



2021

at a glance



Advanced
Research Center
**Chemical Building
Blocks Consortium**

2021

at a glance

Introduction	3
Greenifying Chemistry	4
Timeline	5
NWO evaluation	6
Our Partners	7
Lustrum event 2021	8
Bert Weckhuysen	9
In the Spotlights	
<i>Akansha Goyal</i>	10
<i>Morteza Hadian</i>	11
In the media – Wetenschap.nu & C2W	12
Our People	
<i>Young Talent</i>	13
<i>Tenure Tracks</i>	14
Organization & Governance	15
In the media – Change Inc.	16
Our publications	
<i>List of Publications 2021</i>	17
<i>Cover page Eva Blokker</i>	18
Hans Kuipers	19
In the Spotlights	
<i>Jiaying Li</i>	20
<i>Lotte Metz</i>	21
Our projects	
<i>Bilateral</i>	22
<i>Multilateral</i>	23
Ben Feringa	24
In the Spotlights	
<i>George Hermens</i>	25
<i>Bas Terlingen</i>	26
ARC CBBC in numbers	27



Advanced
Research Center
Chemical Building
Blocks Consortium

Introduction

2021 at a glance

'Connection' is one of the underlying core values of the Advanced Research Center - Chemical Building Blocks Consortium (ARC CBBC). More than once in the past two years, it became clear to me how much this connection needs a physical component to actually manifest itself in concrete terms. From one day to the next, we were forced to switch to a virtual system, which led to a proliferation of digital meetings. Our globalised world, in which we were accustomed to move about freely and where we could be in contact with everyone at every moment of the day or night, suddenly began to appear incredibly small on many fronts.



It is true that we were still able to reach one another easily – which would hardly have been conceivable several decades ago – but now that communication was taking place exclusively via our screens, it also became clear how technology can also impede connection. Despite the undeniable advantages offered by digital tools, they are a means to an end; not a surrogate. Research is, after all, the work of human hands and brains. It is therefore imperative that we explore all the possibilities offered by and within a partnership. Cooperation is also about the chemistry between people amongst themselves, and whether they can get on well with one another cannot always be assessed from behind a screen. Flipping ideas back and forth when communicating with someone via a screen is no easy task, after all.

The return to the work floor resulted in a reverse movement: we suddenly had to start getting used to meeting one

another face to face again. It took some effort to strike the same balance we had achieved in the old situation, and I am certain that every consortium will agree with me on that point. In the next few years, we at ARC CBBC will continue to facilitate human encounters. This is because I am convinced that science is the product of interaction between engaged, brilliant and creative people. Interaction such as this, however, requires a physical environment. In addition, our research requires courage, an eagerness to learn, to try out new things, and the ambition to explore new horizons. The inherent set-up of ARC CBBC facilitates these interactions and stimulates curiosity.

ARC CBBC was already off to a good start, but has started going full steam ahead only recently, in my opinion. Our destination may still be unknown to a certain extent, but that is one of the wonderful things about science. We are, after all, undertaking a journey in which we will encounter

many interesting people and places, and of which the final destination is uncertain. On the way, new PhDs will board our proverbial train and established researchers will disembark to follow their own track, carrying with them the knowledge and expertise they gleaned at ARC CBBC, and which will take them to their next station faster and more easily.

In brief: the momentum we have been seeking has been achieved. This is not only because our projects are significant within our own fields of interest. As the scientific director of ARC CBBC, I also take into account the greater good, for both science and society. The programmes that we develop at our research centre contribute to something that goes far beyond the incremental. Our goal, after all, is to enhance the sustainability and circularity of our society, one step at a time. This is something of which we can be justly proud.

Bert Weckhuysen



Greenifying chemistry



Currently, the chemical production industry is walking a tightrope: providing for today's need for innovation, acceleration and comfort without compromising the demands of tomorrow is a daunting task indeed. This is where consumer concerns, political ultimatums, industrial demands, and scientific curiosity all need to converge. Through a concerted effort, we can reconsider the materials and production routes currently in use, and reinvent the way in which chemistry is applied on an industrial scale.

Industrial production can become more sustainable – and we have the best people on board to learn how to do this. At ARC CBBC, we are engaged in rethinking the design of the chemical building blocks that make up the products we use in our everyday lives and the convenience this brings us. We are also investigating the manufacturing routes and use of chemical products and processes, and looking at these with a critical eye. Aside from this, we are uniting universities, researchers, the corporate community and ministries, with whom we are collaborating closely. All of this is done with a single goal in mind: to provide the world with the molecules of the future.

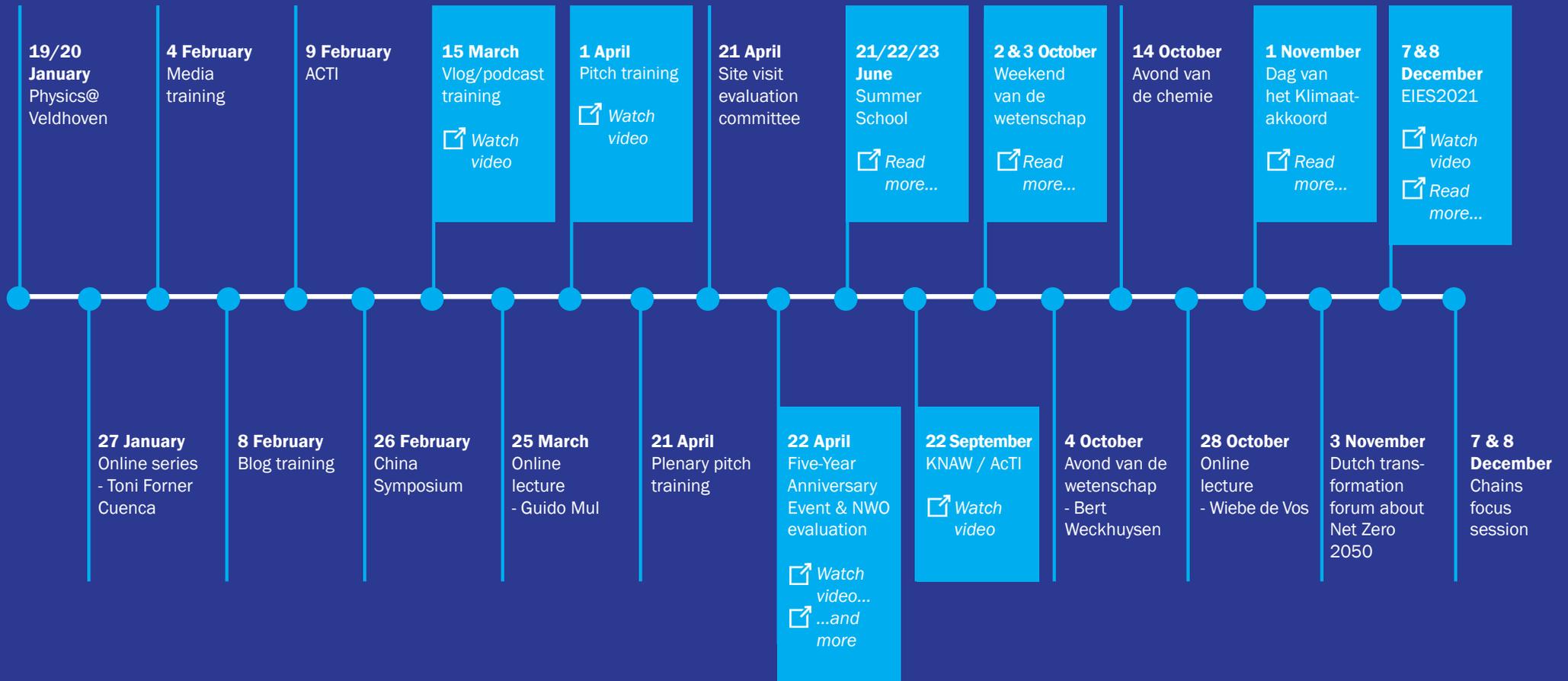
Our public-private organization, founded in 2016, uses cutting-edge technology to conduct far-reaching research.

In ARC CBBC, the universities of Eindhoven, Groningen and Utrecht collaborate intensively with AkzoNobel, BASF, Nouryon and Shell in multidisciplinary chemical, physical, materials and process technology research. The consortium is supported by the Dutch government and ChemistryNL. Some 40 high-profile scientists, together with industrial researchers, are engaged here in the development and fostering of new academic talent. ARC CBBC is an open consortium, founded on the principles of academic need-to-know and industrial need-to-have, in which neither is inhibited by the other. We have academic knowledge, boundless curiosity and horsepower at our disposal, while our industry partners warrant the need for practical application and provide the materials and equipment we need. Together, we can accelerate circular solutions within the chemical industry – for the chemical building blocks of tomorrow.

