution of 9 micrometres.

The versatile Zaman developed the scanning protocol, in addition to writing all of the software and building the prototype that he used in the Gallery of Honour for the official opening of the Rijksmuseum, while Queen Máxima passed by his lens. His graduation project was rewarded with a 10.

At first glance, the copy looks shockingly real

Thick layers of paint

"The use of impasto was one of Rembrandt's characteristic techniques", notes Michel van de Laar, referring to the technique of painting with thick layers of paint. The senior curator of paintings works in a beautiful studio at the north end of one of the buildings behind the Rijksmuseum. Upon exiting the lift, visitors enter a grey-white hall with old masterpieces placed on easels to the left and to >>

‘Rembrandt wanted to create living images; impasto was a part of the process’

the right. The yellowed varnish has been removed from a part of one of these works. The original tones emerge from under this layer as fresh as a baby’s blush.
As Van de Laar explains, “Rembrandt sometimes used blobs of paint in order to represent a structure. That was one of his tricks for creating something that seems to be alive. Since the advent of photography, we have come to see images as things that are of the past. Rembrandt wanted to create living images. Impasto was a part of this process, particularly in contrast to smooth sections elsewhere in the painting.” The most finished, most thickly applied elements attract the most attention. Smooth, thinly applied elements form the background. According to van Laar, Rembrandt’s paintings were a source of inspiration for Vincent van Gogh. He explains that, upon visiting the new Rijksmuseum in 1885, van Gogh had said that he would trade ten years of his life for the opportunity sit before The Jewish Bride for fourteen days, with only a crust of bread as food. “Van Gogh felt confirmed by Rembrandt”, remarks van de Laar. “It was something along the lines of, ‘What you’re doing is okay.’” Painting thickly, that is.
It is therefore not surprising for reproductions to seek to reproduce the paint thickness as well. According to van de Laar, reproductions with relief were already being manufactured and sold in the late 19th century. He was referring to an invention which the Brabant publisher Henri Bogaerts had patented in 1878 under the name Peinture Bogaerts. In addition to reproducing paintings in line and colour, this technique also imitated the surface. This was done by creating a relief with a thick primer, using a metal cliché. The exclusive reproductions were touted as “jewels for rectories and monasteries as well as Catholic living rooms”.

Van de Laar, whose grandfather Arnold van de Laar earned his living by painting copies on commission, sees the 3D technique largely as the next step in reproductions. There is nothing wrong with that. He has even purchased a reproduction of Isaac Blessing Jacob by Govert Flincks at the Rijksmuseum, and he enjoys it every day.
The curator of 17th-century paintings Pieter Roelofs shares this view. He just happens to have the 3D copy of The Jewish Bride on his desk. First, there were glossy colour images, then canvas prints and, now, relief prints. “It’s all going to happen. In about 10–15 years, 3D reproduction will be the standard. There’s nothing wrong with that. Every reproduction is an ambassador for the Rijksmuseum.”

Painting process

Joris Dik wants more. He would like to see the 3D technique take on a serious role in the field of art-historical research. For example, it could be used in combination with the XRF technique, which reveals underlying layers of paint. Dik can see it already: printing successive stages of the painting in 3D, revealing the creation of a work of art. Van de Laar is sceptical. Although the underlying images are clear, the order is much less clear. For example, consider The Syndics. One of the background figures changes places three times; the hands on the table keep changing, and the half-standing figure on the left has taken on a different, more active posture. “All sorts of things are happening. In the painting process, everything runs together”. Because it is impossible to determine the order of the various changes, we can only guess at the successive ‘stages’. Van de Laar therefore considers it “not useful” to make reproductions from uncertain reconstructions of earlier stages in the painting process of a particular painting.


Tim Zaman.


Jo Geraedts.


Joris Dik.


Pieter Roelofs.

Photos: Sam Rentmeester

He does, however, think that the production of 'dummies' could be useful. These could be used for reconstructions, for example. "They could show how the final painting originally looked. As a curator, you want to return to the intention of the artist. If the media have become discoloured on their own – that is to say, without any external influences – there's a limit. You can't do anything about it." For example, it has been established that Rembrandt used the pigment called 'smalt', a deep-blue powdered glass containing cobalt. In the course of time and because of the varnish, this blue colour in the tablecloth of The Syndics has become little more than an indefinite beige. The colour can be digitally retouched to appear as Rembrandt had probably intended. For van de Laar, a 3D print of the painting could be temporarily hung close to the original, in order to allow comparison.

Curator Roelofs also sees potential advantages in dummies. For example, they could be used for educational purposes. Professional guides now often carry along various objects to help support their stories. Relief reproductions (or parts thereof) could be very helpful in this regard.

Roelofs thinks that the scanning technique could be very useful in the lending of paintings, given the long distances that paintings travel as a result of collection mobility. Currently, the curator inspects the painting before departure and upon return. Such inspections are performed decimetre by decimetre, resulting in a report. It is conceivable that these inspections could be performed automatically, and that comparison of the two datasets could provide a very precise and objective overview of changes (i.e. damage that might have been incurred during transport). A 3D scan can thus be a future standard feature of the condition report.

The suggestion that the entire question of transport could be eliminated by transferring the database and reproducing it on-site is "inconceivable" for Roelofs, and actually inappropriate. "The experience of authenticity can never be reproduced."

Colour

Joris Dik has also noticed that, despite advanced technology, important differences remain visible between originals and copies. One of these differences involves the transparency of the layers. Rembrandt produced a very lively red in the dress of The Jewish Bride by using semi-transparent layers, thus endowing the colour with a depth that cannot be found in the reproduction – at least not yet.

A few hundred metres away, the Van Gogh Museum already has 3D reproductions on sale. These 'Relievo' prints are produced through a process developed by Fujifilm, and they are apparently intended primarily for the Asian market. Five different works have been reproduced exactly – right down to the stickers on the back – and certified by curators of the museum. The selling price is unclear. It is advised that relievographs not be hung above a fireplace. <<

In Van Goghs paintings, every stroke of the brush makes a petal.

Rembrandt liked to model with paint.

The scanning technique could be very useful in the lending of paintings

Timo de Rijk:

‘We plant the seed’

Art historian Timo de Rijk was appointed Professor of Design, Culture and Society in Delft and Leiden last September. He calls this combination ‘a real breakthrough’. ‘Leiden University studies the workings of culture, while TU Delft aims at creating new things. These are fundamentally different approaches. I am the bridge between the two.’

Saskia Bonger

Hanging from Timo de Rijk’s coat rack are two intriguing little bags. Both contain artificial hair, but the locks in one bag are straight and blond, and those in the other black and red and curly. The new Professor of Design, Culture and Society at TU Delft and Leiden University keeps them as a memento of a research project in Rotterdam-Zuid. He had his students from VU University Amsterdam’s Design Cultures programme spent several weeks trying to uncover the aesthetic ideal of the residents of a multicultural neighbourhood built in the 1980s.
He laughs: ‘One of my fascinations is the history of hair. I found these hairpieces in a beauty shop. Pieces like these costs five euros. It’s a pretty insane sight seeing all that hair hanging here in these bags. But they are popular, especially among black women. I wanted to know what the habitat was of the groups living in this neighbourhood. How do they dress and why? What is their beauty ideal? These were the things I wanted the students to find out.’

What can a designer do with this information?
‘You can think about how you can design products for specific target groups. If your goal is a social one, you can discover how to reach these groups. In that case you will need to know how they live their lives and what they find important. The government has a grand ambition to prevent society from falling apart. In order to do this you need to understand cultures and subcultures. One way of doing this is to look at the products they use. This is all the more important now that the cohesion between the various groups is breaking down and people are keeping to their own circles more and more.’

People often do not know themselves why they do or like something.
‘We take many things for granted because we believe that this is the way it should be. That is how culture works. All your prejudices are part of cultural framing. A researcher has to interpret this. People rarely give a direct answer to a question. That makes the designed environment an important source of information.’

Do you take to the streets together with the students of Leiden University and TU Delft?
‘We have not yet done so in groups. Teaching at TU Delft is at a larger scale than in Amsterdam or Leiden. There are some fifty first-year students of Art History at Leiden University, while at TU Delft we have a hundred new students participating in the programme. My chair was created because the deans of the faculties in Delft and Leiden believe that the philosophical-analytical side and design practice have much to learn from each other. This is a real breakthrough: the one studies the workings of culture while the other aims at creating new things, These are fundamentally different approaches. I am a bridge, with one foot in art history and the other in the world of design. One of my ambitions is to make the potential offered by Leiden University available to TU Delft. In Leiden, you have academics who know everything about themes such as the culinary history of Japan, pop culture in the Islamic world and the relationship between East and West.

How can a designer and someone who knows all about the culinary history of Japan help each other?
‘I admit it is highly specific. Our students at >>

'TU Delft students are less sensitive to what I call the 'metaphysics'; the symbolical meanings in the world'

TU Delft conduct a lot of target group studies. These studies could be enriched by the knowledge available in Leiden. For example, the Chair of East-West Relations carries out in-depth studies into cultural differences. This information is very useful to TU Delft.'

Are the students of TU Delft interested in this information?

'Not all of them, but we can see that it is catching on. We are increasingly able to communicate the importance of culture for designers. Design history is no longer the same subject it was when I came here in the late 1990s. The question then was: Where do we come from as designers? Were we engineers who translated technologies into the needs of consumers? Or artists who came up with artistic applications? The latter situation applied in the 18th century. In those days there already was something like a consumer society. At manufacturers, artists learned to create products for groups of customers who they did not know themselves. This had never been done before. You might well ask why it is we train people to become designers at TU Delft. It was the government who conceived this idea after the Second World War. The Netherlands had to be transformed into an industrialised society. TU Delft resisted at first, but in the late 1950s the University decided to include the discipline in its Architecture programme. They were almost too late, because in the 1960s it became clear that the Netherlands was failing in its goal to create an industrial society following Germany's example. We make too few end-products. Take the automotive industry, for example. Germany has several car manufacturers, the Netherlands can boast only suppliers at most.'

