Conference on CO_2-based Fuels & Chemicals 2023

19–20 April • Cologne (Germany)

Conference Journal

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co2-chemistry.eu

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9:30–18:15 (CET)

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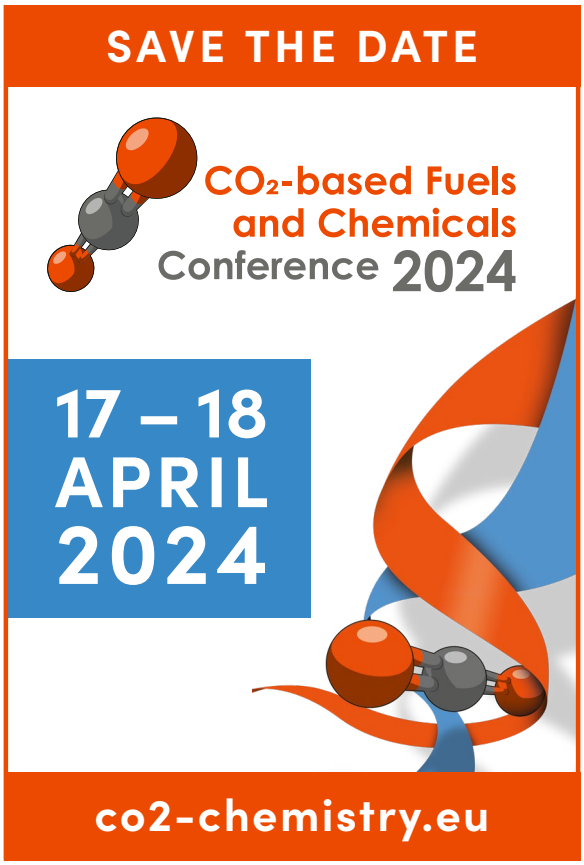


Conference on CO_2-based Fuels & Chemicals 2023

19–20 April • Cologne (Germany)

Dear Participants,

Welcome to the now 11th edition of our "Conference on CO_2-based Fuels and Chemicals" in Cologne – and as you may know, the number 11 is a very important one in this city: In the 19th century, the eleven became the number of the Rhineland Carnival, organised by a board of 11 (Elferrat) and officially starting on 11 November at 11:11 am. Cologne's coat of arms is also adorned with eleven small black flames, which are meant to remind us of the 11 virgins of Saint Ursula. But this only as a sidenote.

In our last edition in 2022, we learned that China already has large plants producing CO_2-based ethanol using emissions from the steel industry – and plans to increase this. Other industrial players are planning to build large methanol plants in the Netherlands and Germany using CO_2 from waste incineration or industrial point sources, and others are planning to build similar plants based on large solar thermal power plants in Tunisia. Several plants for the production of aviation fuel are about to be built, for example in France and Norway. So how are these plans developing, and what else is happening in the world of CCU?

The use of alternative feedstock sources other than fossil carbon remains high on the agenda of many industry players. The production of e-kerosene as a sustainable aviation fuel (SAF) is being stimulated mainly by a forthcoming quota and supporting activities, as we see today in the US and the EU. In addition, a large number of European cross-sector projects for hydrogen production via large electrolysers have been announced or are already under construction, and recent discussions in Canada on green hydrogen also indicate future needs. This is in line with the energy transition plans forced by the war in Ukraine and the need to become independent of Russian gas and oil. In addition, industrial transition efforts to phase out CO_2-emitting energy production, such as coal-fired power plants, to avoid greenhouse gas emissions and limit the effects of anthropogenic climate change are progressing.

All relevant industries, and especially the organic chemistry industry, where most processes depend on the carbon embedded in their products, are looking for alternatives to fossil fuels and are aiming to reduce and eliminate the use of fossil carbon from the ground, leaving the industry with only three options: biomass, recycling of existing materials and the use of CO_2 from the atmosphere or from industrial point sources. The nova-Institute calls this approach "renewable carbon" and has successfully launched the "Renewable Carbon Initiative" to highlight the importance of finding the right feedstock solutions for a sustainable future for the chemical industry. But what would a renewable carbon refinery of the future look like and what are the most suitable technologies? CO_2 as a feedstock is one of the most interesting options and is becoming increasingly visible to the public.

Over the next two days you will have the opportunity to discuss with new and leading players the developments in CCU and the need to create the right framework to promote it. Learn more about the latest technical and political developments and discuss future strategies in numerous panel discussions. It's all about communication and networking!

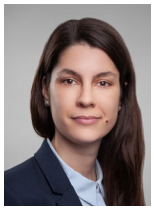
We wish all participants new insights, great ideas and lots of inspiration.

The future belongs to the use of CO_2 and we have the chance to actively shape this path together.

Yours sincerely

Michael Carus
CEO

Dr Pia Skoczinski
Program



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Registration

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Venue & Accommodation

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Kardinal-Frings-Str. 1–3
50668 Köln (Cologne)
Germany

Phone: +49 221 – 1631-0
frontoffice@maternushaus.de
maternushaus.de

Recommended Hotels
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Entrance Fee

Day 1 & 2
19–20 April 2023
Ticket for on site (and online) attendance
incl. dinner buffet
945 €

Day 1
19 April 2023
Ticket for on site (and online) attendance
incl. dinner buffet
640 €

Day 2
20 April 2023
Ticket for on site (and online) attendance
580 €

Day 1 & 2 Online Ticket
19–20 April 2023
Ticket for virtual attendance
450 €

Day 1 & 2 Student Ticket
19–20 April 2023
Ticket for on site (and online) attendance
incl. dinner buffet
350 €

Message from the Minister, Mona Neubaur, to the Conference on CO_2-based Fuels and Chemicals 2023

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Minister Mona Neubaur,
Ministry of Economic Affairs, Industry, Climate Action and Energy of the State of North Rhine-Westphalia

It is the most important project in our time: with crisis after crisis stacking up, we need to embark on the transition to climate neutrality and sustainability, paving the way and speeding up things. North Rhine-Westphalia must become Europe's first climate neutral industrial region.

This is a huge challenge to the chemical industry in particular, which has always been relying on the use of fossil resources – in terms of both energy and material – to create the basic substances needed in the production of everyday goods, food and medicines, resulting in the emission of enormous quantities of greenhouse gases.

The combination of rapidly rising prices for fossil fuels and continuing supply constraints is acting as a catalyst for the inevitable transformation of the sector. The use of renewable energy sources, hydrogen and alternative products is becoming more and more profitable whilst circular production techniques and business models are gaining popularity. Those who today bank on resource conservation, sustainability and green technology have opted not only to embrace the key challenge of climate change but also for the best way to ensure economic viability.