Even though 2021 was characterized by the COVID-19 pandemic, ARC CBBC continued to work on achieving its goal. Whether online or live, we have been continuing our work in ways that suit to situation. Therefore, it is no less than fitting to look back at what we have achieved in 2021 by presenting you with:

2021 at a glance!

Timeline 2021





NWO evaluation

In April, five years after the establishment of the consortium, ARC CBBC underwent an assessment by an independent committee commissioned by NWO and chaired by Prof. Rob Hamer. The primary aim of this evaluation was to assess the quality of the research, its relevance to society and industry, and the viability of the consortium, as well as to provide recommendations with a view to improving these aspects.

'The committee strongly commends the ARC CBBC consortium with its performance over the past five years. Appreciating the complexity and challenges of this endeavour, the committee concludes that ARC CBBC has succeeded in building a unique public-private consortium. The joint efforts of both the staff and stakeholders has resulted in trust, a high-quality research program, and initial compelling results.'

We are proud of the positive feedback we have received and highly appreciate all recommendations made by the committee to take ARC CBBC a step further towards building a strong community of researchers collaborating with the manufacturing industry with a view to greenifying the chemical industry in this country.

[↗](#) Press release: Greenification of the chemical industry one step closer thanks to the expansion of ARC CBBC



Our Partners



**Industrial production can be made sustainable.
And we've got the best people to figure out how.**

In ARC CBBC, the hub universities of Eindhoven, Groningen and Utrecht collaborate intensively with AkzoNobel, BASF, Nouryon and Shell in multidisciplinary chemical, physical, materials and process technology research. The consortium is supported by the Dutch Research Council (NWO), the Ministry of Economic Affairs and Climate Policy and ChemistryNL.



We unite universities, researchers, businesses and ministries, with whom we work closely together. All with one aim: to provide the molecules of the future.

ARC CBBC Partners at the Five-Year Anniversary Event 2021

top left: Robert Terörde (BASF), Joost Hoebink (moderator), Evren Ünsal (Shell), André van Linden (AkzoNobel)

top right: Klaas Kruithof (AkzoNobel), Dirk Smit (Shell)

middle left: Derk Jan van Dijken (BASF), Jitte Flapper (AkzoNobel)

middle right: Peter Berben (BASF), Sander van Bavel (Shell)

bottom left: Esther Groeneveld (BASF)

bottom right: Mathieu Ahr (Nouryon)



AkzoNobel

BASF
We create chemistry

Nouryon





Five-Year Anniversary Event 2021

'Collaboration is of paramount importance, particularly if you want to change things. There are so many possibilities for collaboration on a global scale.' Those inspiring words came from former Prime Minister Jan Peter Balkenende, whom we were honoured to welcome as a guest during 'The Reinventing Chemistry Together' symposium held in celebration of the consortium's first five-year anniversary. During his interview, Mr Balkenende emphasized the importance of collaboration.



Several other guests from industry, the government and academia were invited by moderator Joost Hoebink to take the stage or participate in a panel showcasing ARC CBBC's accomplishments and the projects it has in the pipeline.

The first part of the symposium, 'Perspectives to Develop Sustainable Chemistry for the Future', focused on the necessity of innovation in the chemical sector, the development of young talent and the importance of

'We bring together all the talents we have and give them the financial support and research infrastructure they need. Thanks to this collaboration, we will make great things happen.'

*- Marjan Oudeman
(Chairperson of the Supervisory Board)*

collaboration between the government, industry and academia. The second part focused on the role of young researchers. The lectures, discussions and interviews were alternated with animated videos of the multilateral projects and videos of the hubs.

The symposium also marked the start of the Reinventing Chemistry Together movement as a symbol for the consortium's mission to join forces to reinvent chemistry and to work towards enhancing the sustainability and circularity of the chemical industry.

- [Intro of the Five-Year Anniversary Event 2021](#)
- [Interview Jan Peter Balkenende at the Five-Year Anniversary Event 2021](#)
- [Full report of the Five-Year Anniversary Event 2021](#)



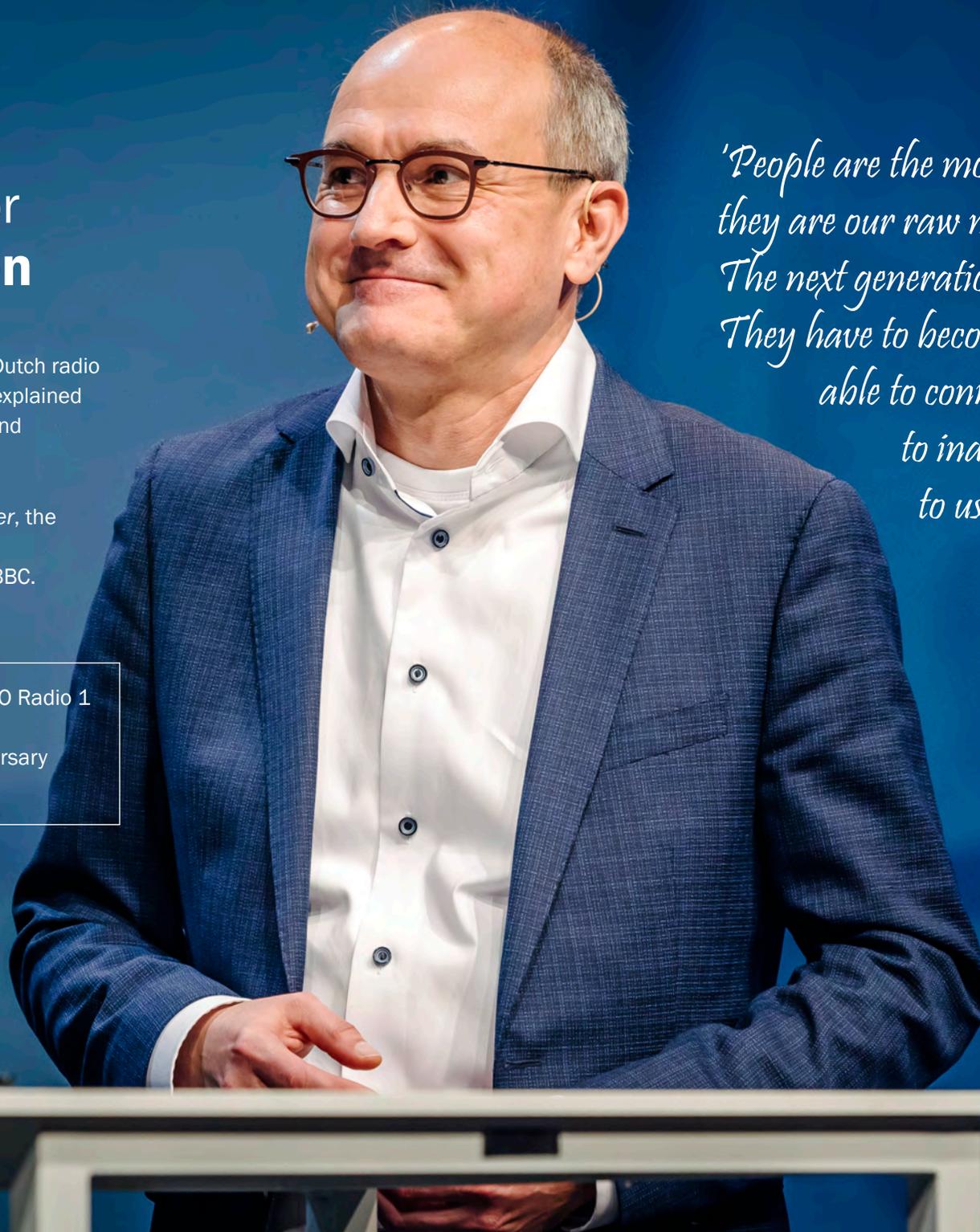
Scientific Director & Program Director **Bert Weckhuysen**

Bert Weckhuysen (UU) was a guest on the Dutch radio show 'Sprakmakers' on NPO Radio 1. He explained the importance of the various transitions, and discussed the urgency to take action.

Bert Weckhuysen was interviewed by *Venster*, the Shell's quarterly magazine. He spoke about the origins, mission and direction of ARC CBBC.

- [🔗 Interview Bert in 'Sprakmakers', NPO Radio 1](#)
- [🔗 Interview in Shell's *Venster*](#)
- [🔗 Interview Bert at the Five-Year Anniversary Event 2021](#)

*'People are the most important,
they are our raw material.
The next generation.
They have to become connectors
able to connect to society,
to industry,
to us.'*



Akansha Goyal

Nature can be a perfect source of inspiration on the road towards enhancing the sustainability of the chemical industry. Many natural processes are inherently sustainable, so recreating them for industrial purposes would be phenomenal. Plants, for example, need CO₂ to survive, as they convert it into valuable nutrients such as glucose. What if we were able to replicate this, and use CO₂ to make valuable products ourselves?