Is that bad?

'Not at all. We have a large SME sector who build all kinds of things. And the original disadvantage of producing too little while at the same time training too many designers has turned into an advantage. Design is not limited to making products, and in fact this aspect may well be becoming less and less important. Moreover, the relative distance to industry has become standard practice. We now outsource a lot of the manufacturing to countries such as China. That means it has become less important to be in direct contact with the factory and what is going on there. Our designers are given a broad education. A designer trained in Germany is trained in such a way that he can start at Siemens or BMW straight away. And yet you do see a lot of Dutch designers working for companies like these. Their role is typically that of supervising the design process, in which engineering, design, ergonomics and marketing all play a role.'

Are the students of TU Delft capable of writing design history?

'We don't make attractive flower vases. In fact, we do not make anything; we train students. They are not asked to make things that look nice and shiny on an exhibition stage. They are supervised through a process. Sometimes the result is unsophisticated or incomplete. But we do plant the seed. Design is powerful because it involves a product and a place for this product in society. That is where it acquires its meaning. A piece of art in a museum has the meaning that the artist has given it.'

What is the difference between the students of Leiden University and TU Delft?

'TU Delft students are less sensitive to what I call the 'metaphysics'; the symbolical meanings in the world. They are more interested in facts. What you see is what you get. Yet no designer creates a design based only on figures. You can't say: 98 per cent of the users of a space is female, so I will design a female space. The design is determined by research, facts and figures. The shape this takes is up to the designer. This is contrary to the classical idea of engineering; that there is only one unavoidable solution.'

What are your plans for the coming years?

'I want to focus more on socially engaged design, social design. How can you use design to help implement social processes or behavioural change? I want to know more about how products are used in different cultures. Then we will be able to design products that are more attuned to public spaces. I once did a research project on barbecues. North African and Turkish people sometimes spend a whole Sunday outside with the family. Have we ever thought about this properly in the Netherlands? Hardly. We have parks and we say: you can sit there. But there are few specific facilities. The government has to ensure that public spaces meet the needs of the people. If they do not then there will be widespread frustration. Most products have a cultural component. Take cleaning products, for example. Smell is partly culturally determined. Our idea of a fresh smell is different to that in India. Designers can take this into account.' <<

Who is Timo de Rijk?

Timo de Rijk (1963) graduated from Leiden University as an art historian in 1988. He started his career at the auction house Van Stockum and then made the move to TU Delft. In 1998 he submitted his doctoral thesis entitled 'The electric house', in which he provided an overview and analysis of the design and acceptance of household electrical appliances. He has been working at TU Delft ever since. Between 2010 and 2013 he also served as a professor by special appointment of Design Cultures at VU University Amsterdam. As of September 2013, De Rijk is Professor of Design, Culture and Society. This is a joint chair shared by Leiden University and TU Delft. He teaches two subjects in Delft: Design History in the Bachelor's phase and Design, Culture and Society in the Master's. De Rijk has organised countless exhibitions and is Editor-in-Chief of the Dutch Design Yearbook. He is also president of the Association of Dutch Designers.

Column

Show me the money!

Remco de Boer is a technology & science communications specialist

Although our prosperity is based on it to a large extent, energy from fossil fuels is increasingly seen as the enemy. There is even a Fossil Free movement in the Netherlands. Boxtel is already "free", and Leeuwarden has the same ambition. For the sake of the locals, let's hope that those in power do not adhere to this too strictly, or they will have to endure many evenings of playing board games by candlelight.
But it is not just grey energy that is in the spotlights: green energy is also under fire. Deep geothermal energy calls for fracking, so we can forget about that. What about wind turbines? They also face fierce opposition. Last month local residents near Utrecht demanded three million euros in compensation for the damage inflicted by three wind turbines in their area. Even if they do not receive the money, they will have won: PvdA (Labour) councillors in Utrecht, who are in favour of wind energy, recently voted against six new turbines because of lack of public support. This opposition is even more galling for the environmental organisations as their own, meticulously-developed strategies are being turned against them. And they too have no response to it: sowing doubt is always easier than dispelling it.
In a final attempt to save wind energy from a total demise, eight environmental organisations, including Friends of the Earth Netherlands, proposed allowing residents to benefit financially from wind turbines in their area. A great idea, thought the GroenLinks (GreenLeft) councillor for spatial planning, nature & the environment in the municipality of Bergen in Noord-Holland. He is also in favour of wind energy, but not wind turbines it seems.
It emerged last month that he would like energy company Eneco to provide compensation for nuisance that will be caused by a new wind farm that is yet to be built. It will be 20 km away, in the North Sea – let me repeat, 20 km out! He argued that "it will still cause nuisance, in this case of the visual kind. We want something in return for that." Eneco could help fund the redesign of the city centre, for example.
By now it has also become clear that everyone in the world of compensation applies their own definitions. When Minister Kamp recently announced plans to consider compensation for the potential exploitation of shale gas, Friends of the Earth described that as "bribery". What can one say?

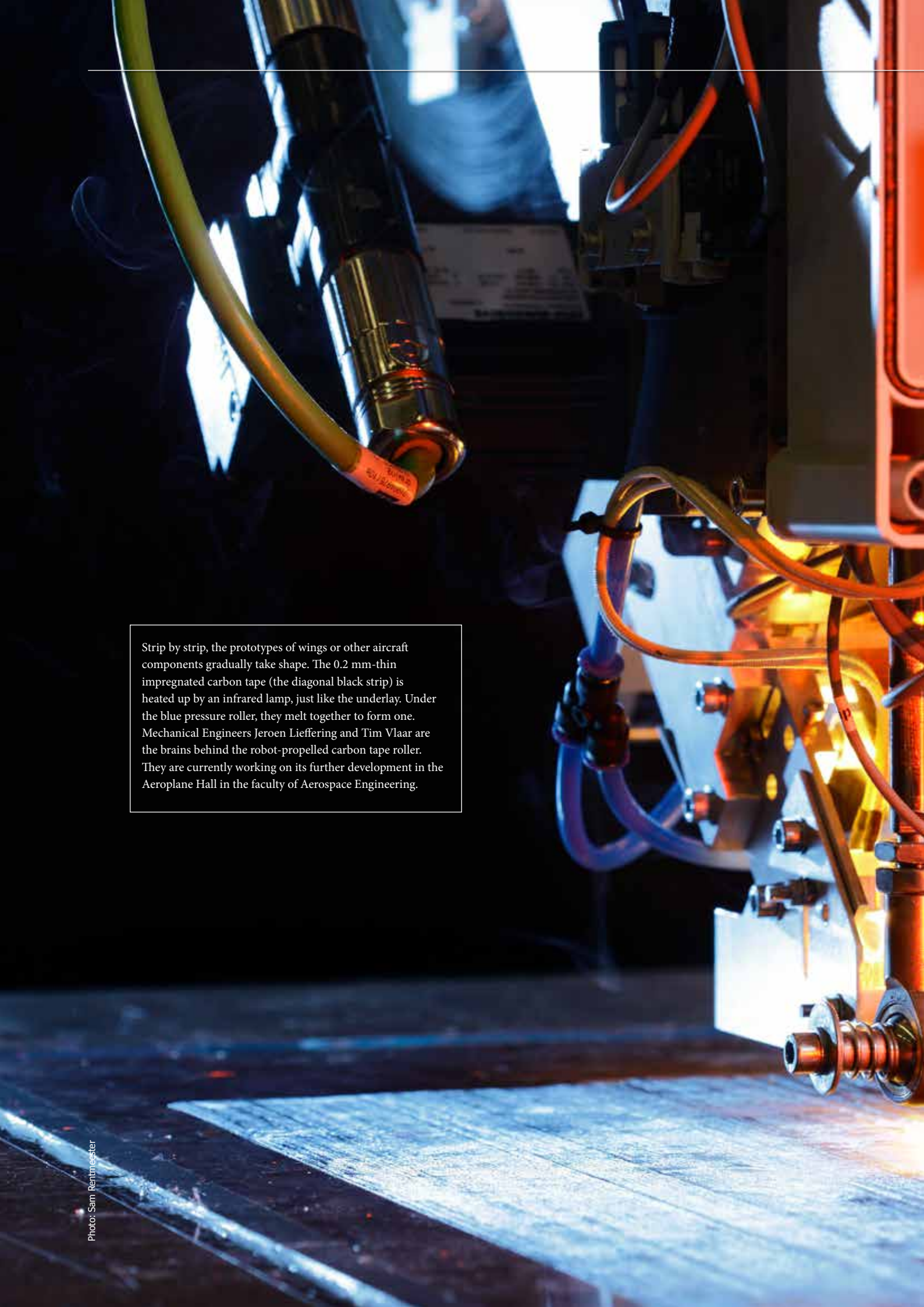
Of course, it's important that benefits and burdens are shared out fairly, and money can play a role in that. But before we have even begun to understand this application of this instrument in the Netherlands, we are already teking things to extremes.
If just the appearance of wind turbines at a distance of 26 km – possibly only visible on a clear day if you look really carefully – calls for financial compensation, there will be no end to it. That means the sky's the limit when it comes to demanding recompense. It will open the door to a compensation culture in which begging for handouts becomes the norm, an attitude satirised by comedian Hans Teeuwen in his take on a lazy street musician: "Lalalalala, now show me the money".