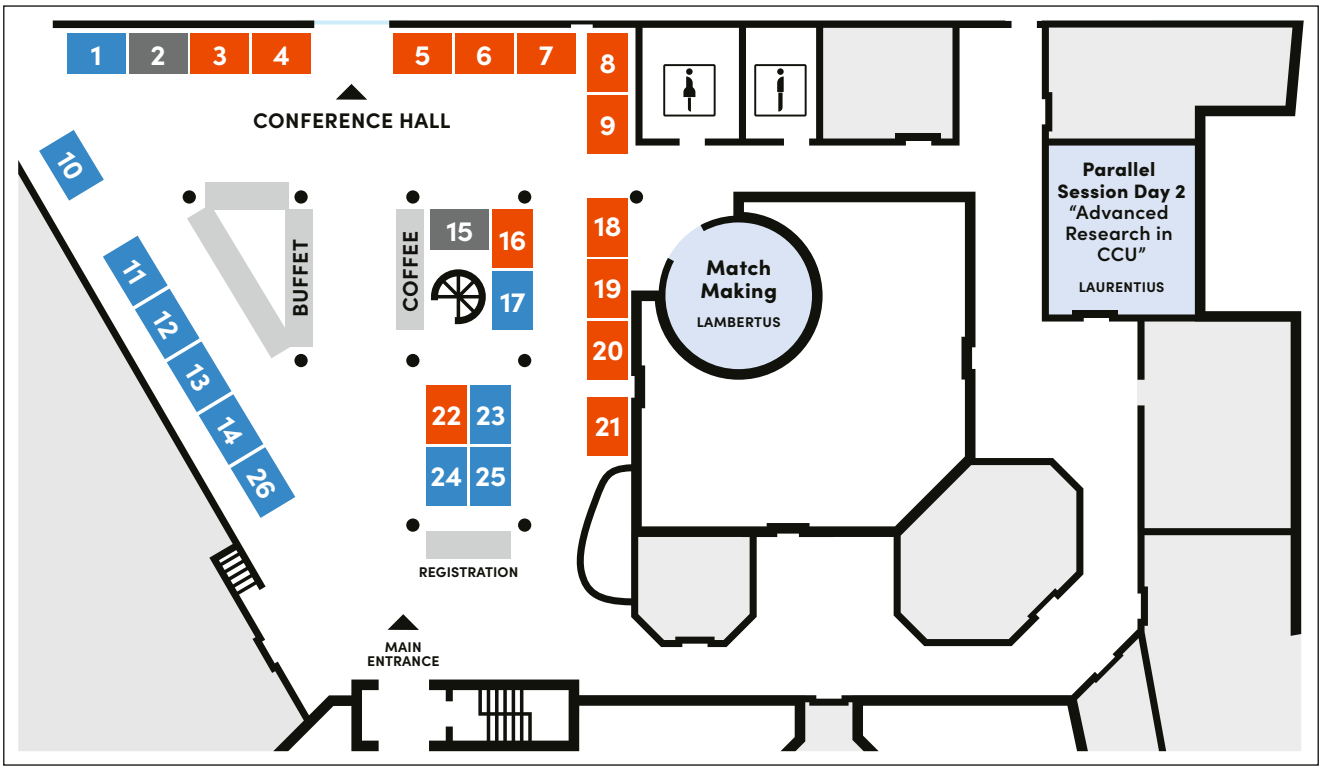
The chemical industry has the unique opportunity to benefit from the creative reuse of unavoidable quantities of carbon dioxide. By utilising CO_2 to produce synthetic fuels or chemicals, the industry will not only contribute to a significant reduction of greenhouse gas emissions. It will also manage to secure its own resource base and competitive edge in the green markets of the future.

When it comes to the all-hands-on-deck project of transforming the economy, the combination of entrepreneurial and political determination will enable us to properly focus the upcoming reinvestment efforts with a view to implementing the circular and sustainable economy as soon as possible.

Dialogue and cooperation are crucial to the success of any joint ventures, and especially those as important as this big challenge to humankind. On that note, I would like to wish the participants of the Conference on CO_2-based Fuels and Chemicals a whole lot of extra insight and food for thought, and may it motivate you to push ahead with the transformation.

Exhibition

Free Reserved for Sponsors Booked



List of Exhibitors

Booth 03 Borealis (AT)
Booth 04 GIG Karasek (AT)
Booth 05 YNCORIS (DE)
Booth 06 nova-Institute (DE)
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Booth 20 Innovation Award "Best CO_2 Utilisation 2023"
Booth 21 Innovation Award "Best CO_2 Utilisation 2023"
Booth 22 NANOGAP (ES)

book your booth soon

Book your booth:
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Status: 17 April 2023
More exhibitors expected:
co2-chemistry.eu/exhibitors

nova-Institute for Ecology and Innovation

Technology & Markets

- Market Research
- Innovation & Technology Scouting
- Trend & Competitive Analysis
- Supply & Demand Analysis
- Feasibility & Potential Studies
- Customised Expert Workshops

Communication

- Comprehensive Communication & Dissemination in Research Projects
- Communication & Marketing Support
- Network of 60,000 Contacts to Companies, Associations & Institutes
- Targeted Newsletters for 19 Specialty Areas of the Industry
- Conferences, Workshops & nova Sessions
- In-depth B2C & Social Acceptance Research

Sustainability

- Life Cycle Assessments (ISO 14040/44, PEF Conform)
- Carbon Footprint Studies & Customised Tools
- Initial Sustainability Screenings & Strategy Consultation
- Holistic Sustainability Assessment (incl. Social and Economic Impacts)
- GHG Accounting Following Recognised Accounting Standards
- Critical Reviews for LCA or Carbon Footprint Reports

Economy & Policy

- Strategic Consulting for Industry, Policy & NGOs
- Political Framework, Measures & Instruments
- Standards, Certification & Labelling
- Micro- & Macroeconomics
- Techno-Economic Evaluation (TEE) for Low & High TRL
- Target Price Analysis for Feedstock & Products

nova-Institute is a private and independent research institute, founded in 1994. nova offers research and consultancy with a focus on the transition of the chemical and material industry to renewable carbon.

What are future challenges, environmental benefits and successful strategies to substitute fossil carbon with biomass, direct CO_2 utilisation and recycling? What are the most promising concepts and applications? We offer our unique understanding to support the transition of your business into a climate neutral future.

Our subjects include feedstock, technologies and markets, economy and policy, sustainability, communication and strategy development.
Multidisciplinary and international team of 45 scientists.

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Concentrating the Essentials

GIG KARASEK
A Member of Dr. Aichhorn Group

GIG Karasek offers cutting-edge CO_2 electrochemical utilization technology for converting captured CO_2 emissions into valuable chemicals and fuels in various industries.

Our portfolio includes individual and customized process technologies ranging from **pilot plants** and **skid units** to **industrial plants**.