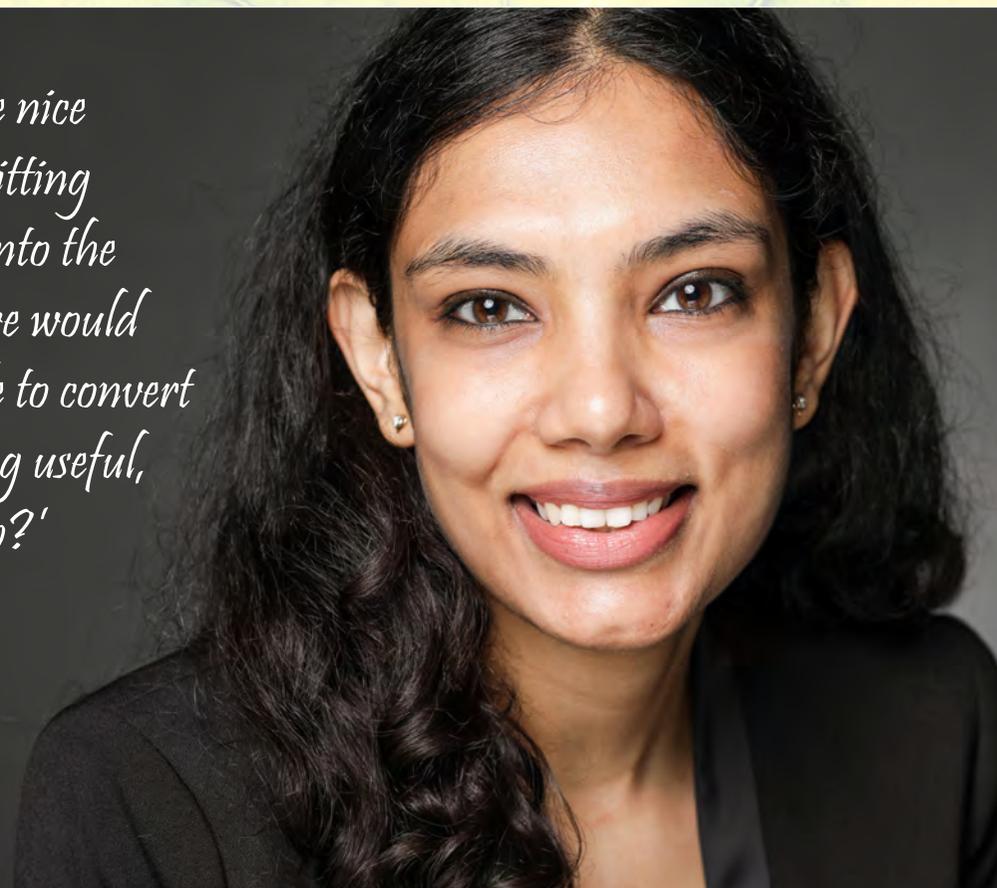
Akansha Goyal accepted this challenge and investigated the possibilities of using CO₂ to produce useful energy carriers to store renewable energy. As the supply of some renewable energy sources is irregular, we sometimes have access to more energy than we need. Therefore, it would be a real breakthrough if we could store this energy: by converting CO₂ into fuel, for example.

[↗ Akansha about her project in her pitch](#)

Akansha tells us about her project in her pitch: 'During my research project at ARC CBBC, I collaborated with researchers from other Dutch universities as well as with our industrial partner Shell Global Solutions B.V., and I believe that this collaborative approach will ultimately help in bridging the gap between academic research and industrial application. Hopefully, scientists such as myself will play a big part in this.'

Akansha on her experience at ARC CBBC: 'The ARC CBBC consortium has brought my research out of the lab and into the world at large. This has really helped me to grow as a scientist. Through various symposiums, public events and training programmes, I was given a chance to present my work, not only to other scientists, but also to a more general audience. This was a great training, as it gave me the confidence to speak about my branch of science more effectively to a wider audience.'

'Wouldn't it be nice if instead of emitting harmful CO₂ into the environment, we would actually be able to convert it into something useful, just as plants do?'

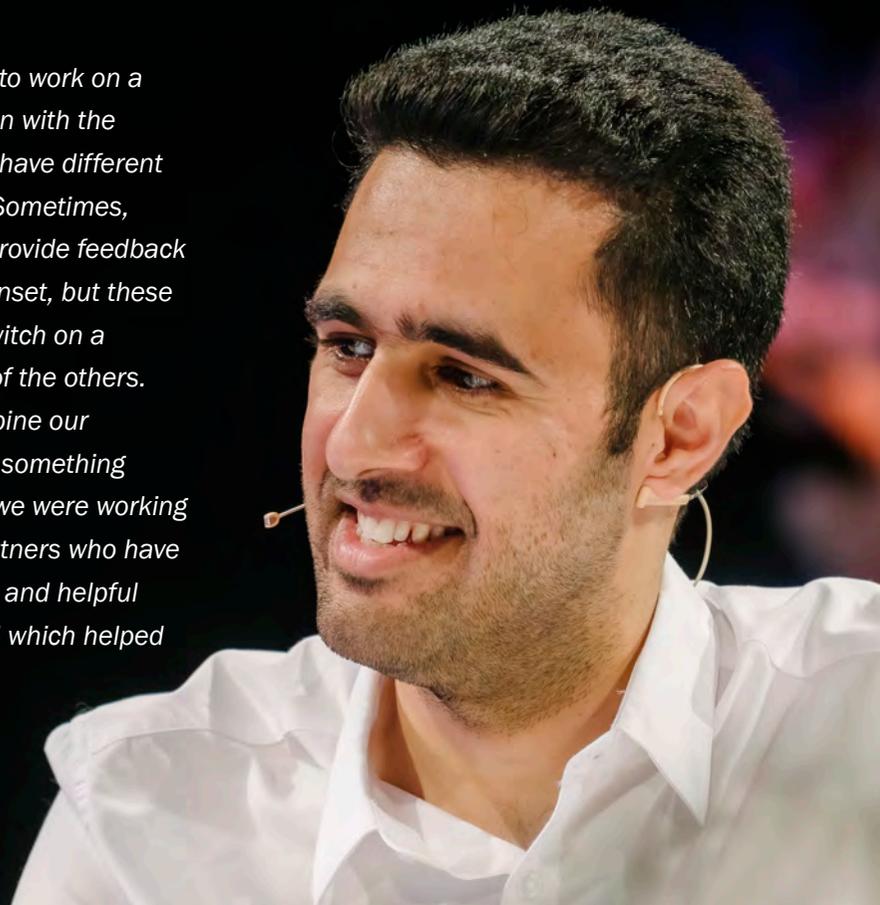


Morteza Hadian

Morteza Hadian is one of our researchers at the Technical University of Eindhoven (TU/e). He is currently investigating how we can use methane to create valuable chemical building blocks. Methane has always been used in processes that emit CO₂, such as combustion to generate heat. When methane is used to create these building blocks, it does not emit CO₂, making it a greener process. Morteza also pitched his project to our panel and was also a guest at the 2021 Five-Year Anniversary Event. Together with Sander van Bavel from his industry partner Shell, he showed us why his project is so important.

- 📄 Interview with Morteza by Jan Douwe Kroeske
- 📄 Pitch about Morteza's project
- 📄 Morteza and Sander van Bavel (Shell) at the Five-Year Anniversary 2021

'It's exciting and also challenging to work on a multilateral project in collaboration with the chemical industry. My colleagues have different interests and areas of expertise. Sometimes, we get ideas from each other or provide feedback that may not seem viable at the onset, but these outside-the-box comments can switch on a proverbial lightbulb in the minds of the others. We can help each other and combine our expertise and facilities to achieve something more significant than we could if we were working alone. There are also industry partners who have already given me materials, ideas and helpful remarks from which I learned and which helped me gain a more comprehensive perspective and expand my horizons.'



Morteza Hadian's project focuses not only on establishing the optimal conditions for the conversion of methane into building blocks, but also on how these conditions can be upgraded to an industrial scale. To do so, he makes computer simulations based on his research results. This makes his research a great example of the 'molecule to device' mindset at ARC CBBC. He was recently interviewed by Jan Douwe Kroeske, in which he spoke about his progress.

As a PhD student, Morteza focused in making his research more easily approachable to society. As mentioned earlier, he made a pitch, appeared at the 2021 Five-Year Anniversary Event, and was interviewed during a visit to the ARC CBBC lab in Eindhoven. In addition, Morteza started a podcast series, in which he interviews guests representing relevant branches of industry and applications in society, as well as people who are connected in some way to his research project.

ARC CBBC was in the spotlight in the chemistry magazine C₂W. Several of our members spoke about their projects and the origins of ARC CBBC. They also gave some concrete examples of how green chemistry is applied!