Photo: Sam Rentmeester

Under Construction

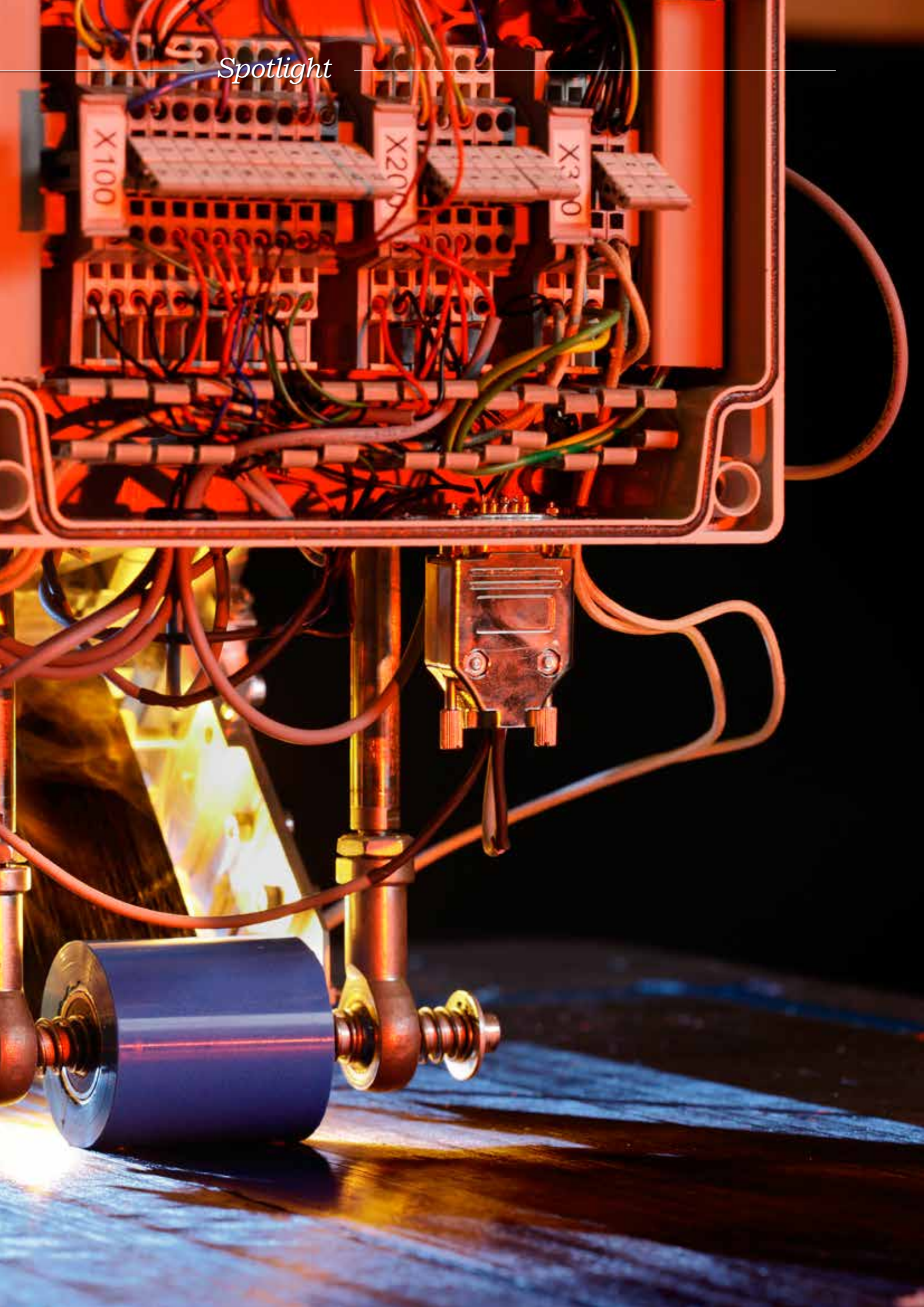
Photo: Sam Rentmeester

Here, on the site of the building that formerly housed the faculty of Architecture and the Built Environment, the Green Village was supposed to have been built early this year. The plans of Professor Ad van Wijk (Future Energy Systems, Applied Sciences) for "a living laboratory as a showcase for sustainable technology" have been delayed "for bureaucratic reasons". At any rate, the piers that are currently standing on the site have nothing to do with the Green Village, which is now expected to be realised in the summer of 2014. Van Wijk promises Future Labs, Engines (energy supply), a Green Tech Store (with 3D printing and LED lamps) and flexible workspaces. To view the plans, please visit **www.thegreenvillage.org**



Strip by strip, the prototypes of wings or other aircraft components gradually take shape. The 0.2 mm-thin impregnated carbon tape (the diagonal black strip) is heated up by an infrared lamp, just like the underlay. Under the blue pressure roller, they melt together to form one. Mechanical Engineers Jeroen Lieffering and Tim Vlaar are the brains behind the robot-propelled carbon tape roller. They are currently working on its further development in the Aeroplane Hall in the faculty of Aerospace Engineering.

Photo: Sam Rentmeester


X100
X200
X300

Profit from heat

Quite a bit of heat is lost in industry and on the road. A technique that involves using residual heat has been attracting more and more interest.

Jos Wassink

In the cement industry, 40% of the energy flies out through the chimney. Other sectors with large quantities of waste heat include blast furnaces, the chemical industry and refineries. The same applies to road traffic. Despite the near-optimisation of the internal combustion engine, at least 60% of energy is still converted into heat. People are becoming increasingly less likely to accept this loss of efficiency as a matter of course.
This trend is being reinforced by the emergence of a technique that can be used to convert heat into electricity - a type of steam turbine for lower temperatures. The technique is named after the versatile Scottish engineer William Rankine (1820-1872) and is called the Organic Rankine Cycle, or ORC (see Box).
During the energy crisis of the 1970s, Professor Gianfranco Angelino began working at the university of technology in Milan. This would mark the beginning of the 'Italian school' of the ORC. The Turboden company, which produces ORC systems, emerged from it. An Israeli-American school emerged as well, resulting in the Ormat company, which focuses on the exploitation of geothermal energy. The recently established Dutch company Triogen uses a Finnish turbine to recover energy from industrial waste heat starting at 350°C.
Triogen was co-founded by TU Delft professor emeritus Jos van Buijtenen. Prof. Piero Colonna (of the chair in Power and Propulsion within the faculty of Aerospace Engineering) earned a PhD at Angelino in Milan. He is continuing the Italian school in Delft, as it were.

Renewable

Fifty years ago, William Rankine would never have imagined that his modified steam cycle would be applied primarily to the problem of renewable energy sources and energy recovery. The reason for this has to do with the fact that ORC has a lower operating temperature than the steam cycle. Although fossil fuels can easily achieve steam temperatures of 500°C or higher, waste heat or heat from sustainable sources usually have lower temperatures. Biomass is one example. In Germany, Austria and Denmark, small biomass-fuelled community power stations now often use ORC systems. The temperature of the vapour does not become any higher than around 320°C, and it condenses at 90°C. According to the laws of thermodynamics, the efficiency of a thermal cycle improves as the difference between upper and lower temperature increases. In this context, the electrical yield of 18% is relatively low. Combined with the heat, however – as is the case with community power stations – the total yield increases to 88%. The heat output of such community power stations (the speciality of Turboden) is typically between 6 and 10 megawatts, with an electrical capacity between 1 and 2 megawatts.

Rozy

According to a recent overview article,* geothermal energy is suitable for generating electricity with ORC beginning at 80°C. As reported in this article, Europe has the potential to generate as much as 34 thousand megawatts. This would allow the closing of 30 coal-fired power stations. This sounds highly optimistic, however, and it fails to consider economic feasibility. The electrical yield of geothermal energy sources is low, particularly for low-temperature sources, and considerable electricity is needed to operate the pumps (between 30% and 50% of the system's own production). At higher temperatures (beginning at 150°C), the condensation temperature is often set relatively high (e.g. at 60°C). Although this comes at the expense of electricity production, it does keep the water hot enough for urban heating. This situation can also be described like this: if a source of geothermal energy provides a temperature that is higher than is required for the heating network, ORC can skim the surplus heat by generating electricity.
In theory, ORC systems can also be used for solar energy, but this is not very common. Existing solar panels are obviously a good

How does ORC work?

Like a steam turbine, the Organic Rankine Cycle operates through a liquid that evaporates in a closed cycle and, in gaseous form under high pressure, drives a turbine and then condenses again.
The difference has to do with the active medium, which is not water, but an organic substance, allowing for a wide range of choices: cooling media, hydrocarbons (pentane, butane, toluene) or silicon oil. This range of choices makes it possible to adjust the critical point (the temperature above which a gas can no longer be compressed into a liquid) to the temperature of the waste heat.
In the Rankine cycle, the liquid is pumped from a reservoir and pressurised. A recuperator pre-warms the fluid with hot gas escaping from the turbine. Evaporation follows, using the waste heat from the primary process (e.g. the exhaust of a gas engine). The hot vapour drives the turbine under a pressure of several dozen bars. Cooling then takes place in the recuperator (warming the pumped-in fluid), along with condensation against a coolant in the capacitor, after which the active medium flows back into the reservoir.
Behind the substance which, for the sake of convenience, is referred to here as the 'active medium', lies an entire branch of science and industry focusing on developing liquids with adjustable operating temperatures, high vapour density, good lubricating properties, low viscosity (thinness) and little or no toxicity, in addition to being affordable and not harmful to the ozone layer or encumbered by a major greenhouse effect.

Photo: Sam Rentmeester

Despite the near-optimisation of the internal combustion engine, at least 60% of energy is still converted into heat

alternative and, in solar-thermal systems, parabolas and solar towers surrounded by mirrors can reach temperatures high enough for a steam cycle. The ORC technology is potentially interesting only for solar troughs (with upper temperatures between of 300°C and 400°C), particularly smaller systems with a capacity of a few to several dozen kilowatts.

Recovery

The Dutch company Triogen in Goor, Twente, is committed to recovering energy from waste heat. Most of the twenty devices that have been delivered thus far have been mounted behind gas engines fuelled by biogas and gas from landfills. The ORC systems in these devices generate an additional electrical capacity amounting to approximately 10% of the capacity of the main system. Any system that generates sufficient heat with a temperature of at least 350°C would be suitable. This would also include industrial systems in the steel, concrete, chemical and petrochemical industries.