Sustainable Solutions for Carbon-intensive Industries

- Circular economy
- Decarbonization
- Defossilization

- Significant improvement of CO_2 balance
- Meet carbon neutrality goals
- Modularized, adapt- and scalable to specific requirements
- Zero-emission technology

Target industry sectors

- Energy production
- Chemical manufacturing
- Construction sector such as cement industry
- Refineries
- ... and many more

Final valuable products

- Organic acids: Forming acid, oxalic acid, acetic acid
- Carbon monoxide
- Methane
- Ethylene
- Methanol
- Ethanol

Stepwise implementation - CO_2 conversion in kt/a:

Pilot plants:	0.1 kt/a, 0.05 MW
Demonstration units:	5 kt/a, 2.66 MW
Commercial units:	20 - 40 kt/a, 10 - 20 MW
Industrial plants:	50 - 200 kt/a, 25 - 100 MW

The feasibility of our carbon conversion technology has been already proven on a pilot plant scale!

Contact us to apply our solution to your application or become partners:
office@gigkarasek.at

www.gigkarasek.com

The Rising of Carbon Dioxide (CO_2) as a Renewable Carbon Feedstock – more than 1.3 million tonnes capacity for CO_2-based products already exist and are expected to at least quadruple by 2030

New report on CO_2 utilisation for chemicals, advanced fuels, polymers, proteins and minerals from the nova-Institute – A deep and comprehensive insight into the evolving technologies, trends and the dynamically growing market of CO_2 transformation and utilisation.

For the first time, the Intergovernmental Panel on Climate Change, in its 6th assessment report released in 2022 (IPCC 2022), recognises Carbon Capture and Utilisation (CCU) as one of the solutions to mitigate climate change. Several future scenarios for a net-zero chemical industry in 2050 show that between 10 and 30 % of the demand for embedded carbon will come from the utilisation of CO_2 (Kähler et al. 2023).

The potential of CCU has also been acknowledged by several global brands which are already expanding their feedstock portfolio. Cooperation along the value chain is key to properly level the costs and benefits. In Europe, investments and prospects for CO_2 utilisation are largely undermined by a lack of policy support. In contrast, we find supportive regulations in the USA with the Inflation Reduction Act as well as in China. In the USA the use of CO_2 for fuels and chemicals from air capture and also from point sources is supported, including commercial plants (de la Garza 2022). Such smart policies are needed to build the bridge between now and 2050 for companies to remain competitive in the sustainable transformation.

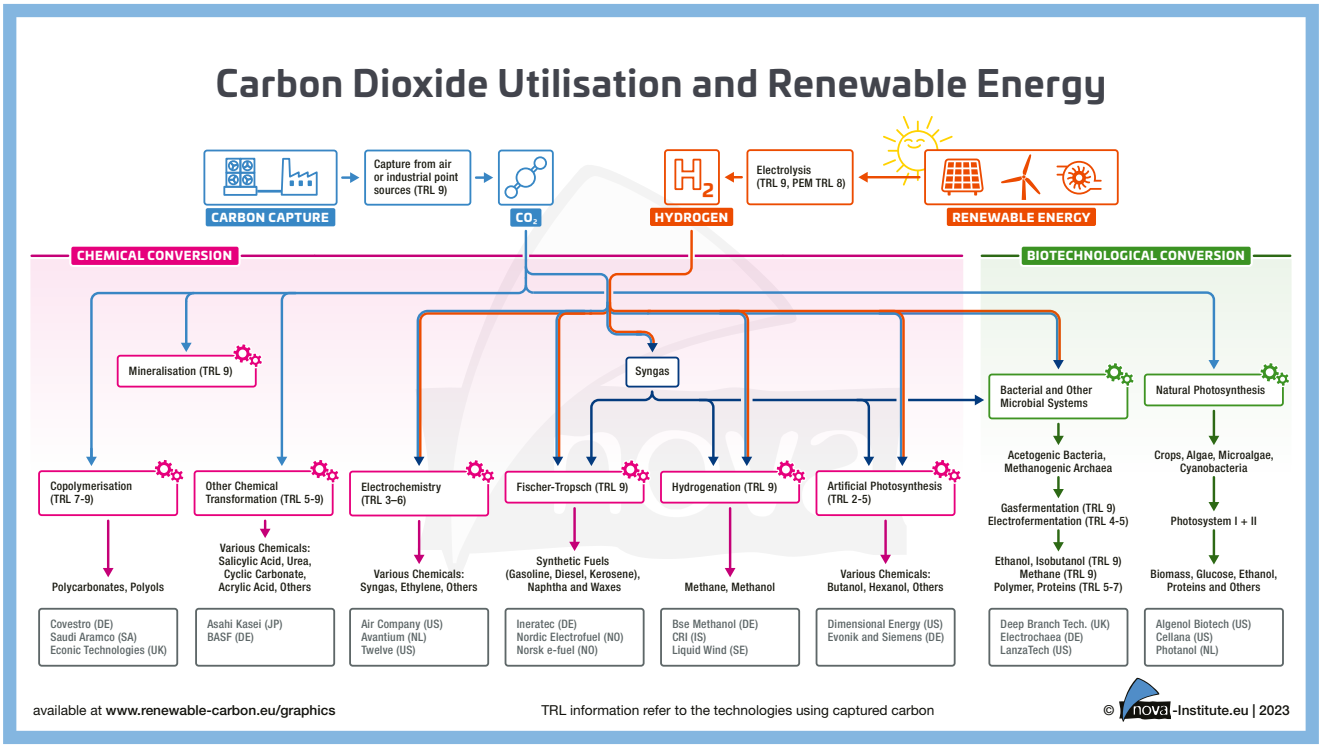


Figure 1: Carbon Dioxide Utilisation and Renewable Energy

Thankfully, academics and industries have not waited to intensively develop and implement CCU technologies. Several successfully implemented technologies used at commercial level are now in place and many more at the laboratory and pilot phase. Currently, CO_2 and other C1-rich gases like carbon monoxide (CO) are captured from fossil and biogenic point sources, but also Direct Air Capture (DAC) projects are multiplying. From there, CO_2 can be converted by chemical, biotechnological and electrochemical pathways into chemicals, advanced fuels, polymers, proteins or minerals.

Conventional chemical conversion of CO_2 has been used since decades at the commercial level for the production of chemicals such as salicylic acid, urea, ethylene and propylene carbonate. CO_2 can also be used directly e.g. for enhanced oil recovery, fire extinguishers or as plant growth accelerator in green houses. Novel chemical pathways focus on CO_2 transformation, the most promising currently being the CO_2 hydrogenation to methane or methanol. The first can be fed into the natural gas grid and contribute to the strategy to reduce the dependence from natural gas providers, the latter can be easily and highly efficiently used as fuel for the transportation sector or as a chemical building block.