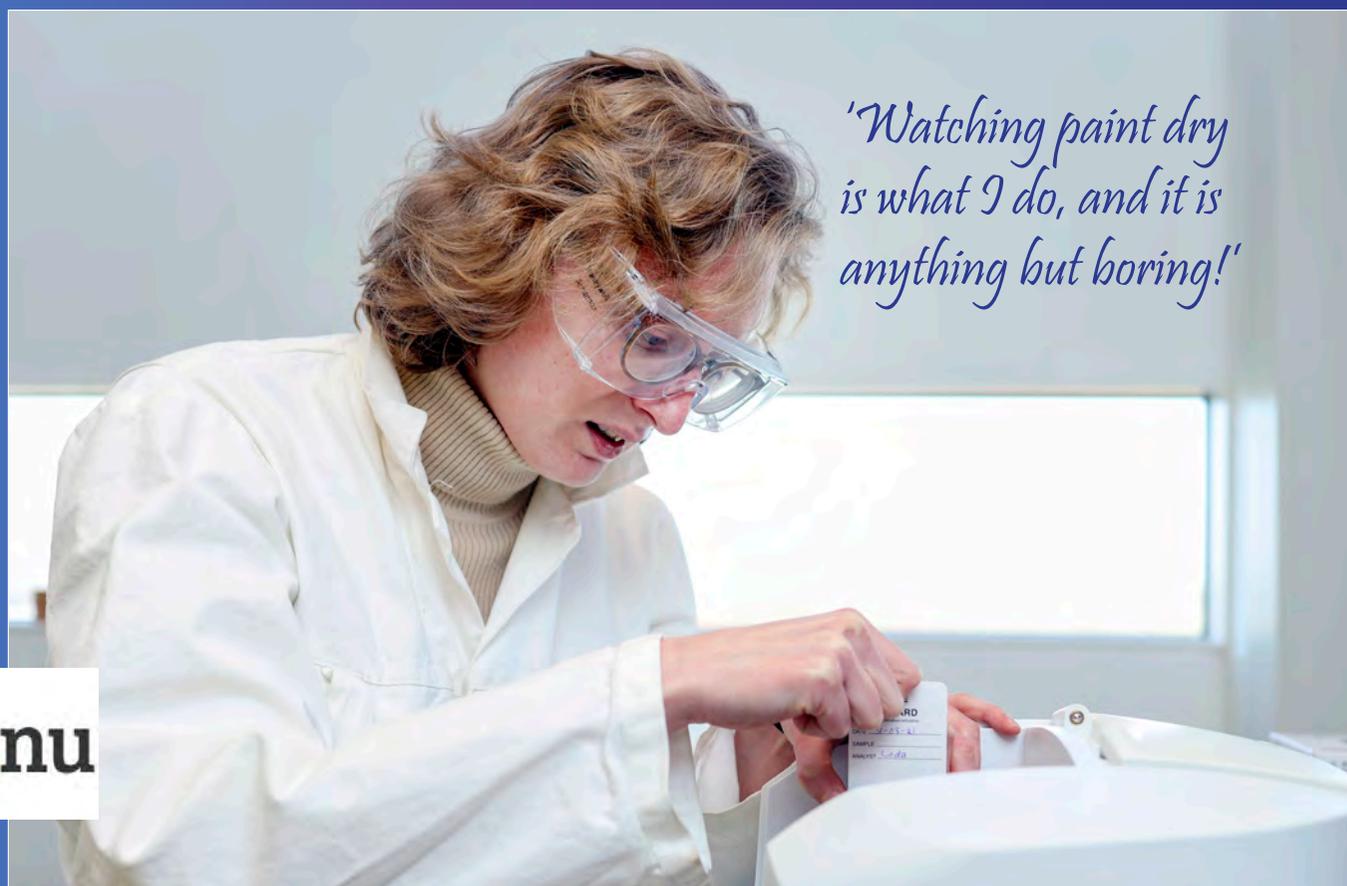
[Sciencelink.net/dossiers-and-collecties/dossier-de-groene-toekomst-van-de-chemie/20306.article](https://www.sciencelink.net/dossiers-and-collecties/dossier-de-groene-toekomst-van-de-chemie/20306.article)



ARC CBBC in the Media

Linda Eijnsink from the University of Groningen wrote an article for the science website Wetenschap.nu. She explained her research on coatings and why it is so important to make changes to the coatings we are currently using. How can we change the recipe without making concessions to the product?

[Wetenschap.nu: waarom staren naar drogende verf-allesbehalve saai is](#)



Our People

Young talent

In our mission to enhance the sustainability of the chemical industry we wish to attract the best researchers in the world today. Not only are we proud of our outstanding scientific achievements, represented by the pool of principal investigators who lead our research projects; we are particularly happy with the young talent we have managed to get on board.

Their passion for fundamental research is inspiring, and their awareness of the fact that changes start with people and willingness to collaborate and share expertise is highly motivating. During the course of last year, they regularly reached out to connect with a broad audience to underline the importance of fundamental research and joining forces to make real changes.

-  Interview Sarina Massman & André van Linden (AkzoNobel)
-  Nikolay Kosinov at the Five-Year Anniversary Event 2021
-  Eline Hutter at the Five-Year Anniversary Event 2021

Last year, our team was expanded with many new young talented researchers. Our dedicated lab infrastructure was staffed with tenure track assistant professors and many postdoctoral researchers and PhD candidates were hired. Meet some of our staff members in the lab tours at our various hub labs!

-  Lab Tour TU Eindhoven
-  Lab Tour Utrecht University
-  Lab Tour Groningen University

Our new researchers in 2021



Tom Welling - UU (Postdoc)



Rafael Mendes - UU (Postdoc)



Nathália Tavares Costa - UT (PhD)



Floran Peeters - TU/e (Postdoc)



Sofie Ferwerda - UU (PhD)



Niklas Thiel - RUG (Postdoc)



Bram Kappé - UU (PhD)



Maartje Otten - UU (PhD)



Shrinjay Sharma - TUD / UvA (PhD)



Victor Drozhzhin - TU/e (PhD)



Jason Heinrichs - TU/e (PhD)



Demi Snabilié - UvA (PhD)



Mathieu Lepage - RUG (Postdoc)



Maurits de Roo - RUG (PhD)



Claudia Keijzer - UU (PhD)



Ryan Napier - UL (PhD)



Nicolette Maaskant UU (PhD)



Ning Wei RUG (PhD)

Our new tenure tracks in 2021



Michael Lerch

After having worked with Prof. Feringa while he was a PhD candidate, Michael will now be focusing on smart coatings and life-like materials at the RUG.



Sebastian Beil

Sebastian's ambition is to combine his interests in redox catalysis with an investigation into new procedures for the creation of conjugated bio and other molecules.



Ina Vollmer

Supported by a Veni grant, Ina will develop mechanochemical and catalytic means to recycle polymers to valuable building blocks.



Matteo Monai

Matteo will focus on pushing the boundaries of rational catalysts design and synthesis by breaking scaling relations in the activation of specific bonds.

 [Introduction Tenure Tracks](#)

Organization & governance

Executive Board (EB) Members

Prof. Dr ir. Bert Weckhuysen – *Scientific Director Utrecht University*
Prof. Dr Ben Feringa – *Chair University of Groningen*
Prof. Dr ir. Hans Kuipers – *Eindhoven University of Technology*
Ir. André van Linden – *AkzoNobel*
Dr Robert Terörde – *BASF*
Dr Frank Wubbolts – *Shell*
Dr Mathieu Ahr – *Nouryon*

The EB members are supported by the following knowledge experts:

Dr Jitte Flapper – *AkzoNobel*
Dr Peter Berben – *BASF*
Dr ir. Sander van Bavel – *Shell*
Dr Emma Winkels-Liaison – *NWO*

The following members have left the EB in 2021:

Dr Frank Wubbolts – *Shell*
Dr Mathieu Ahr – *Nouryon*

The following member has joined the EB in 2021:

Dr Evren Ünsal – *Shell*

Supervisory Board (SB) Members

Mr. Marjan Oudeman – *Chair*
Prof. Anton Pijpers – *Utrecht University*
Prof. Jasper Knoester – *University of Groningen*
Dr Dirk Smit – *Shell*
Dr Robert-Jan Smits – *Eindhoven University of Technology*
Dr Katrin Friese – *BASF*
Dr Klaas Kruithof – *AkzoNobel*

The SB members are supported by the following observers:

Prof. Dr Stan Gielen – *Netherlands Organisation for Scientific Research, NWO*
Ir. Jacqueline Vaessen – *Holland Chemistry*
Dr Emma Winkels – *NWO*
Drs. Michiel Sweers – *Ministry of Economic Affairs and Climate Policy*

The following members left the SB in 2021:

Dr Klaus Harth – *BASF*
Prof. Dr Stan Gielen – *Netherlands Organisation for Scientific Research, NWO*

Scientific Advisory Board (SAB) Members

Prof. Dr Matthias Beller, Chair – *Leibniz-Institut für Katalyse, Germany*
Prof. Dr Markus Antonietti – *Max-Planck Institute of Colloids and Interfaces, Germany*
Prof. Dr Ib Chorkendorff – *Technical University of Denmark, Denmark*
Prof. Dr Christophe Copéret – *ETH Zürich, Switzerland*
Prof. Dr Tanja Cuk – *University of California at Berkeley, CA, USA*
Prof. Dr John Dennis – *University of Cambridge, UK*
Prof. Dr Rodney O. Fox – *Iowa State University, USA*
Prof. Dr ir. Bettina Frohnapfel – *Karlsruhe Institute of Technology, Germany*
Prof. Dr Joseph Keddie – *University of Surrey, UK*
Prof. Dr Martin Möller – *Leibniz Institute for Interactive Materials, Germany*
Prof. Dr Ferdi Schüth – *Max-Planck-Institut für Kohlenforschung, Germany*
Prof. Dr Timothy Swager – *Massachusetts Institute of Technology, USA*
Prof. Dr ir. Guy Marin, Deputy Chair – *Ghent University, Belgium*
Prof. Dr Beatriz Roldan – *Fritz Haber Institute of the Max Planck Society, Germany*
Prof. Dr Helma Wennemers – *ETH Zürich, Switzerland*
Prof. Dr Unni Olsbye – *University of Oslo, Norway*

The following members have left the SAB:

Prof. Dr Matthew Gaunt – *University of Cambridge, UK*

Members

Prof. Dr ir. Adri Minnaard – *Groningen University*
Prof. Dr Albert Schenning – *Eindhoven University of Technology*
Prof. Dr Alfons van Blaaderen – *Utrecht University*
Prof. Dr Bas de Bruin – *University of Amsterdam*
Prof. Dr Ben Feringa – *University of Groningen*
Prof. Dr Bert Meijer – *Eindhoven University of Technology*
Prof. Dr ir. Bert Weckhuysen – *Utrecht University*
Dr Catarina de Carvalho Esteves – *Eindhoven University of Technology*
Dr Daniela Wilson – *Radboud University Nijmegen*
Prof. Dr Detlef Lohse – *University of Twente*
Prof. Dr ir. Emiel Hensen – *Eindhoven University of Technology*
Prof. Dr Erik Garnett – *University of Amsterdam*
Prof. Dr Evgeny Pidko – *Delft University of Technology*
Prof. Dr Floris Rutjes – *Radboud University Nijmegen*
Prof. Dr Frank de Groot – *Utrecht University*
Prof. Dr Freek Kapteijn – *Delft University of Technology*
Prof. Dr Guido Mul – *University of Twente*
Prof. Dr ir. Hans Kuipers – *Eindhoven University of Technology*
Prof. Dr Hans de Vries – *University of Groningen*
Prof. Dr ir. Jan van Hest – *Eindhoven University of Technology*
Prof. Dr ir. Jasper van der Gucht – *Wageningen University & Research*
Prof. Dr Joost Reek – *University of Amsterdam*
Prof. Dr ir. Kitty Nijmeijer – *Eindhoven University of Technology*
Prof. Dr ir. Krijn de Jong – *Utrecht University*

Prof. Dr Marc Koper – *Leiden University*
Prof. Dr Marjolein Dijkstra – *Utrecht University*
Prof. Dr Matthias Bickelhaupt – *Vrije Universiteit Amsterdam*
Prof. Dr Moniek Tromp – *Groningen University*
Dr Monique van der Veen – *Delft University of Technology*
Prof. Dr Nathalie Katsonis – *University of Twente*
Prof. Dr ir. Niels Deen – *Eindhoven University of Technology*
Prof. Dr Peter Bolhuis – *University of Amsterdam*
Prof. Dr Petra de Jongh – *Utrecht University*
Prof. Dr Pieter Bruijninx – *Utrecht University*
Prof. Dr ir. René Janssen – *Eindhoven University of Technology*
Prof. Dr ir. Ruud van Ommen – *Delft University of Technology*
Prof. Dr Sijbren Otto – *Groningen University*
Prof. Dr Syuzanna Harutyunyan – *Groningen University*
Prof. Dr ir. Thijs Vlugt – *Delft University of Technology*
Prof. Dr ir. Wesley Browne – *Groningen University*
Prof. Dr ir. W.M. Wiebe de Vos – *University of Twente*
Dr Wilson Smith – *Delft University of Technology*

Tenure tracks

Matteo Monai – *Utrecht University*
Eline Hutter – *Utrecht University*
Ina Vollmer – *Utrecht University*
Michael Lerch – *University of Groningen*
Sebastian Beil – *University of Groningen*
Nikolay Kosinov – *Eindhoven University of Technology*
Marta Costa Figueiredo – *Eindhoven University of Technology*

Technicians

Hannie van Berlo - van den Broek – *Utrecht University*
Ramon Oord – *Utrecht University*
Peter de Peinder – *Utrecht University*
Larry de Graaf – *Eindhoven University of Technology*
Brahim Mezari – *Eindhoven University of Technology*
Nicole Imholz – *University of Groningen*

ARC CBBC Support Office

The ARC CBBC Support Office is hosted by the coordinating partner, Utrecht University. The composition of the Support Office in 2021 was as follows:

Maurice Mourad – *Programme Coordinator*
Anita ter Haar – *Financial Controller*
Hannah Thuijs – *Community Manager*
Anita den Heijer – *Office Manager*
Anne-Eva Nieuwelink – *Project Manager*
Julien Daubignard – *Project Manager*
Marijke Badings – *Communication Officer*
Bram van Reemst – *Data Specialist*

ARC CBBC In the media



Het dreamteam: de magische top tien chemietalenten

"The future belongs to those who believe in the beauty of their dreams."
Dit magische team is de verpersoonlijking van de wijze woorden van wijlen Eleanor Roosevelt in 1937, voornamelijk *Franklin* van de Verenigde Staten. Zie hier, tien talenten uit de chemie die verbonden zijn aan het Nederlandse onderzoekscentrum ARC CBBC, klaar om de wereld te veranderen, te verduurzamen en daarmee ook te veroveren. Van het halen van koolstof nanodeeltjes uit aardgas, tot het omzetten van methaan naar bruikbare chemicaliën. Algemeen onderzoek die, als ze slagen, zorgen voor een betere wereld. Een wereld voor de mensen die geloven in de schoonheid van hun dromen. Meer dan Roosevelt kun je het niet zeggen. Maak kennis met de uitvindes van deze eeuw!

door Eva Segzaan en Willemijn van Berchem

Change Inc

The Christmas edition of *Change Inc* featured some of our young researchers! They were interviewed about their projects, and they tell us how those contribute to a more sustainable world!

[Full article Change Inc](#)

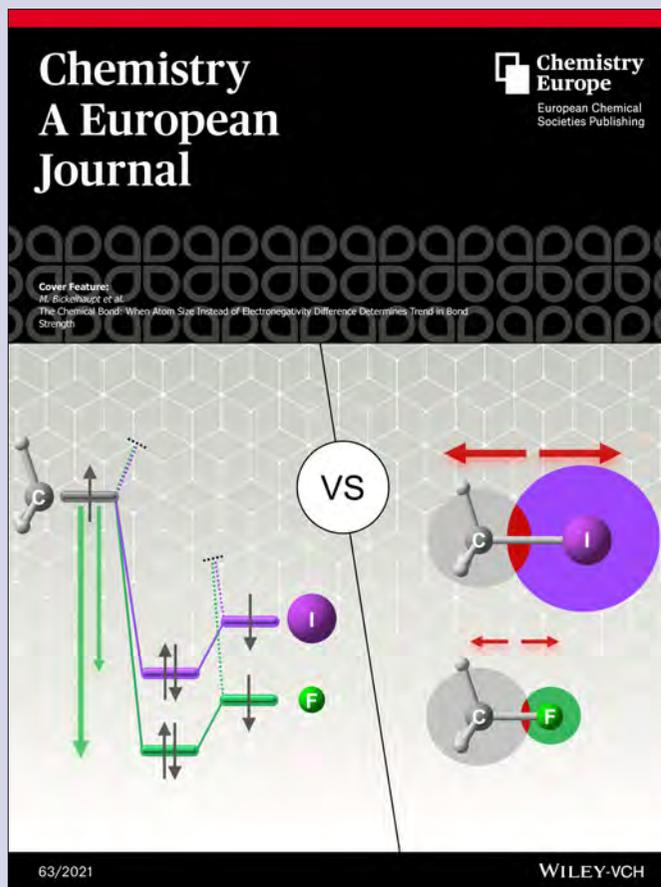
Our Publications – List of Publications in 2021