At the heart of the Triogen system is a small turbo-generator (25,000 rpm, 60-170 kilowatts electric), with a height of 1 m and a diameter of 50 cm. Feeding this generator, however, is a large yellow cabinet filled with pipes, pumps and drums, along with heat exchangers to extract heat from the main system. At a little distance, another grey cabinet contains power electronics for feeding the electricity that has been produced into the net.

Whether the use of waste heat will be interesting to a company depends on the price of electricity, according to van Buijtenen. He estimates that a fee of 11 cents per kilowatt hour is a minimum. The payback period for continuous operation would thus be approximately five years, and the system has a lifespan of 20 years.

TU Delft Professor Piero Colonna is working on developing smaller ORC devices for lorries. "We have to shift from megawatts to a few dozen kilowatts", states Colonna, summarising his mission, "in addition to making the devices small and light." He is therefore collaborating with big names in the trucking industry: the American Dana-Spicer and the German Bosch. Colonna's group focuses on the development of a micro-turbine. According to estimates, it should be possible to recover about 10% of the mechanical power from the 60% waste heat generated by the engine. This electricity can be used on-board for cooling, communication and other purposes. Such a system would not be truly interesting, however, unless the electricity could be used for actual transportation. Colonna believes in a hybrid lorry that will be able to travel within the city using only electricity.

All applications of the technology will be discussed at the conference – from industry to smart boilers, and from biomass furnaces through geothermal heat to solar troughs. Colonna hopes that standardisation in the ORC community will eventually make this technology cheaper and more accessible. Instead of a few hundred special systems, ORC should become a quite ordinary addition to any place where heat drains away unused. <<

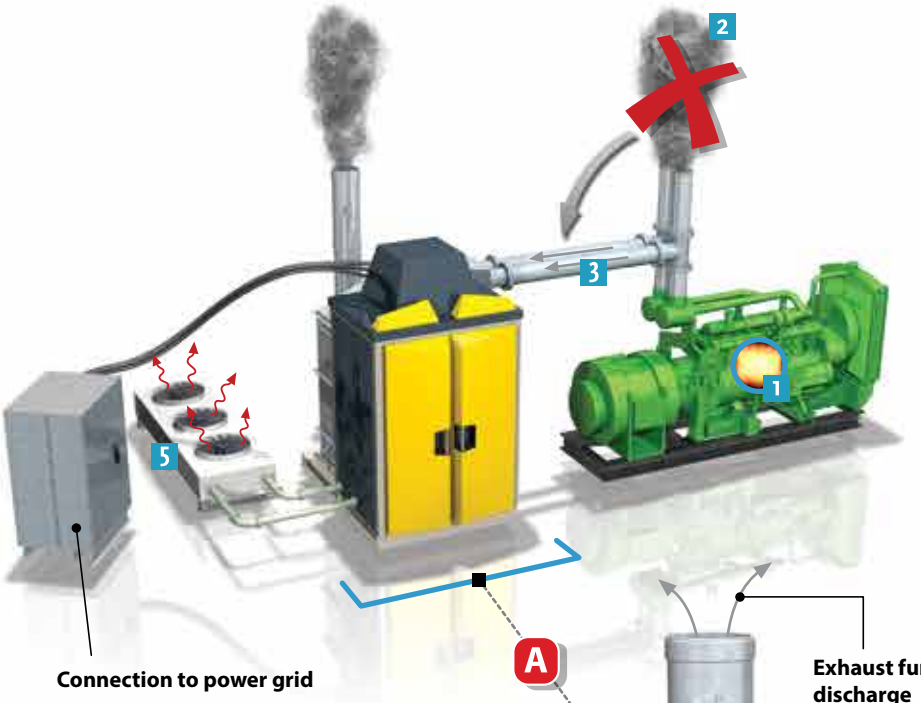
(*) Sylvain Quoilin e.a.: 'Techno-economic survey of Organic Rankine Cycle (ORC) Systems', Renewable and Sustainable Energy Reviews 22, 2013

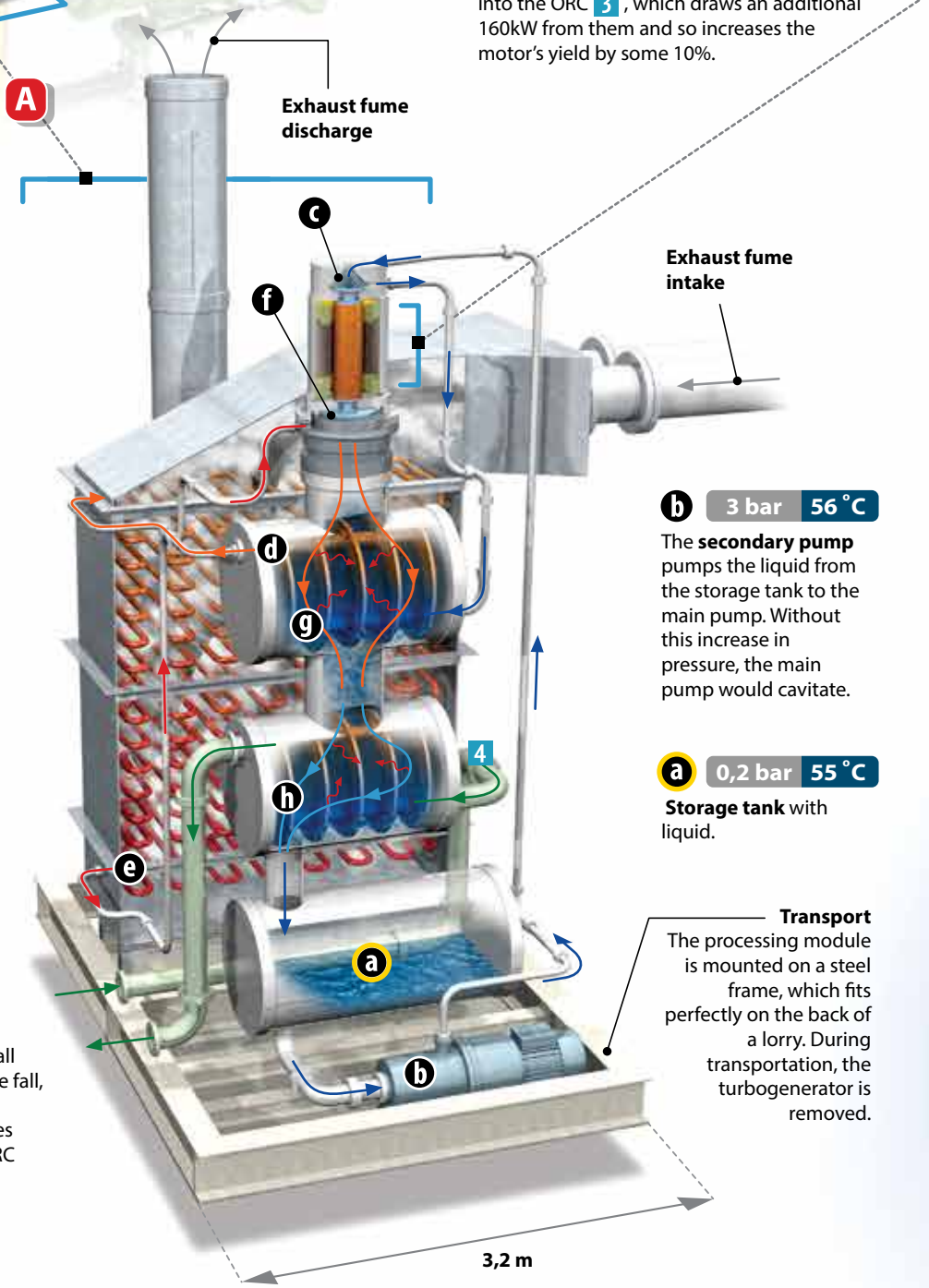
'Within the current ecomony, ORC is one of the few sectors that are growing'

Biogas motor
Fermenting maize and manure produces bio-gas. Energy entrepreneurs such as farmers burn this fuel 1 in a gas motor at 1200°C to drive a generator. At least 60% of the energy is converted into heat. But hot (400-500°C) exhaust fumes 2 often go straight up the chimney; their temperature is too low to power a steam turbine.

Triogen ORC A

The ORC from Triogen generates electricity from residual heat. Fitted downstream from a biogas motor (yield 1500kW), exhaust fumes at a temperature of at 350°C are fed into the ORC 3 , which draws an additional 160kW from them and so increases the motor's yield by some 10%.





c 32 bar 60 °C

The **main pump** compresses the liquid. This higher pressure is needed to force the medium through the turbine. Because it requires relatively low pressure, an ORC unit is safer and less structurally complex than a steam turbine.

d 32 bar 150 °C

The liquid in the **recuperator** is heated by the residual heat still present in the vapour after expansion in the turbine.

e 220 bar 500 °C water/steam

e 32 bar 320 °C **ORC**

In the **evaporator**, exhaust fumes heat the fluid until it vaporises. Further heating creates superheated vapour. In the case of steam this is necessary so that no condensation droplets settle on the turbine blades during expansion (see **f**); they would damage the blades, reducing the efficiency of the turbine. Because most organic fluids do not condense during expansion, it is not necessary to superheat the vapour during the ORC process. This means that the temperature of the exhaust gases can be considerable lower than that of the steam in the turbine.

f 0,4 bar 200 °C

The vapour expands and is forced through a small hole in the **turbine**. Its pressure and temperature fall, but its velocity increases substantially.
The vapour turns the turbine, which in turn drives the generator. Because of its low pressure, an ORC requires only a simple single-stage turbine.

g 0,3 bar 70 °C

The vapour sheds its heat in the recuperator.
In the condenser **h**, a coolant 4 (eg. water) extracts heat so that the vapour condenses to become a liquid. The water is cooled by air coolers 5 . The working medium flows into the storage tank.

b 3 bar 56 °C

The **secondary pump** pumps the liquid from the storage tank to the main pump. Without this increase in pressure, the main pump would cavitate.

a 0,2 bar 55 °C

Storage tank with liquid.