High interest is also observed in the Fischer-Tropsch technology to produce synthetic fuels and chemicals. As such, this technology is a hundred-year-old and mainly used for coal gasification and utilisation. Coupled with CO_2-based syngas, it is able to produce sustainable CO_2-based hydrocarbons such as kerosene, diesel and naphtha and waxes. A strong activity is seen for CO_2-based kerosene, the most important Sustainable Aviation Fuel (SAF). Also, CO_2-based polycarbonates, polyurethanes (PU) and polyethylene (PE) are available on the market. Finally, CO_2 can also be mineralised into a carbonate for construction materials: these technologies on the market uses the carbonation process to produce substitute products from the cement industry.

The most notable CO_2-based biotechnological conversion pathways produce ethanol at commercial scale, which is used for fuel application and for the chemical (e.g. for ethylene glycol) and the polymer (polyethylene) industry, and methane. Additionally, biodegradable polymers called polyhydroxyalkanoates (PHA) can be made via gas fermentation and are commercially available, and several other pilot plants are running for the production of chemicals and proteins via gas fermentation. Most advanced electrochemical pathways allow for the conversion of CO_2 into CO (or syngas), methanol, formic acid or ethylene. Many pilot plants are running and CO (or syngas) production via this pathway will soon be implemented in a commercial plant, combined with Fischer-Tropsch technology for the production of a wide range of hydrocarbons.

Products	CO_2-based carbon content	Production capacity 2022	2030 Outlooks
Novel CO_2-based products – 1.3 Mt/a in total in 2022, outlook at more than 6 Mt/a in 2030			
Aromatic polycarbonate (PC)	5 %	900,500 t/a	1.2 Mt/a
Ethanol	100 %	138,000 t/a	700,000 t/a For advanced fuel, chemical and polymer
Aliphatic polycarbonate (APC)	11–12 %	120,000 t/a	300,000 t/a Mostly PPC, PEC, high molecular weight
Methanol	100 %	ca. 115,000 t/a	1 Mt/a Mostly by CO_2 hydrogenation, some electrochemical pathways in development
Polycarbonate polyols	5–6 %	50,000 t/a	Increasing capacity by 2030 Low molecular APC, used in polyurethane synthesis
Polyhydroxy-alkanoates (PHA)	100 %	5,000–10,000 t/a	ca. 30,000 t/a
Minerals	100 %	3 commercial plants, several pilot and demonstration plants	Several commercial plants Mostly used for cement applications
Methane	100 %	Several pilot plants	ca. 320,000 t/a fed into the gas grid
Hydrocarbons Include kerosene, diesel, gasoline, naphtha, waxes	100 %	ca. 700 t/a	Due to the ReFuel Aviation EU proposal synthetic sustainable aviation fuels (SAF) should reach a share of 5 % by 2035, this would mean about 3 Mt/a, automatic additional capacity will be achieved for the other fractions.
Proteins	100 %	Pilot plants	2 commercial plants, first in 2030 Mostly for feed applications

Table 1:
CO_2-based products: 2022 production capacity and 2030 outlooks

A current total production capacity of novel CO_2-based products of ca. 1.3 Mt/a in 2022 is observed. The production capacity in 2022 is dominated by the production of CO_2-based aromatic polycarbonates, ethanol from captured CO/CO_2, aliphatic polycarbonate and methanol. The capacity outlook by 2030 for CO_2-based products will probably exceed 6 Mt/a of CO_2-based products. High dynamic growth is observed for methanol projects, methane plants, ethanol and hydrocarbons – the latter especially for the aviation sector.

CCU-based products have lower greenhouse gas emissions (GHG) than comparable fossil-based products – if the entire energy used to capture and transform CO_2 comes from renewable sources and green hydrogen. Already today, many technologies can achieve high GHG emission reduction up to 90 % when compared with fossil-based technologies.

nova-Institute's new report examines this renewable carbon source in detail: which products can be produced from CO_2, and by which processes? How far have the technologies already been developed and implemented in pilot, demonstration and commercial plants? Which companies are working on technologies to uses CO_2 as a feedstock? What are the trends in the coming years in CO_2 utilisation? This report addresses the fuel, chemical and materials industry, brands, technology scouts, investors, and policy makers. The report provides 240 pages of information around CO_2 utilisation. All mentioned companies are described in 116 detailed company profiles.

Meet the main authors of this nova report at the conference! Pauline Ruiz, Pia Skoczinski, Achim Raschka, Nicolas Hark and Michael Carus would be glad to exchange with you on any topics around Carbon Capture and Utilisation.

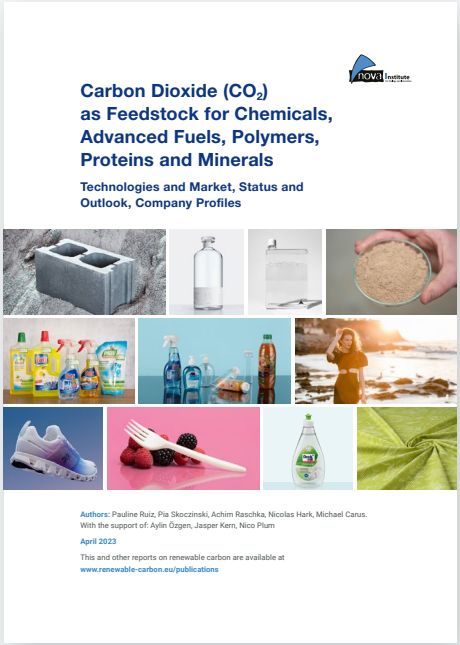
Additionally, don't miss the presentation of Pauline Ruiz on the 2nd day of the conference at 11:00: "CO_2 Utilisation for Chemicals and Materials – An Overview on Technologies, Key Players, Markets and Trends". She will provide a comprehensive overview of the main findings of the report, focusing on chemicals and materials.

References:

De la Garza, A. 2023: The Inflation Reduction Act Includes a Bonanza for the Carbon Capture Industry (www.time.com). Last access 23-03-01. https://time.com/6205570/inflation-reduction-act-carbon-capture/

IPCC 2022: Climate Change 2022 Mitigation of Climate Change. Last access 2022-12. https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_FullReport.pdf

Kähler, F., Porc, O., Carus, M. 2023: RCI Report: Carbon Flows. Compilation of supply and demand of fossil and renewable carbon on a global and European level. Renewable Carbon Initiative, February 2023 (Ed.), Download at www.renewable-carbon-initiative.com