- **E. Blokker, X. Sun, J. Poater, J. M. van der Schuur, T. A. Hamlin, and F. M. Bickelhaupt**, 'The chemical bond: when atom size instead of electronegativity difference determines trend in bond strength', *Chem. Eur. J.*, vol. 27, no. 63 (11 November 2021), pp. 15616-15622, doi: 10.1002/chem.202103544
- **C. J. Bondü, Z. Liang, and M. T. M. Koper**, 'Dissociative adsorption of acetone on platinum single-crystal electrodes', *J. Phys. Chem. C*, vol. 125, no. 12 (1 April 2021), pp. 6643-6649, doi: 10.1021/acs.jpcc.0c11360
- **S. Chandrashekar, H. Geerlings, and W. A. Smith**, 'Assessing silver palladium alloys for electrochemical CO₂ reduction in membrane electrode assemblies', *ChemElectroChem*, vol. 8, no. 23 (1 December 2021), pp. 4515-4521, doi: 10.1002/celec.202101258
- **K. Datta, B. T. van Gorkom, Z. Chen, M. J. Dyson, T. P. A. van der Pol, S. C. J. Meskers, S. Tao, P. A. Bobbert, M. M. Wienk, and R. A. J. Janssen**, 'Effect of light-induced halide segregation on the performance of mixed-halide perovskite solar cells', *ACS Appl. Energy Mater.*, vol. 4, no. 7 (July 2021), pp. 6650-6658, doi: 10.1021/acsaem.1c00707
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- **A. Goyal and M. T. M. Koper**, 'The interrelated effect of cations and electrolyte pH on the hydrogen evolution reaction on gold electrodes in alkaline media', *Angew. Chem. Int. Ed.*, vol. 60, no. 24 (7 June 2021), pp. 13452-13462, doi: 10.1002/anie.202102803
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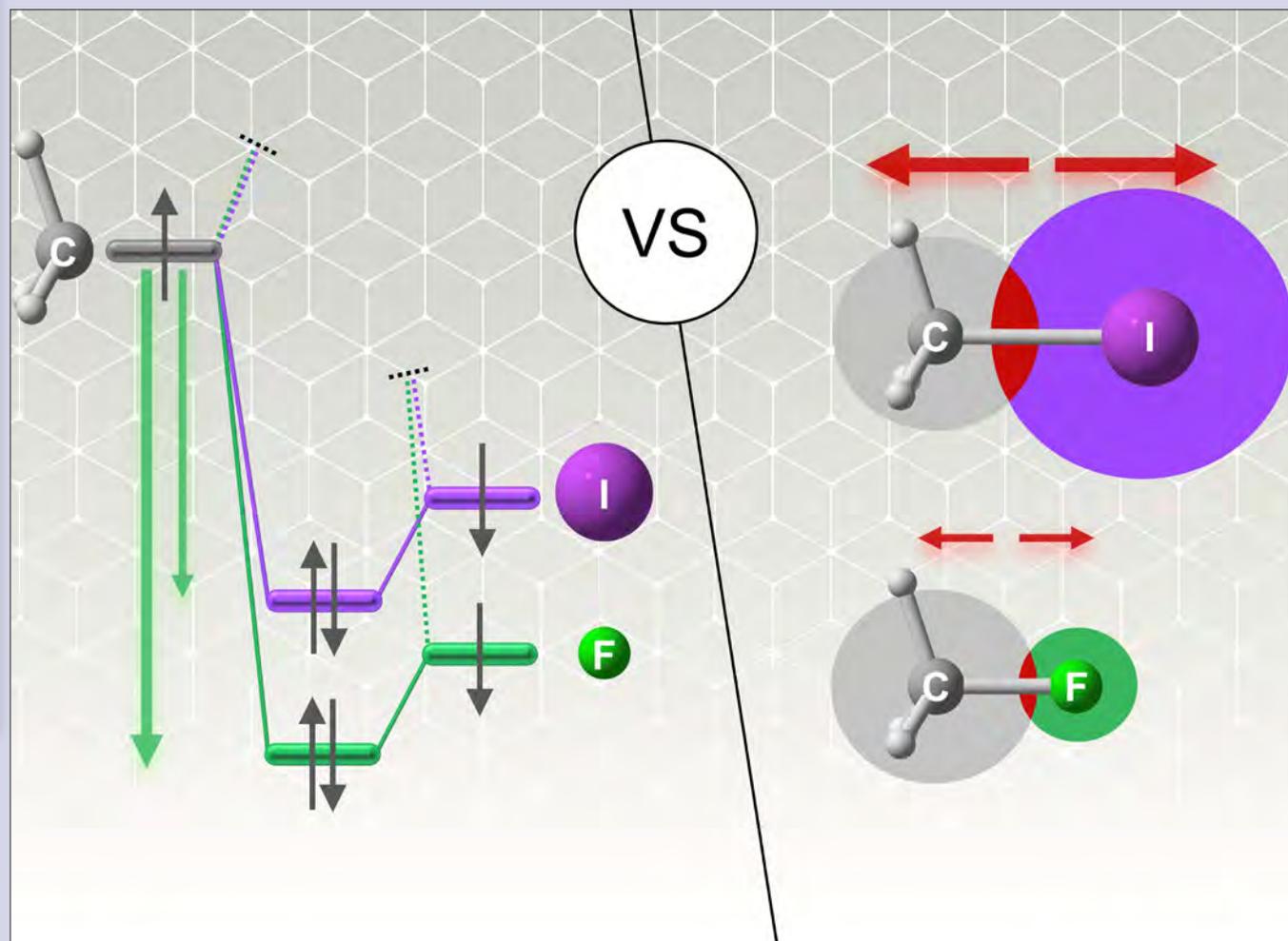
Our Publications – Eva Blokker

The publication by Eva Blokker (VU) and her colleagues was selected to decorate the cover of *Chemistry – A European Journal*.

[Eva Blokker in Eye-Openers](#)



[Cover Page Chemistry – A European Journal](#)



Program Director **Hans Kuipers**

During our Five-Year Anniversary Event, Hans Kuipers (TU/e) spoke about the importance of upscaling, and how he wishes to contribute to the process of upscaling in the chemical industry. Or, in other words: bringing science from the lab to the plant.

📌 From the lab to the plant. Nothing is impossible!

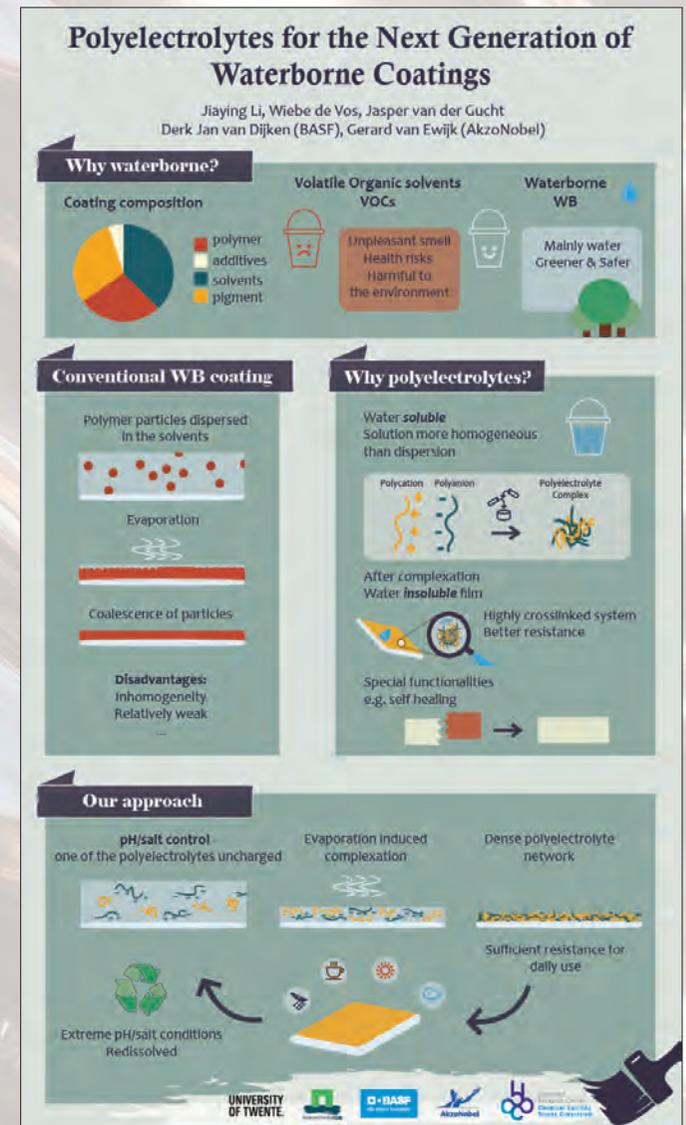
'From fundamental research to new chemistry and technology. To new concepts. Fundamental research is connected to technology, and therefore from molecule to device. This distinguishes ARC CBBC, and gives the consortium a unique impact. The unique collaboration and the connection to technology provides a translation from a concept to a fully continuous process, on a large scale and in an economically viable manner.'