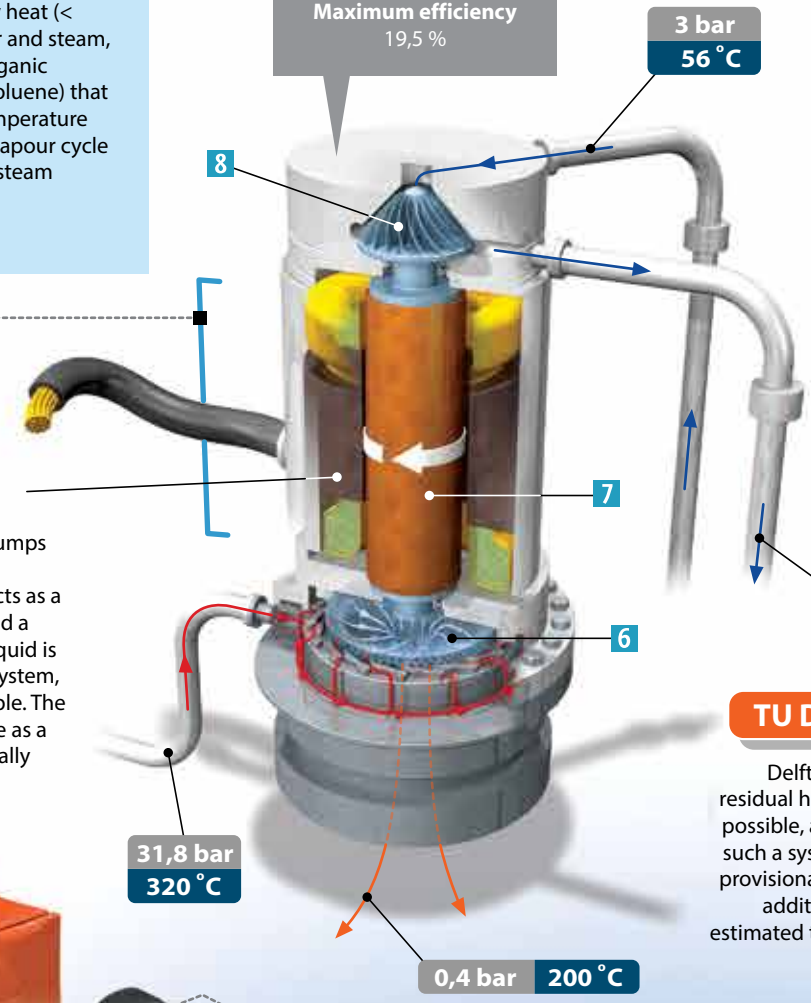
Transport
The processing module is mounted on a steel frame, which fits perfectly on the back of a lorry. During transportation, the turbogenerator is removed.

Organic Rankine Cycle

The purpose of an ORC is to drive a turbine at relatively low heat (< 500°C). Instead of water and steam, this is done using an organic working medium (eg. toluene) that vaporises at a lower temperature than water. The liquid-vapour cycle is the same as that in a steam turbine.

Effective power
60 - 165 kW

Maximum efficiency
19,5 %



Turbogenerator and pump in a single housing

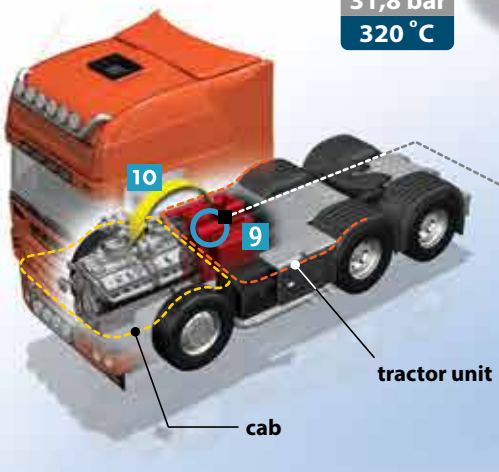
What makes the Triogen ORC so special is that the turbine 6, generator 7 and pump 8 are all connected to the same driveshaft. Consequently, the turbine drives both the generator and the pump. The starting point for this feature was the optimum rotation speed of the turbine (25,000 rpm). A unique generator was then developed with the same high speed of rotation, as well as a pump which delivers the correct mass and flow of liquid at that speed. Because no gearing is needed between the turbine and the generator, they and the pump can all be contained inside the same sealed housing. There are no openings for the driveshaft and no sealing rings, and hence no opportunity for the working medium to leak.

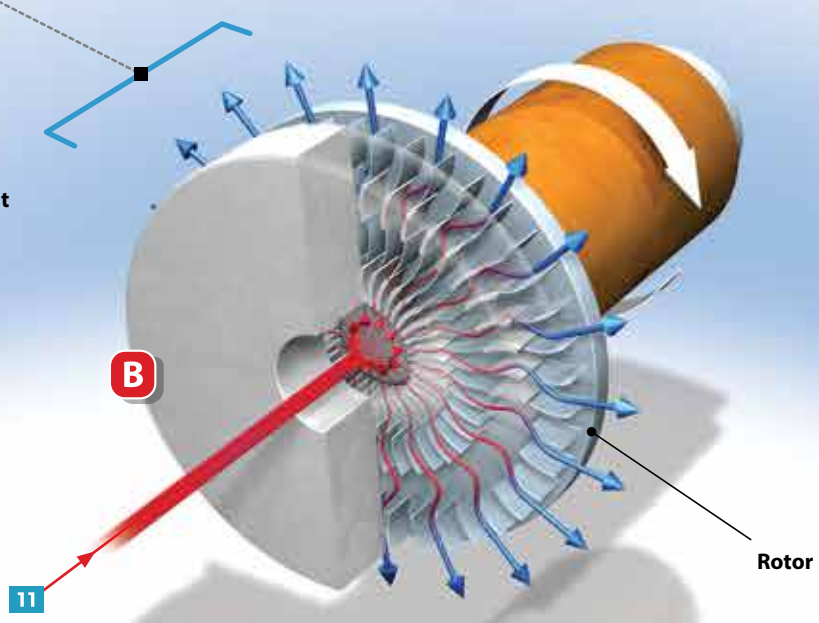
Triple function of working medium

The secondary pump also pumps the working medium to the turbogenera¬tor, where it acts as a lubricant for the bearings and a coolant. Because only one liquid is being pumped around the system, its structure is relatively simple. The working medium can double as a coolant because it is electrically inert.

TU Delft Mini-ORC B

Delft researchers are currently working on a residual heat system for lorries. This is technically possible, although no working ORC prototype of such a system has been produced until now. The provisional design indicates that it can deliver an additional 9.6 kW from a 150 kW engine. It is estimated that the exhaust gases can increase the efficiency of the engine by about 10%.





R&D CHALLENGE

1 Integration

The inclusion of a mini-ORC 9 will increase the volume of the engine by 12-50%. Since that amount of room is not available, adding a separate ORC module is not an option. Only by cleverly 10 integrating its components within the existing engine can it be incorporated into a lorry without increasing its volume.

R&D CHALLENGE

2 Turbine miniaturisation

The research is focusing upon the development of a turbine with axial shift 11 . The small rotor, (diameter 8-20 cm) rotates at very high speeds (10,000-40,000 rpm) because the working medium flows at the same rate as in a unit of normal size (the thermodynamic process is scale-independent).

R&D CHALLENGE

3 Ideal working medium

The aim is to develop a thermally stable, non-flammable working medium with a low boiling point and a critical point equal to the temperature of the exhaust fumes.

Prototype test

The mini-turbine should be ready about two years from now. The project partners, TU Delft and Dana-Spicer Delft, will then measure its perfor-mance on an ORC testbed.

Nuna7 smart and fast

Photos: Jorrit Lousberg/Nuon Solar Team

Nuna7 laadt haar batterij op, door naast haar zonnepaneel gebruik te maken van concentrators. Hierdoor gaat het laden extra snel.

After two silver medals, the students of the Nuon Solar team once again won the gold medal at the World Solar Challenge held this autumn. This was thanks in part to a "bloody clever" interpretation of the rules.

Tomas van Dijk

Up to the penultimate day, the students from Delft had been in a neck-and-neck race with their main competitor, the Tokai Challenger from Japan's Tokai University. In the past two races, this Japanese team won the biennial World Solar Challenge (which was held this year from 6 through 10 October), leaving the TU Delft to be content with silver.

During the penultimate day, the Nuna7 was in the lead, increasing its distance from the Japanese team. Both teams were struggling with very strong cross-winds, at times up to Beaufort force 6, and it required considerable effort for them to stay on the road. Leslie Nootenboom, one of the drivers, later wrote on the Delft team's blog: "Particularly after calm stretches – as when passing through forested areas – we had to be very careful." He was also distracted by "a large (5 cm) and very annoying grasshopper in the small cockpit."

This was the seventh time that the Nuon Solar Team from TU Delft competed in the race, which runs along the 3000-km motorway across Australia, from Darwin in the north to Adelaide in the south. This was the team's fifth gold medal. In all, 29 teams from all over the world were competing in the Challenger Class. In addition to this class, which is all about speed, eight teams competed in the Cruiser Class, which emphasises designing a practical and user-friendly solar car.

On the last day of the race, the Japanese team drove themselves "to pieces", according to Nooteboom. "The Japanese team wanted to keep up with us no matter what, and they emptied their batteries completely. Because the sun wasn't shining today, they weren't taking in any more power, and they had to stop by the side of the road to recharge. We started with a significant lead in the morning, and we never gave it up." The Nuna7 would ultimately roll over the finish line three hours before the Tokai Challenger.