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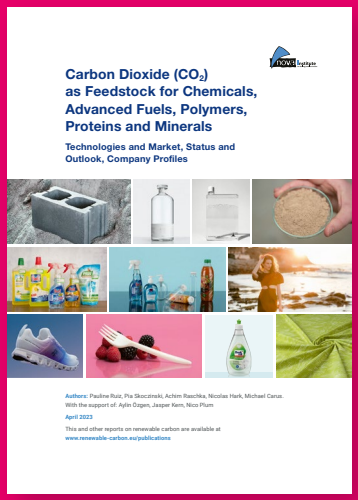
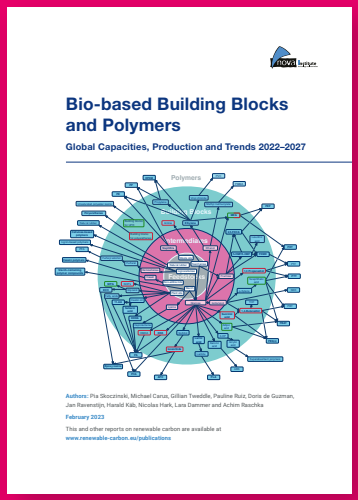
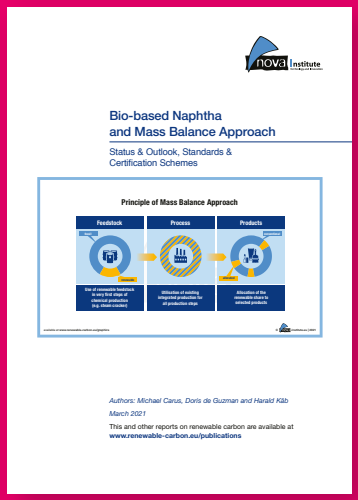
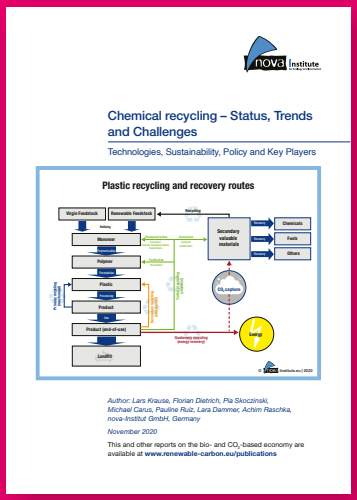
nova Market and Trend Reports on Renewable Carbon

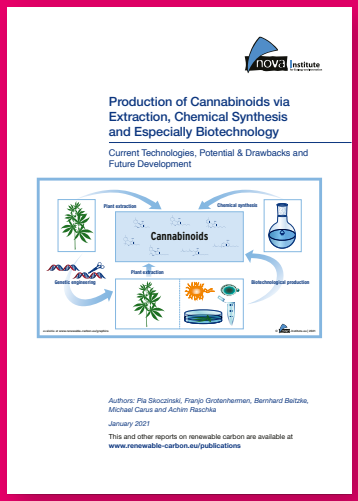
The Best Available on Bio- and CO_2-based Polymers & Building Blocks and Chemical Recycling

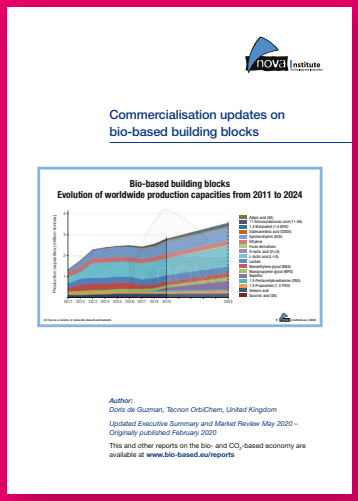


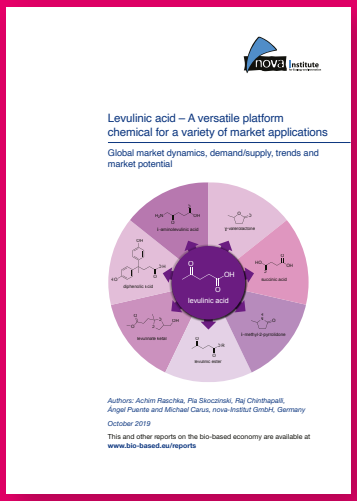












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Carbon capture and storage or utilization (CCS/CCU) is a key strategy that businesses can adopt to reduce their CO_2 emissions. By selecting the right technologies, pressing climate change mitigation targets can be met while benefitting from new revenue streams.

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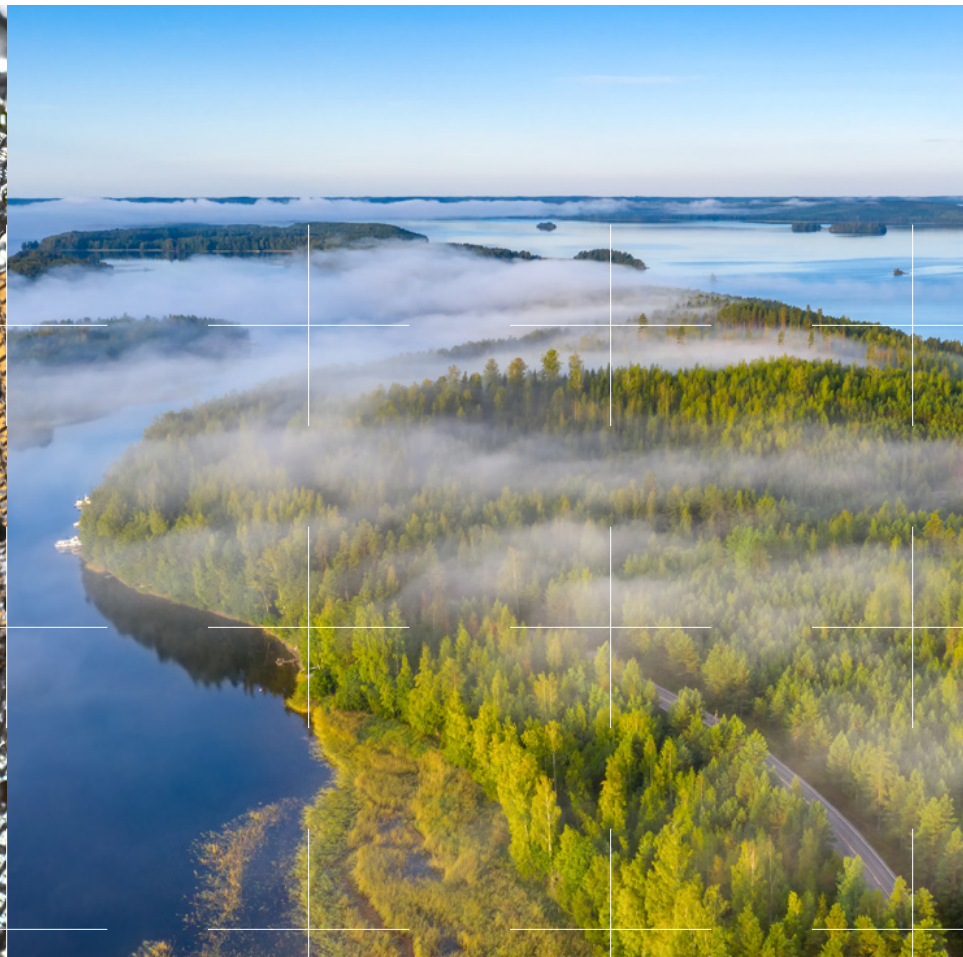


Day 1

19 April 2023
9:30–18:15 (CET)

9:30

Michael Carus
nova-Institute (DE)
Conference Opening

Innovation, Strategy and Policy

Chairpersons: Achim Raschka & Pia Skoczinski
nova-Institute (DE)

9:50

Michael Carus & Christopher vom Berg
nova-Institute (DE)
CCU is much more than a Carbon Removal Technology

10:10

Anastasios Perimenis
CO_2 Value Europe (BE)
A European Roadmap for Carbon Capture and Utilisation (CCU)

10:30

Stephen McCord
University of Michigan (US)
Track 2 CO_2-based Products

10:50

Wim van der Stricht
ArcelorMittal (BE)
The ArcelorMittal Strategy towards Carbon Neutral Steel Production

11:10

Nicolas Hark
nova-Institute (DE)
What does EU Policy have in Store for Carbon Capture?