'As a PhD student, doing good research in the lab is just one small step toward achieving my overall goal. ARC CBBC provides this unique platform and serves as a bridge between academia, industry and society. At this flagship organization, we regularly share our ideas and are always open to help. In my project, communication with BASF and AkzoNobel helps me shape the direction in which my project is travelling and to constantly keep it relevant to the real world. Moreover, I also learn about what is currently available on the market and what else the market demands.' - Jiaying Li

Jiaying Li

In our transition towards a more sustainable world, we should not only focus on the process of recycling itself, but also on the recyclability of our products. How can we make sure that the products we make are suitable for recycling? This question is exactly what is keeping PhD student Jiaying Li from the University of Twente occupied. She is examining how we can use recyclable, waterborne, bio-based coatings to replace poorly recyclable metallic coatings. Together with her industry partners BASF and AkzoNobel, she is exploring ways to replace items such as food packaging with alternatives that can be recycled more easily.

In her blog, Jiaying explains all the details of her research, and how the new type of coating she is working on contributes to a greener world. She also made an infographic about her topic, clearly highlighting the most important aspects of her research.



[↗ Jiaying's blog 'Where did the silver go'](#)

Lotte Metz

'My dream is being able to design and customize catalysts so that we can improve the world on the macroscale by controlling it on the nanoscale.' Lotte Metz was clear about her hopes for the future during our 2021 Five-Year Anniversary Event.

Lotte Metz is examining how we can improve our catalysts in our journey towards a more sustainable world. In this video, she explains how catalysts can make chemical processes more efficient (i.e. ensuring that they use less energy and produce less waste).

Lotte Metz focuses on one particular element: nanoparticles. These nanoparticles are the smaller components of which catalysts are formed, and their properties have a major impact on the functionality of the catalyst. She is examining how we can control aspects such as the size of the nanoparticles, and by doing so impact the efficiency of the catalyst. In other words: how we can improve the world on the macroscale by controlling it on the microscale!

*'The matter
that we can't see
does matter'*

The ARC CBBC was also represented at the European Energy and Industry Summit (EIES2021). Lotte was one of our representatives; she gave a presentation about her research and participated in some of the panels with industry partners and other researchers. One of the topics she discussed was whether or not fear of the unknown has an influence on the energy transition, and if the energy transition can take place without research into catalysis.



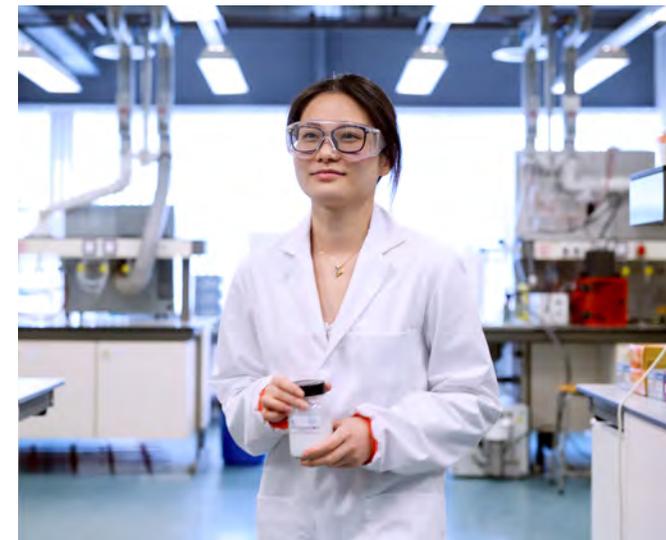
- [📄 Lotte Metz and Robert Terörde \(BASF\) at the Five-Year Anniversary Event 2021](#)
- [📄 Vlog Lotte Metz](#)
- [📄 Presentation Lotte Metz at EIES 2021](#)
- [📄 Lotte Metz at the Panel Discussion at EIES 2021](#)

Our projects

Bilateral projects *update & outlook*

The goal of ARC CBBC is to provide the knowledge and understanding that enables its private partners to realize new and improved products, processes and services, focusing on fundamental research for breakthrough options and underpinning technologies.

Each of our projects can be related to one or more of our research themes: the materials transition, the feedstock transition and the energy transition. With regard to the materials transition, the focus is on making the materials we use more durable, enhancing their functionality and making catalysts that last longer and are more efficient. The feedstock transition aims to facilitate the transition from traditional feedstock (often based on fossil fuels) to circular and sustainable feedstock, such as biomass, CO₂, or recycled plastic waste. Thirdly, the goal of the energy transition is to switch from fossil fuel-based energy to renewable energy, such as electricity from solar or wind energy. This also includes solving practical concerns by using renewable energy sources, such as storing energy when more is produced than needed at a given point.



Our bilateral project portfolio is composed of all projects initiated by one of our industry partners. These projects are often topic-based and related more closely to the business undertakings of our partners. In 2021, the last projects of the first term were allocated, yielding a total of 69 bilateral projects within the first term of ARC CBBC.



Our projects

Multilateral projects

update & outlook



In our multilateral projects, researchers collaborate with multiple industry partners on pre-competitive research topics. Our multilateral programme on new chemistry for a sustainable future was approved in April by the Scientific Advisory Board. Seventeen researchers from eight universities are working on the recycling of plastics, using CO₂ as feedstock for the production of chemicals, and redesigning chemical reactions to reduce the energy needed for this.

- [Animation Fundamentals of Catalysis](#)
- [Animation Small Molecule Activation](#)
- [Animation Coatings and Functional Materials](#)

Together with the other programmes on waterborne coatings, fundamentals of catalysis, and small molecule activation, our multilateral portfolio of the first term was completed. Now that we are moving into the second term of ARC CBBC, the Executive Board is currently working on three new multilateral programmes to follow on the first three.

'Meetings on a regular basis with experts from the scientific and industrial communities provide us with a great opportunity to seek advice concerning the direction in which the project is travelling and discuss results and challenges. The informal meetings between the researchers serve as an immense catalyst for the progress of our research. And, apart from this, they are fun!'

- David Rieder ►
(Multilateral Fundamentals of Catalysis, TU/e)



[Interview Anne-Eva Nieuwelink](#) ▲



Chair of the Executive Board & Program Director **Ben Feringa**

Ben Feringa (RUG) was interviewed by Venster, the quarterly magazine issued by Shell, and Petrochem. He speaks about his visions for a greener chemistry, fundamental science and the synergy between industry and academia.

In the TV show 'De Vooravond', Ben Feringa discussed the role chemistry should play.

- [📄 Ben Feringa in TV Program 'De Vooravond'](#)
- [📄 Ben Feringa interview in Shell's Venster](#)
- [📄 Ben Feringa interview in Petrochem](#)

*'Give young people
the space to wander'*



AkzoNobel supports George in this process. In this way, George's research reflects the intentions of ARC CBBC; the unique collaboration between academia and industry enables outstanding scientific research to find its way to application on a large scale.

presented the Innovation Award for his excellent work highlighted in his presentation titled 'A coating from nature'.

George was also one of the guest speakers at the Coatings Science International Conference (CoSI) of 2021. He was

- [George's high-speed lecture](#)
- [George's virtual lab tour](#)

George Hermens

Research at ARC CBBC is categorized into three themes: materials transition, energy transition and feedstock transition. Every project relates to one of those themes, but this does not impose any boundaries. PhD student George Hermens is the living example of this philosophy.

The research conducted by George establishes links between all three themes. He is currently engaged in examining ways to facilitate the switch from coatings made from fossil fuels such as oil to biobased coatings made from sustainable sources. But how does he integrate all three research themes? He explained this in a high-speed lecture at ARC CBBC's 2021 Five-Year Anniversary Event. In addition, he showed us part of his experimental setup in the virtual lab tour of the 2021 edition of the ARC CBBC Summer School.