The Nuna7's secret weapon was its concentrators: boxes of lenses that concentrate sunlight by a factor of 1100 onto the small but very efficient solar cells located beneath them. These were used to provide additional charging while the vehicle was stationary during the mandatory pit stops of 30 minutes every 300 kilometres. The boxes, which were tucked away under the bonnet, were then removed from the car and aimed at the sun.

Charging capacity

The students kept this additional charging capacity a secret until the last possible moment. When the car was presented to the press last summer, the focus was on the design of the vehicle. It had been necessary to revise the design completely, because the organisation of the World Solar Challenge required four wheels this year, while all of the previous Nunas had been three-wheelers.

"We had to go back to the drawing board", recounted Allard Lambers, one of the people responsible for the car's aerodynamics, in an interview with Delta. The race organisation had decided to require a four-wheeled version in order to nudge the designers in the direction of more regular vehicles.

The four-wheeled Nuna7 was the first to have the driver's seat on the side. The students chose to locate it on the right-hand side, because they were convinced that this would allow the solar cells to capture the most sunlight. "Our greatest competitors, the Americans and the Japanese, thought that the left would be better", continued Lambers. "When we saw that, we thought, 'How stupid!'"

But the biggest trick was yet to come: the concentrators.

Eindhoven wins

"TU Eindhoven, Winner of the World Solar Challenge" read the headline on the front page of the NRC Handelsblad newspaper on Tuesday 15 October. The TU Eindhoven had placed an advertisement in order to take credit as well – and rightly so. Students from the Solar Team Eindhoven won the Cruiser class with their solar-powered family car. Their car, Stella, carried three or more occupants for most of its racing kilometres. A jury also evaluated the Cruiser-class cars on such aspects as comfort, convenience, boot space and parallel parking.

According to the rules, teams must choose. They may build either six square metres of silicon solar cells into their car, or half of this amount of the much more expensive and much more efficient gallium arsenide cells. At least, this is how most of the participants interpreted the rules.

Concentrators

The TU Delft students built 5.9 square metres of silicon solar cells into the exterior of the car. They then filled up the remainder of the permitted quota with a set of 3600 gallium arsenide cells, which they equipped with the solar concentrators.

During first inspection, the Nuna attracted quite a few stares from the competing teams, particularly when the bonnet was raised to expose the carbon boxes with the solar concentrators. Nooteboom: "The students from Tokai University and the University of Michigan were looking at the boxes with their mouths wide open." "A lot of people had no idea what they were. In the audience, one team member from the University of Michigan's Solar Team did say to one of his team mates: 'Oh shit... I know what that is.'"

The Delft team's strategy was not without risk, however. They were fortunate that the weather during the race was mostly sunny. "The concentrators work only in direct sunlight. If there are a lot of clouds during the race, so it's also cloudy during the pit stops, you might be dragging along 14.4 kilograms of dead weight."

According to a journalist from the popular scientific journal New Scientist, the director of the Solar Challenge, Chris Selwood, had a good laugh when he saw the TU Delft team's trick. Selwood commented: "The limits are always being stretched." He did add, however, that the organisation will have to consider very carefully whether this type of adaptation should be allowed in the future. "This was bloody clever, though." <<

'Concentrators were its secret weapon'

Nuna7

The four-wheeled Nuna7 was the first to have the driver's seat on the side. Another difference from the previous Nunas is that the underside of latest model is hollow. There is also no bump on the underside where the driver's seat had been in the previous Nunas. This reduces the disturbance of the airflow, and therefore resistance. At 100 kph the wind resistance is equal to that of one hand held outside of the window of a vehicle. This is partly thanks to the streamlined design, but also due to a special dust-repellent coating. The car weighs 150 kilograms. With a peak power of 1500 Wp, it can run at a speed between 90 and 100 kph. The Nuna7 also has about 5 kWh storage in its 21 kilograms of Li-ion batteries (the maximum allowed capacity), for additional power when overtaking or during cloudy stretches.

Propositions

In a democracy every vote counts equally. This does not mean that every opinion is equally important.
Rolf Hut, water engineer

Learning Dutch in the Netherlands is impossible.
Cuong V. Dinh, computer engineer

Not all mistakes and failures can become e a lesson learned.
Peerawan Wiwattananon, aerospace engineer

Time is like water in a sponge; as long as you are willing to sqeeze you will always have it.
Xiaohua Lian, electrotechnical engineer

Making journals open-access reduces plagiarism in developing countries.
Duong Anh Hoang, fluid mechanics

Developing countries may violate intellectual property rights.
Chaitanya Krishna Ande, materials engineer

As long as the outcome of a so-called intelligent system is predictable or cotrollable, its intelligence is questionable.
Muhammed Bolotkale, electrotechnical engineer

Proposition

The modern field of biomaterials science has its origin in the reuse of technological developments from the First World War.
Bogdan Stefan Necula, biomaterials engineer

Defence

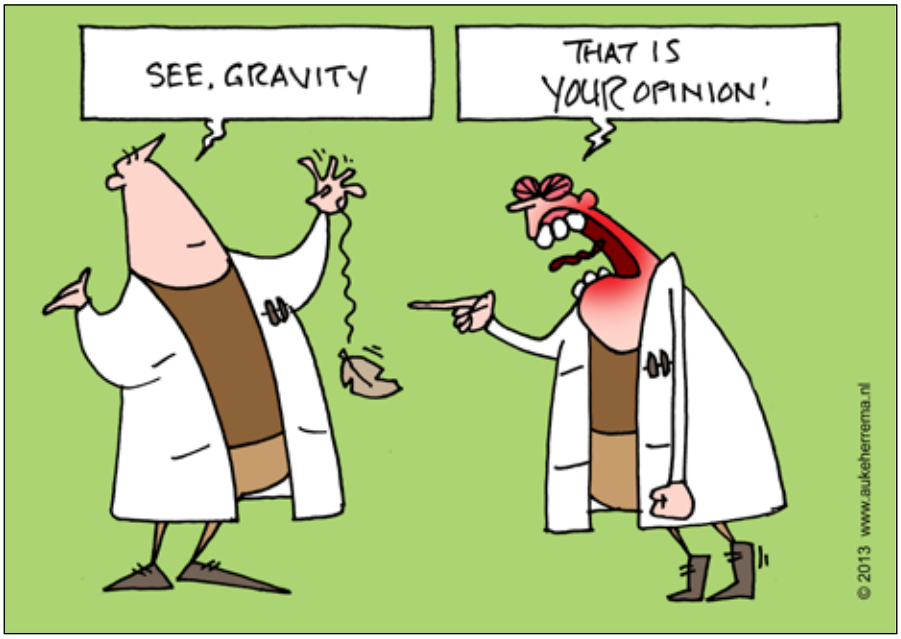
"Immediately after the end of the First World War, doctors had a huge arsenal of new materials at their disposal. Suddenly, they had access to Teflon, polyurethane, titanium and stainless steel. These materials were developed for the purposes of war: for the manufacture of aircraft, vehicles and radios. After the war, some also proved suitable for making prostheses, and there was no shortage of patients who needed new limbs."

Soundbites

"Ikea has ultimately undermined the value of furniture. In the past, we selected furnishings carefully, cherished them and preserved them. Now we see them as things we can quickly dump. In this respect, IKEA resembles H&M, which drastically changed the way we look at clothes."
Professor of Design Timo de Rijk in the AD/Algemeen Dagblad

"States are very reluctant to intervene in countries where massacres occur, because they hope to prevent casualties on their own side. Possession of unmanned weapons could make them more inclined towards humanitarian intervention. It makes sense to start a discussion about conditions for the development and deployment of automated weapons systems now."
Weapons system researchers Thomas Baar and Dr Alexander Leveringhaus, in de Volkskrant.

"Oh, I am sure I'd be able to find a use for a fund of 1.5 billion But if you see how much effort it takes the political system to reduce the budget by 6 billion, it is not likely to welcome a wish list from the universities. What we currently need most is financial peace – a certain consistency in policy. That would allow us to retain our position as a world leader for the next ten years."
TU Delft President Dirk Jan van den Berg, in de Volkskrant



Emotions are big barriers that block one to see the world in the way it is.

Peerawan Wiwattananon, mechanical engineer

Down with garbage

In twenty years, there will be almost no more garbage in Europe. Professor of Resources and Recycling Peter Rem thinks that in the future we will reuse almost everything.

Even though it may not look like it, a garbage dump is a treasure trove. Rem and his colleagues are developing methods and techniques for recovering raw materials from garbage. One example of this is indium, a scarce element that is used in the screens of smartphones and tablets. Another example is the re-use of concrete and plastic.
The current problem, however, is that design, production and recycling take place within a fragmented chain. "The government sets the rules, collection is done by another party and yet others clean and reuse the materials", explains Rem. "This is complex and cumbersome. Certainly there is room for improvement here."
Creating a garbage-free society will not be easy. "It will require several inconceivable things to happen. Designers are currently being trained to focus on functionality. That is their expertise. They should start paying much more attention to reuse and the impact of materials", asserts the Professor of Resources and Recycling. "Fortunately, intelligent tools are being developed for this purpose."

'It would be fantastic if manufacturers would use transparant plastic'

Suppose that a designer has devised a vacuum cleaner. The tool would help the designer see how materials can be reused, clearly showing the the impact of materials usage and design. "Plastic packaging can be any colour; the sky is the limit", continues Rem. "For example, there are many coloured shampoo bottles. The problem with coloured plastic, however, is that it's almost impossible to re-use. That's a shame. It would be fantastic if manufacturers would use transparent plastic, which is much easier to recycle."
The benefits of having virtually no more garbage in Europe would extend beyond the environment. "Interestingly, this also has a major impact on the economy", emphasizes the Professor of Resources and Recycling. "According to Janez Potočnik, the European Commissioner for Environment, Europe could be earning €250 billion per year through recycling."
Rem also expects a sharp increase in the use of bio-based materials, which are biodegradable. "Consider bio-plastics, for example. They have enormous economic potential, and they obviously mean that less garbage is produced. They can be used to make just about anything. Even an aeroplane can be made of bio-polymers."
Such changes will not take place automatically. According to Rem, it will require vision. "But I'm hopeful that we will have almost no more garbage in Europe twenty years from now." (RV)

Photo: Sam Rentmeester

Fred Kavli

The Norwegian-born physicist and philanthropist Fred Kavli has died of cancer at the age of 86.