11:30
Discussion with all Speakers of the Session

11:45
Lunch & Networking

Carbon Capture and Green Hydrogen Production

Chairpersons: Achim Raschka & Pia Skoczinski
nova-Institute (DE)

13:15

Nicoletta Brazzola
ETH Zürich (CH)
Policy Pathways to Reduce DAC Costs

13:35

Enric Prats-Salvado
Institut für Future Fuels, Deutsches Zentrum für Luft- und Raumfahrt (DLR) (DE)
Solar-Powered Direct Air Capture: Techno-Economic and Environmental Assessment

13:55

Selina Ambrose
Promethean Particles (UK)
Metal Organic Frameworks (MOFs): Enabling Energy-Efficient Carbon Capture for the Growing CO_2 Utilisation Market

14:15

Henrike Gebhardt
RWE (DE)
Green Hydrogen as Enabler for CO_2-based Value Chains

14:35
Discussion with all Speakers of the Session

14:50
Coffee Break & Networking

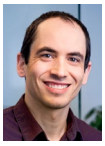
Power-to-X

Chairpersons: Achim Raschka & Pauline Ruiz
nova-Institute (DE)

15:20

Elena Perez Gallent
TNO (NL)
Process Intensification of CCU Technologies: Integration of CO_2 Capture with Electrochemical CO_2 Conversion Towards Added Value Products

15:40



Emeric Sarron
Carbon Recycling International (IS)
Commercial Scale Production of Methanol from Captured CO_2 and Hydrogen

16:00

Babette Pettersen
LanzaTech (US)
Enabling a Circular Economy: Carbon-Negative Fuel and Chemical Production by Eliminating Waste

16:20
Discussion with all Speakers of the Session

Presentations of the Nominees for the "Best CO_2 Utilisation 2023"

Chairpersons: Michael Carus & Asta Partanen
nova-Institute (DE)

16:35
Michael Carus
nova-Institute (DE)
Innovation Award Introduction

16:45
Anastasios Perimenis
CO_2 Value Europe (BE)
Innovating to Make CCU Products Part of our Everyday Life

16:55
Michael Mitsakos
Arkeon (AT)
Arkeon

17:05
Thomas Mairegger
Rohrdorfer (DE)
AURORA – The Sunrise by Electrochemically-produced Formic acid from Cement-based CO_2

17:15
Rahul Shendure
CarbonBuilt (US)
CarbonBuilt: Ultra-low Carbon Concrete

17:25
Marc Vocht
DITF Denkendorf (DE)
$CellCO_2$

17:35
Babette Pettersen
LanzaTech (US)
CleanCloud together with On, Technip Energies and Borealis

17:45
Andrew Symes
OXCCU Tech (UK)
OXCCU

17:55
Online Voting

18:05
Martin Lindmeyer
YNCORIS (DE)
Innovation Award Ceremony

18:15
Networking with Local Beer (Sponsored by Borealis)

20:00
Gala Dinner

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Our mission is to engineer defossilisation for the chemical & bio-based industry:

- Engineering of production processes from pilot- over demo- to industrial-scale
- Accompanying engineering projects from early stage to full-scale commissioning including technology assessment, feasibility studies, etc.
- Process optimization due to experiences in plant operation

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www.yncoris.com

Innovation Award "Best CO_2 Utilisation 2023"

Conference Advisory Board

We would like to thank the experts of the conference advisory board for their great help in selecting the best submitted papers and innovations.

Heleen De Wever
VITO (BE)

Markus Müller
CLIB (DE)

Volker Sick
University of Michigan (US)

Christoph Gürtler
Covestro (DE)

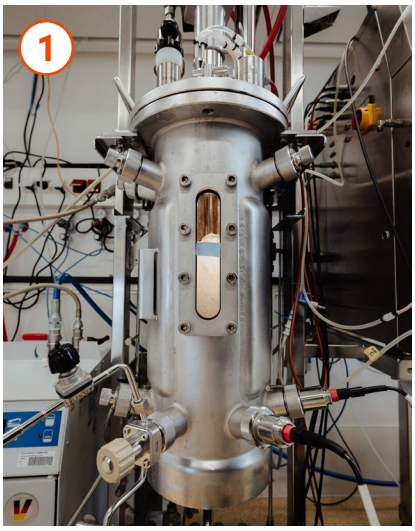
Célia Sapart
CO_2 Value Europe (BE)

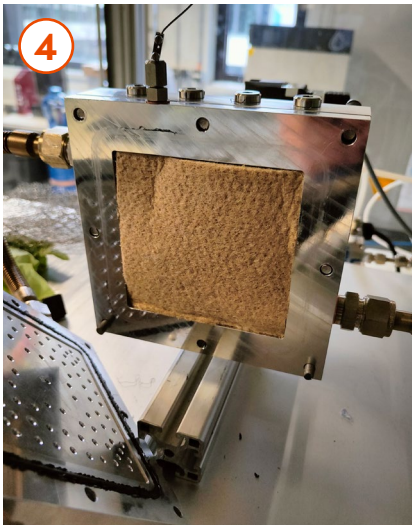
Haralabos Zorbas
IBB Netzwerk (DE)

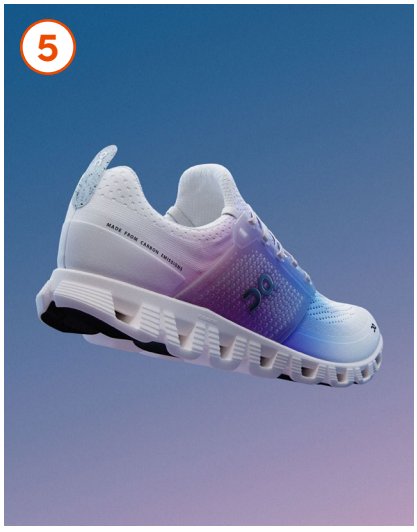
Martin Lindmeyer
Yncoris (DE)