George also explained how he does not only study the fundamentals of science, but also examines how the process can find its way to the chemical industry on a large scale. The industrial expertise of partner

"It is evident that we need sustainable alternatives in tomorrow's chemistry and materials"



Bas Terlingen

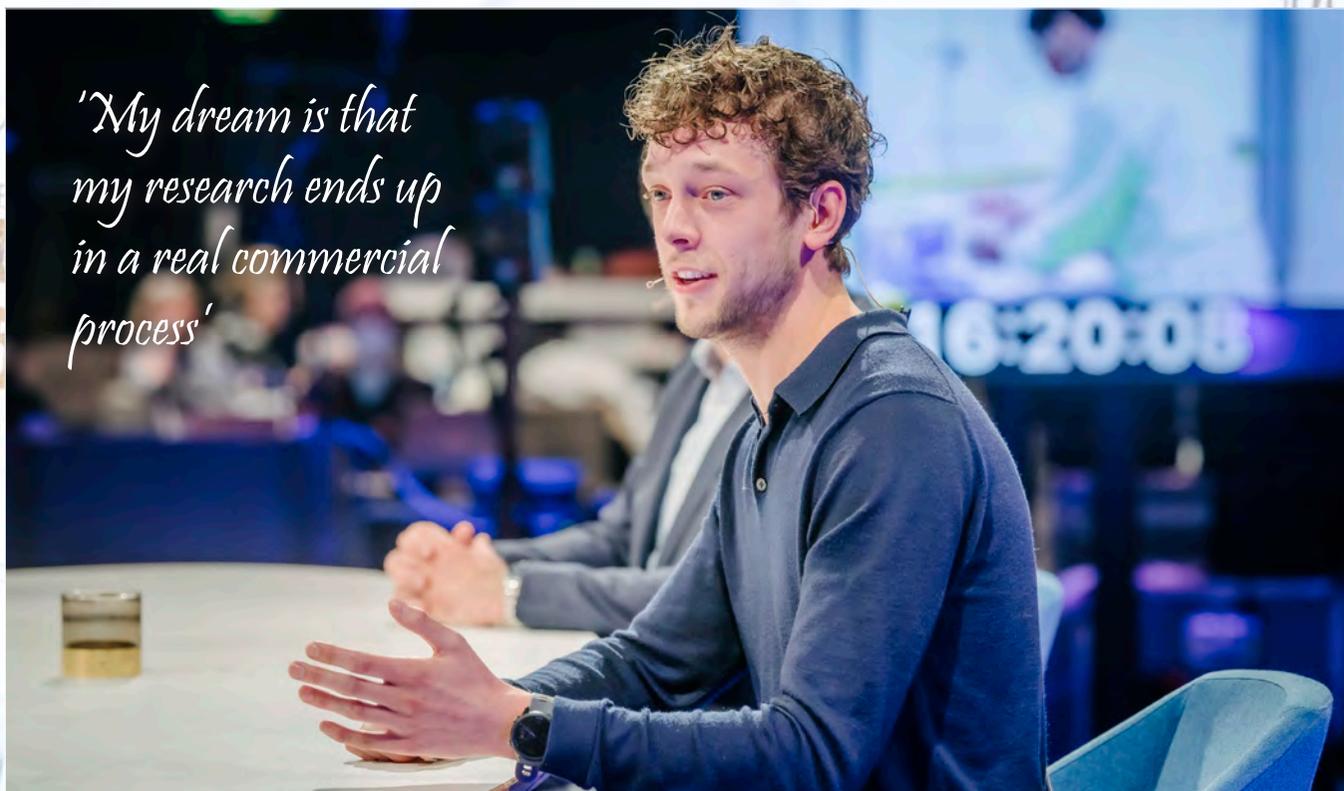
Bas Terlingen is one of our Utrecht University researchers who focuses on recycling in the chemical industry. However, he does not work on the aspect of recycling that we see in our everyday lives, which generally involves plastic or cardboard. Bas is currently examining how hydrogen chloride (HCl) can be recycled.

- [Bas explaining recycling HCl on Youtube](#)
- [Bas in the virtual UU lab tour](#)
- [Bas in vlog interview](#)
- [Bas at the Five-Year Anniversary Event 2021](#)

HCl is the product of many industrial chemical reactions, and is often created as a by-product in the production of other chemicals. Instead of adding yet another waste flow to our industry, we can try to create something valuable out of this HCl. The chlorine in HCl, for example, can be used in the production of disinfectants and PVC tubes. He explained all about his work and its applications on YouTube and showed us his equipment in a virtual lab tour of Utrecht University's hub lab.

In the light of his research, Bas was featured in the live stream of a vlog interview at his lab during the 2021

'My dream is that my research ends up in a real commercial process'



European Industry and Energy Summit (EIES2021). He spoke about his research and shared his visions on his contributions to the future of chemistry. 'As a chemist, contributing to this entire transition is important. We have to make the difference', Bas explained. Earlier in 2021, Bas also took part in the panel discussions at the annual ARC CBBC symposium. Here, he spoke about his personal dreams: 'My dream is for my research to be applied in a genuine commercial process', Bas explained. Through his research, in which he collaborates with partner Nobian, he hopes to turn this dream into reality.



4
Industrial Partners
AkzoNobel
BASF
Nouryon
Shell



3
Hubs
RUG
UU
TU/e



70
Positions
30 bilateral projects
4 multilateral projects
4 hub projects



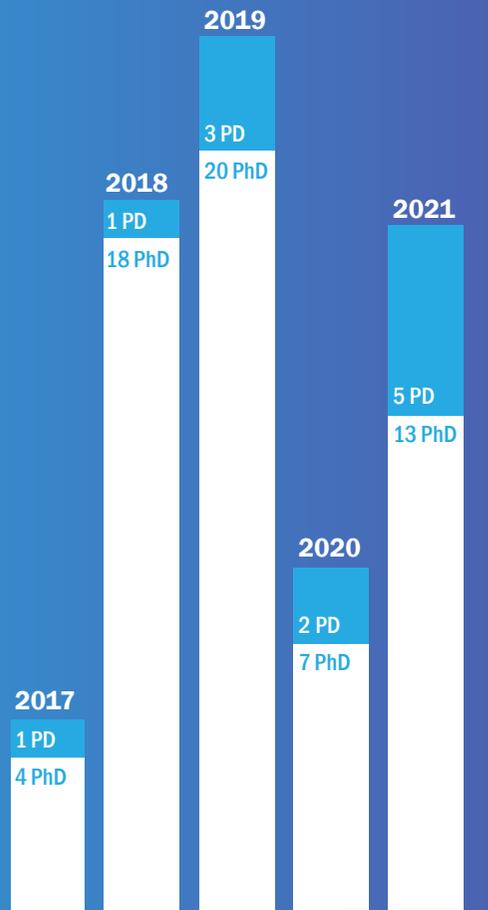
18
New Researchers
13 PhD
5 PD



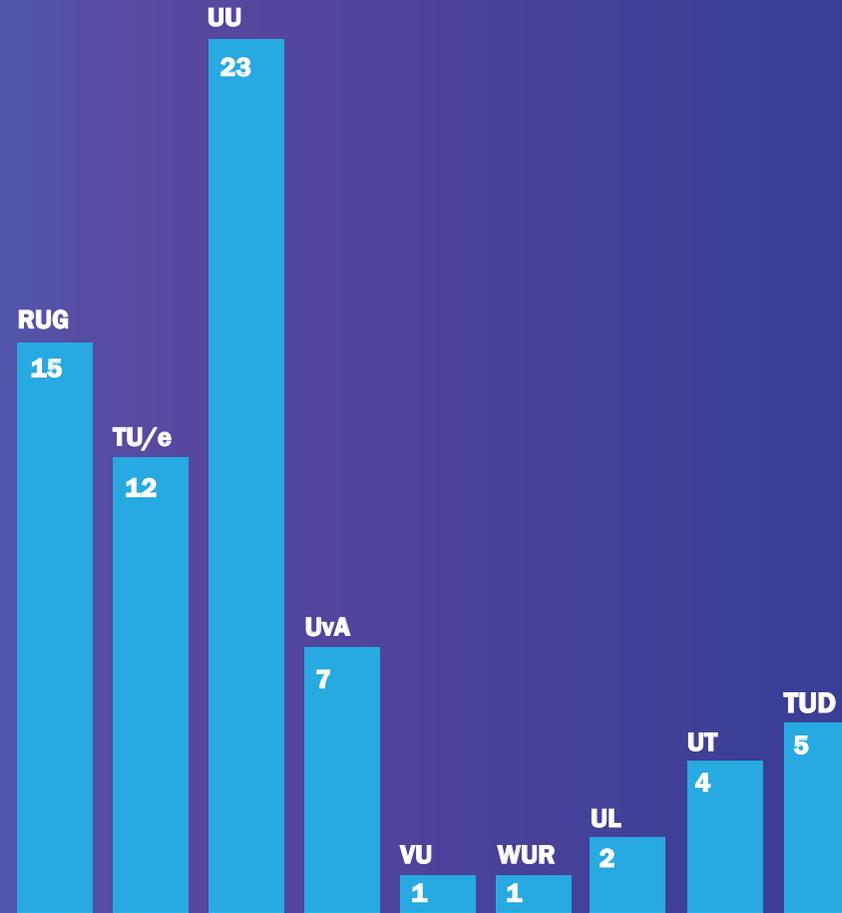
27
Female Researchers



43
Male Researchers



Start of New Researchers per Year



Total of Researchers per University in 2021