Kavli is best known in Delft for the institute of nanoscience which bears his name, incorporating the departments of Bionanoscience and Quantum Nanoscience in the Faculty of Applied Sciences. Born at Eresfjord in Norway in 1927, Kavli studied physics in Trondheim before moving to the United States in 1955. There, in California, he worked on sensors for the Atlas rocket, the first successful intercontinental ballistic missile. Two years later he established his own company, the Kavlico Corporation, which became a leading supplier of sensors to the aerospace, automotive and industrial sectors.
In 2000 he sold the company and set up the Kavli Foundation to support scientific research in the fields of astrophysics, nanotechnology, neuroscience and theoretical physics. It does this by funding research institutes, professorial chairs, symposia and initiatives such as the Kavli Prize, the Norwegian equivalent of the Nobel Prize. The seventeen Kavli Institutes are spread throughout the world, in the US (eleven), China (two), Norway, Japan, the UK and the Netherlands. As Kavli told Physics World in 2007, "I realised that I wanted to use the fruits of a lifetime of hard work in an efficient way for the long-term benefit of humanity by supporting basic science,"
Professor Cees Dekker, director of the Delft institute, met Fred Kavli in 2003. His foundation had appointed a team of scientific heavyweights, amongst them former senior officers of leading universities, to identify the best groups working in nanoscience, astroscience and neuroscience. That was how Delft came into its sights. According to Dekker, Kavli came across as modest and calm. But at the same time he was also determined and professional. As with all the institutes bearing his name, he wanted to know exactly what the university's Executive Board would be contributing in return for an investment from the Kavli Foundation.
The institute is funded through an endowment, as a result of which a capital sum is built up over a period of several years. The institute is free to spend the revenues generated by the interest and dividends over that capital sum. An endowment of €10 million provides an annual income of approximately €500,000. A tidy sum, but not enough on its own to keep a department afloat.
Encouraged by Kavli, the Executive Board also made additional investments in the research group. The contributions from the foundation and the university are usually roughly the same.

'It is not yet clear how Kavli's death will affect the institutes.'

Ultimately, though, says Dekker, it is not so much the money which makes the difference as the acknowledgement that the group is one of the global top five in its field.
It is not yet clear how Kavli's death will affect the institutes. However, the endowment structure has been future-proofed so that there is no danger of their income being dented.
According to Dekker, Fred Kavli will be remembered as a visionary philanthropist who believed so deeply in basic science that he turned over his own fortune to back it. And in so doing put his personal motto into practice: "Fundamental science for the benefit of mankind". (JW)

In Person

While science requires explicit, provable methods, architecture operates largely on the basis of implicit knowledge. Does that mean architecture is unscientific? **Lara Schrijver**, Associate Professor of Architecture Theory has been awarded a grant from the NWO to get to the bottom of this question. In her research, she is drawing together an international research network of architects, philosophers, historians and cultural scientists.

Professor in the Economics of Innovation, **Alfred Kleinknecht** is going to take early retirement. Kleinknecht was a vociferous opponent of wage restraint, which he believed hampers innovation and slows the economy. Kleinknecht played an important and visionary part in discussions on economy, not only in a scientific way but also within the media, concerning innovation, wage restraint and labormarket issues.

At the conference of Dewis (Delft Women in Science), **Ilse Oosterlaken** (TPM) was presented with the 2013 Dewis Award for her thesis: Taking a capability approach to technology and its design. In it, Oosterlaken opts for a new perspective on technology, the capability approach. Originating in economics, this approach is not based on income and possessions, but rather a person's functional capabilities.

More precise radiotherapy using protons: the radiation technique **Patricia Cambraia Lopes** is working on promises to achieve just that. The PhD student in the radiation and isotopes for health department (Applied Sciences) won the first prize in the student paper award competition at the 2013 IEEE Nuclear Science Symposium and Medical Imaging Conference in Seoul. Lopes developed methods for measuring exactly where the protons deliver their dose during a patient's radiotherapy.

Prof. **Freek Beekman** is going to receive the FOM Valorisation Prize 2013 of 250,000 euros. Beekman develops physical models to improve medical scans such as Spect and PET. Thanks to his research, it is possible to capture several biological processes simultaneously: for example to identify how much medication has been administered and how a tumour responds to it.

"The modern engineer is like a nail: capable of penetrating uncharted territory with depth and sharpness." These were the words of Professor **Bert Geerken**, Dean of the CEG faculty since December 2011, in his inaugural address. He extolled the extraordinary role played on earth by water and claimed that social engineering deserves to be given more recognition in society.

"Innovation and new technology are necessary if we want to be able to run more trains in the future too." These were the words of Prof. **Rolf Dollevoet** in his inaugural address as Professor of Railway Engineering. ProRail is investing 5.5 million euros in rail-related research and education at TU Delft. The University will invest 3.1 million euros in the years ahead.

During the Alumni Event, architect **Renske van Dieren** accepted the Delft University Fund's Marina van Damme Grant of €9000. Renske will use the prize money to follow a programme in applied gerontology. Because this was the tenth anniversary of the Delft University Fund's Marina van Damme Grant, the spotlight was also turned on Marina van Damme herself, who received a special medal.

Scott Cunningham and **Claudia Werker** (TPM) have received an FP7 award for their participation in the European Byte project, on the impact of big data on European society. The project aims to develop measures to enable Europe to compete in these new technologies on an economic level. The programme is part of the European ICT programme that aims to ensure that information technology effectively serves both society and business. Partners in the project include the Free University of Brussels and Siemens. **Martijn Wisse** (3mE) also received funding from FP7 - in his case, for the "Factory of the Future" programme, involving an international consortium of sixteen partners (universities and businesses) led by TU Delft. Of the eleven million euros in funding for the next four years, eight million will come from Brussels. "Factory in a Day" aims to help combat fear of computers in SMEs by introducing robots that can be deployed on simple and repetitive tasks within 24 hours.

Name: Dr Mathijs van Ledden (38)
Domicile: Sommelsdijk
Marital status: Married, two children
Degree programme: Civil Engineering
Student association: C.S.R. Delft

Protecting people with dams – that is the cause for which Mathijs van Ledden of Royal HaskoningDHV is fighting. Having worked in New Orleans and Thailand, he has recently joined the United Nations emergency response team.
For four years, he consulted, advised and created designs for new dams in New Orleans. In 2010, after all of his hard work, he was finally standing atop a new dike. "That is the most wonderful moment imaginable for a hydraulic engineer", relates van Ledden, who has worked in various capacities for Royal HaskoningDHV (RHDHV) since completing his PhD in 2003.
It reminds him of the clippings about the Oosterscheldekering which he collected as a small boy. "I came across them last weekend. As a child, I longed to work on major hydraulic engineering projects, protecting people against natural disasters."
Van Ledden had no career plans after completing his undergraduate and doctoral degrees. He did know that he wanted to focus on three pillars: working with water and technology, conducting education and research, and protecting people in an international environment. Anyone observing his career can see that these activities have formed a recurring theme for him.

'That kind of work made a real impact'

For example, since 2011 he has been teaching at TU Delft one day a week, in addition to supervising graduation projects. Another example would be the work he did in Thailand after a major flood in 2011. Within a day, van Ledden was flown in and made part of a team that charted the flood. "One of the things we did was create an emergency dike. We made a real impact with that kind of work."
In all, he seems to have been made for his new position. In addition to his job as Business Development Director for Flood Risk Reduction at RHDHV, he has recently become a member of the United Nations emergency response team. He has just completed his last training, and is ready to be deployed to a disaster area. "I will be part of a team that also includes crisis managers, technical specialists and doctors. It's an opportunity to actually do something – much better than sitting behind a desk." (RV)


Photo: Sam Rentmeester

Biogas


Photo: Sam Rentmeester

Earning money while helping people in developing countries. The SimGas company, which was founded by the brothers Sanne and Mirik Castro, would like to prove that that is possible. SimGas manufactures, sells and installs biogas systems.

Sanne and Mirik Castro could never be accused of a lack of ambition. With SimGas, the company they founded in 2009, they would like to sell biogas plants in all tropical and subtropical countries. The brothers, both of whom studied Systems Engineering, Policy Analysis and Management, are working hard towards this goal. Mirik lives in Tanzania with his family. From there, he travels throughout the region. Sanne, the CEO, is usually in The Hague, although he flies to Tanzania, Kenya or another country at least once a month. For example, he recently went to India to do business with a large milk company.
SimGas started selling and installing biogas plants in Tanzania in 2012 and in Kenya in 2013. They already existed, but in a brick form, which made their installation expensive. SimGas designed a prefabricated biodigester made of plastic. The size of the round tank, which local SimGas employees assemble and embed on site, is variable.
SimGas delivers a cooking unit with each biodigester. A house filled with smoke from a wood fire is thus a thing of the past. "In Africa, air pollution in the home is the cause of the largest number of deaths. We can solve that problem", explains Sanne Castro.
There are other advantages as well. "A household must make a one-time investment, but once it starts cooking with biogas, it can save a great deal of money on wood or charcoal. We are working with micro-financing organisations that can provide loans to people. In this way, they can make a good investment instead of constantly spending small amounts of money, such that they never have any money left over and are trapped in poverty."
Cooking with biogas also helps prevent deforestation, in addition to reducing CO_2 emissions. "Each biogas system reduces CO_2 emissions by five to ten tonnes per year. Moreover, the sludge that remains after fermentation amounts to two pounds of fertilizer per day."
Castro calculates the average cost of a SimGas system at €500. To date, 1,500 have been sold. The company is establishing a new production line in Tanzania, together with a local plastics factory, Sil Africa. There are seven employees in the Netherlands, with another sixty in Africa. This number will grow as SimGas expands into the markets in Uganda and Rwanda next year. All together, investors, grant agencies and lenders have invested €5 million.
SimGas has yet to turn a profit. In the longer term, that is the goal. "We would like to demonstrate that you can earn money in developing countries while solving real problems. I do not believe in helpless people. You can also enter into a relationship of mutual dependence with poor people. We all earn money, and they get a better life. It's not wrong to make a profit that way." (SB)