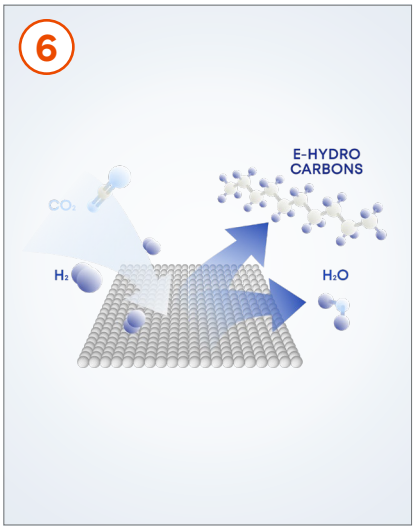
Christian Schweitzer
bse Engineering Leipzig (DE)

Nominees of the Innovation Award









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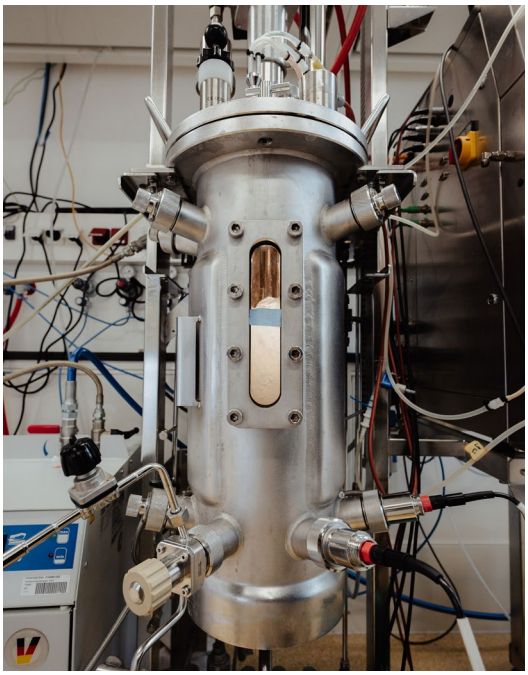
1

Arkeon
Arkeon (AT)



Arkeon's proprietary technology leverages archaea microorganisms that naturally produce all the building blocks of proteins in only one fermentation. The company's process converts CO_2 directly into amino acids and functional peptides, enabling an entirely new world of food products. With a team that comprises world-leading archaea biologists, process engineers, food scientists and fermentation technologists, the company is on a mission to change food production on a global scale.

More information:
www.arkeon.bio

2

AURORA – The Sunrise by Electrochemically-produced Formic acid from Cement-based CO_2
Rohrdorfer (DE)

Formic acid is electrochemically produced from cement-based CO_2 by a single step process. The technology provides a cradle-to-gate process from flue gas to a high-value-added chemical. It entails the first CO_2 capture plant in a cement company and a one-of-a-kind CO_2 electrolyser unit, enabling the single step formation of formic acid, without the further need of purification or acidification. This is achieved by using an adapted PEM water electrolyser setup, modifying only the cathode side, the use of aqueous formic acid as catholyte itself and elevated CO_2 pressures. Formic acid is not only a commodity chemical, used in disinfectants, cleaning supplies or rubber production, but also offers options to revolutionise the cement process, enabling net zero cement production, and the protein production.

More information:
www.rohrdorfer.eu

3

CarbonBuilt: Ultra-low Carbon Concrete
CarbonBuilt (US)

CarbonBuilt's revolutionary carbon utilisation technology reduces the embodied carbon of concrete by 70–100 %. The technology replaces cement with a proprietary mix of low-cost, low-carbon industrial waste materials. The used CO_2 is captured from on-site waste biomass incineration or emerging Direct Air Capture (DAC) technologies to cure (harden) the mix into concrete, storing the CO_2 permanently. Because CO_2 becomes the key ingredient in ultra-low concrete production (a hundred-billion-dollar market) CarbonBuilt expects to be one of the world's largest purchasers of captured carbon and thus accelerate development of capture technologies.

More information:
www.carbonbuilt.com

4

$CellCO_2$
DITF Denkendorf (DE)

The $CellCO_2$ is a CO_2 adsorber material based on amines functionalised cellulosic fibre materials e.g., non-woven. The technology starts with the converting of cellulosic fibres into the non-woven followed by chemical modification of the surface with amines. The advantage of using non-woven is the open, air-permeable structure allowing a high air throughput. Furthermore, non-woven also have a large specific surface area, which is advantageous for binding the largest possible volumes of CO_2. Due to the structure the material can be used in a continuously operating process that permits continuous and energy-saving operation.

More information:
www.ditf.de

5

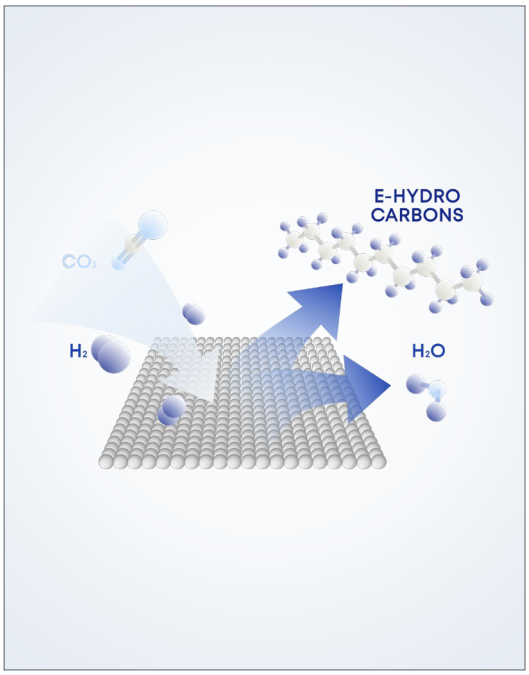
CleanCloud
LanzaTech, On, Technip Energies and Borealis (several)

On is revealing the first ever shoe made from carbon emissions, called Cloudprime. Cloudprime is made from CleanCloud™ ethyl vinyl acetate foam that uses carbon emissions as a raw material. On is the first company in the footwear industry to explore using carbon emissions as a primary raw material for a shoe's midsole. On is moving away from using fossil feedstock and exploring alternative materials for producing high-performance sports products. CleanCloud™ is the result of a pioneering supply chain partnership with some of the most innovative companies in biochemicals, process and material innovation, including LanzaTech, Borealis and Technip Energies.