Alumni Event Flashback

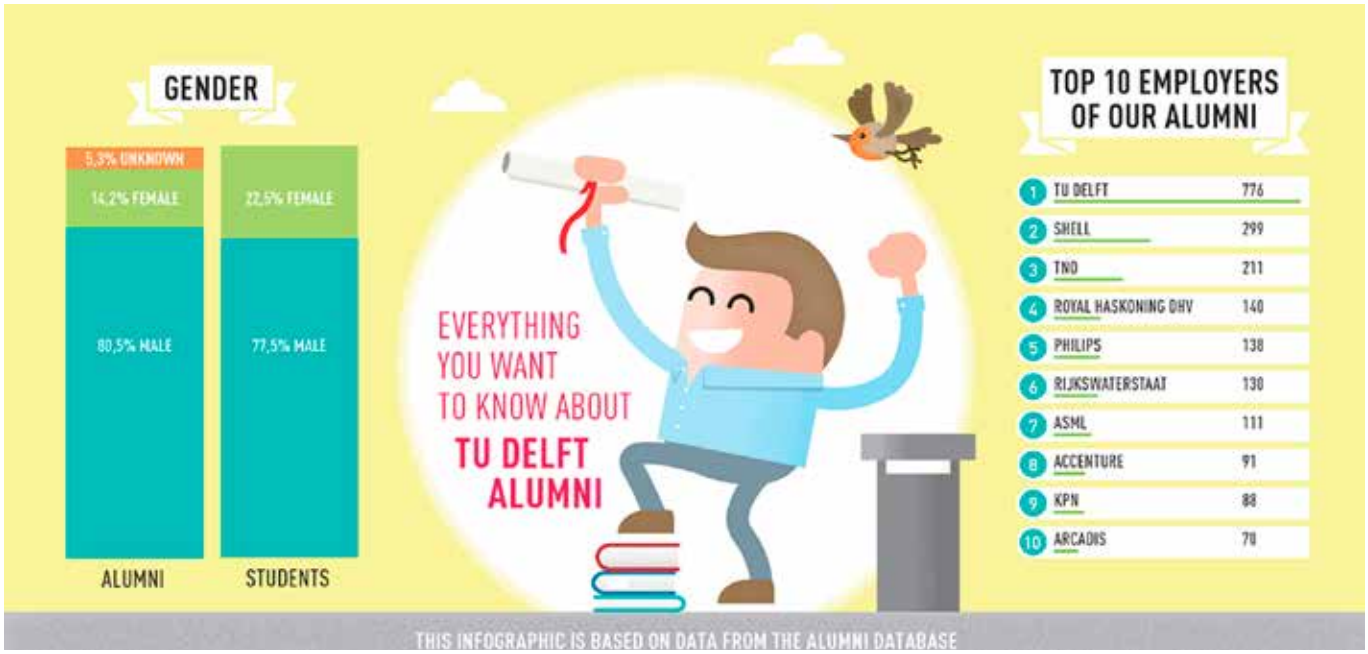
Interviews, lectures, prizes and films alternated with each other during the Alumni Event on 11 October. Nanobiologist Prof. Cees Dekker used video recordings to demonstrate the developments in his field; Dr

Nynke Tromp talked about the social effects of design and technology, and Dr Doris van Halem got the audience up to speed on hand-pump arsenic removal for the recovery of drinking water. The programme was presented by Pieter Jan Hagens.

There was also an extensive report about Nuna7, which took first prize this year at the race across Australia. YesDelft presented the LaunchLab.
In the evening, the 750 attendees could choose from 20 presentations and workshops by the various faculties. In addition, there were plenty of opportunities for catching up with classmates.
You can view photos of the evening at **flickr.com/photos/tudelft** or watch the livestream of the central programme on **collegeramacolleges.tudelft.nl**

Alumnus of the year

Daan Bruggink of ORGA architect is the new Alumnus of the Year. The Delft University Fund awards this prize to an alumnus who is "an inspiration to others or who has made a special contribution to technology, innovation, science or entrepreneurship." Bruggink is proud that his efforts in the field of environmental and bio-based architecture have met with such appreciation. He will invest the monetary award that accompanies the prize in an innovative ecological building concept.



Where do TU Delft alumni come from, and where do they go? Starting with this issue, Delft Outlook will be providing short overviews of data from the alumni database. Have you signed up through our alumni portal already? **alumniportal.tudelft.nl**

Higher Education Monitor

This month, recent graduates received the Higher Education Monitor (WO-monitor). The Higher Education Monitor charts the entrance of graduates from Dutch universities into the labour market and provides a retrospective overview of the quality of your degree programme and its relevance to the labour market. The results are important for improving the quality of education and informing prospective students. The results will be published in the spring of 2014.

Colophon

Alumni portal
www.alumniportal.tudelft.nl
Changes of address
Subscribe or unsubscribe
- e-mail newsletter
- alumni events

Join our LinkedIn group
Register with the Delft University of Technology Alumni group

Friends of TU Delft
Become a 'Friend of TU Delft' and support Talent, Technology and TU Delft with your contribution.
Account number: 22 68 50 471
Stichting UfD, mentioning "Friends"
universiteitsfonds.tudelft.nl

Questions or suggestions?
Alumnibureau@tudelft.nl
Telephone (015) 2789111

‘Businesses should also be funding universities’

It is the responsibility of businesses to provide universities with financial support, according to Bertrand van Ee, Chairman of Royal HaskoningDHV. He calls on the business community to invest in university education and research.

The traditional scenario in which universities receive most of their funding from government is beginning to erode. But the academic world should not see this as reason for despair. “Now is the time for businesses to step into the breach. It is our collective responsibility to ensure that universities survive”, says Bertrand van Ee, CEO at Royal HaskoningDHV.

If the Netherlands wishes to compete at the highest levels, much more money needs to be invested in education and science, he argues. It is also in our own interest, because of the major challenges we face relating to climate change and diminishing fossil fuels. “Innovation is absolutely crucial. Major companies like ours must be ready to support it. If we leave it to government alone, it will fail.”

Van Ee cites the research conducted by Professor of Applied Sciences Mark van Loosdrecht as a prime example of effective cooperation between the business community and universities. The Delft environmental scientist has developed water purification technologies that enable micro-organisms to convert waste into harmless substances. “Businesses are now ensuring that the technology becomes an important export product for the Netherlands. That is already working out very succesfully in Brazil and South Africa. All of this benefits the Dutch economy as a whole.”

Or take the axe bow, developed by Lex Keunig from Maritime Engineering, as an example. Thanks to that, ships have far fewer problems with wave movements and can travel more efficiently. “This invention has been marketed by Damen Shipyards as a strong export product.”

Van Ee is jubilant about the fact that universities are increasingly applying for patents. Engineering firms frequently work together with professors or study programmes in this regard. The Faculty of Civil Engineering and Geosciences, where engineering firms and construction companies are investing in education, is a good example. “Of course, it is also in the interest of the businesses themselves. Where else do they find talented engineers? This is why some of our employees are also employed at TU Delft as lecturers, researchers or PhD candidates.”

But isn’t there a danger in universities and businesses becoming too close? For example, the University could become so dependent on funding from business that it makes a clear choice for research that is commercially attractive. Van Ee does not see that happening anytime soon. “There will always need to be sufficient funding for fundamental research and universities will need to maintain that role. In any case, scientists are stubborn enough to make sure it does. Partnerships between the business community and universities need not undermine fundamental research.”

It is not only important for businesses to invest in universities, according to Van Ee. He also calls on alumni to make a contribution to their alma mater, as they do in the United States. “In this way, alumni ensure that there are always good facilities or they help fund study trips.”

Van Ee sets a good example in this regard. As a board member of the Delft University Fund, he is still involved with TU Delft. This year, he presented the prize for the best teachers and graduates, sponsored by Royal HaskoningDHV.

Van Ee is not only active in Delft. He is also President of the Academy for Technology and Innovation, a member of the Dutch Trade Board and chairman of the core team for export and promotion in the Top Sector for Water. On 1 January, he will be stepping down as chairman of Royal HaskoningDHV. “Everything we wanted to achieve through the merger of DHV with Royal Haskoning has been successful. We have secured some major projects and results are on the right course. A new generation is standing by in the wings, so it is time to hand over the baton.” (RV)

‘Partnerships between the business community and universities need not undermine fundamental research’

CV

Bertrand van Ee (1957) studied mechanical engineering at TU Delft. Between 1983 and 2004, he held various positions at engineering firm Fluor. He then became a board member at DHV, before taking on the role of CEO from 2007. In 2012, DHV merged with Royal Haskoning and Van Ee became the company’s chairman.

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)
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Centre for Transportation Engineering
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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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Open Building Working group (obom)
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Interduct Delft University Clean Technology Institute
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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
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Telephone +31 15 278 5678

Delft University Press
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Fax +31 20 620 34 19
E-mail order@iospress.nl

Information

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Information on facilities for foreign students:
Student Advisory Office
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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
Telephone +31 70 412 3456

(Post Graduate) Courses

Delft TopTech
(vocational courses)
Mekelweg 2
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Fax +31 15 278 1009
www.delft-toptech.nl

Institute for Biotechnology Studies Delft Leiden (bsdl)
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For information on courses in the Dutch language:
Language Laboratory
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