More information:
www.borealisgroup.com
www.lanzatech.com
www.on-running.com
www.technipenergies.com

6

OXCCU
OXCCU Tech (UK)



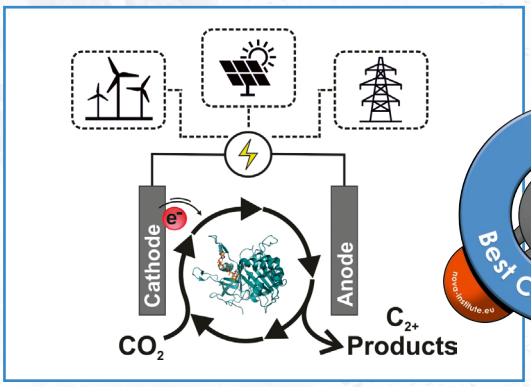
OXCCU is a one-step process that converts CO_2 directly into jet fuel range hydrocarbons (and/or alpha olefins for chemicals) by using a novel iron catalyst. The process and catalyst were developed by Prof. Peter Edwards, Dr. Tiancun Xiao and Dr. Benzhen Yao from the University of Oxford (www.nature.com/articles/s41467-020-20214-z). OXCCU Tech is commercialising this process. ASPEN modelling has shown that this process has the potential to reduce both Capex and Opex cost by half when compared to a hypothetical two-step Fischer-Tropsch process, thereby significantly reducing the cost of synthetic fuel enabling cost effective scalable sustainable aviation fuel to decarbonise aviation.

More information:
www.oxccu.com

Winners of the Innovation Award "Best CO_2 Utilisation 2022"

CleanO₂ Soap
CleanO₂ Carbon Capture Technologies (CA)

Power To Protein
Avecom (BE)



eBioCO₂n Technology
Fraunhofer IGB,
MPI Marburg,
TUM Campus Straubing (DE)

More Than Just Soap

We put captured carbon into premium everyday goods

How do we make captured carbon products?

Our circular concept is simple. We capture carbon from natural-gas heating appliances using our CarbinX™ technology. CarbinX converts that carbon into potassium carbonate, an ingredient that's used in all of our products. From hand soap to fertilizer, our premium products help you fight climate change.

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carbinx@cleano2.ca
carbinx.com

Consumer Product Sales
soap@cleano2.ca
cleano2.ca

2022 1 Best CO_2 Utilisation CleanO2 Carbon Capture Technologies

CleanO2®

Winner of Best CO2 Utilisation 2022

Day 2

20 April March 2023
9:00–17:30 (CET)

9:00

Achim Raschka & Pia Skoczinski
nova-Institute (DE)
Conference Opening

Power-to-Fuels

Chairpersons: Achim Raschka & Pia Skoczinski
nova-Institute (DE)

9:10

Catherine Laroche
IFPEN (FR)
From CO_2 Capture to E-Fuels Production, Integration is Key

9:30

Gunnar Holen
Nordic Electrofuel (NO)
Production of E-Fuels

9:50

Maartje Feenstra
Institute for Sustainable Futures, University of Technology Sydney (AU)
Sustainable Aviation Fuels in the One Earth Climate Model's 1.5 °C scenario: Where Does the (Sustainable) Carbon Come From?

10:10
Discussion with all Speakers of the Session

10:30
Coffee Break & Networking

CO_2-to-Polymers and Materials

Chairpersons: Pia Skoczinski & Michael Carus
nova-Institute (DE)

11:00

Pauline Ruiz
nova-Institute (DE)
CO_2 Utilisation for Chemicals and Materials – An Overview on Technologies, Key Players, Markets and Trends

11:20

Liz Manning
Econic Technologies (UK)
Application of CO_2 Containing Polyols

11:40

Jan Thiel
Institut für Textiltechnik der RWTH Aachen University (DE)
Application of CO_2-containing Thermoplastic Polyurethane Yarns in Elastic Textiles

12:00

Floris Buijzen
Borealis (AT)
Turning Carbon Emissions into Running Shoes

12:20

Heleen De Wever & Deepak Pant
Flemish Institute for Technological Research (VITO) (BE)
Electrochemical Production of C1 Chemicals and their Bioconversion to Polymers

12:50
Discussion with all Speakers of the Session

13:10
Lunch & Networking

CO_2-to-Chemicals and Minerals

Chairpersons: Michael Carus & Pauline Ruiz
nova-Institute (DE)

14:40

Christine Rasche
Fraunhofer IGB (DE)
Combining Chemistry and Biotechnology for the Production of CO_2-based Chemicals – Chances and Risks

15:00

Lucia D'Accolti
University of Bari (IT)
Steel Slag as Low-Cost Catalyst for Artificial Photosynthesis

15:20

Cecilia Mondelli
Sulzer Chemtech (CH)
CO_2 Capture meets Mineralization in the Liquid Phase for a Sustainable Construction Industry

15:40
Discussion with all Speakers of the Session

Room Laurentius, no online transmission

Parallel Session: Advanced Research in CCU

Chairpersons: Achim Raschka & Pia Skoczinski
nova-Institute (DE)

14:40

Sophie van Vreeswijk
Avantium (NL)
Circular Utilisation of CO_2 from Waste Water in the WaterProof Project

15:00

Marcelo Echeverri
Fundacion para el Desarrollo y la Innovacion Tecnologica (FUNDITEC) (ES)
Valuable Chemicals from CO_2 and Renewable Feedstocks, a Polyimine-based Heterogeneous Catalysts Approach

15:20

Verena Süß
Fraunhofer ICT (DE)
Synthesis of Ethanol from CO_2 and H_2

15:40
Discussion with all Speakers of the Session

16:00
Coffee Break

16:30

Mohammad Rezaei
GIG Karasek (AT)
Electrochemical CO_2 Transformation: Efforts and Perspectives of an Industrial Plant Constructor

16:50

Nicholas Flanders
Twelve (US)
Carbon Transformation: A World from Air

17:10
Discussion with all Speakers of the Session

17:25
End of Conference

RENEWABLE MATERIALS CONFERENCE 2023

23–25 May • Siegburg/Cologne (Germany)

renewable-materials.eu

The brightest stars of Renewable Materials

Bio-based, CO_2-based and recycled – 500 participants expected on-site

First day

- Future of the Chemical Industry
- Renewable Refineries
- Carbon Flows and Carbon Management
- Circularity and Chemical Recycling
- PHAs: Deep Dive
- New Label, Product Environmental Footprint (PEF) and Mass Balance
- Biodegradable Plastics

Second day

- Renewable Chemicals and Building Blocks
- PLA, PBAT, PBS and PHA
- Renewable Polymers & Plastics
- Fine Chemicals
- PEF / FDCA / Furanics
- Innovation Award

Third day

- Latest nova Research
- New Technologies for Efficient Renewable Processes
- The Policy & Brands View
- Renewable Plastics and Composites
- Transition Pathways for the Chemical Industry
- Biodegradation

RENEWABLE MATERIAL OF THE YEAR 2023

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1

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Welcome to our Business Directory "Renewable Carbon Companies"

The Who's Who of Renewable Carbon – Find Sustainable Alternatives for Fossil Based Chemicals and Materials

The business directory "Renewable Carbon Companies (ReCaCo)" has established itself as the primary source of information on renewable and sustainable material solutions. Innovative companies in the field of renewable carbon present their products, intermediates and services. ReCaCo began as a directory for bio-based businesses in 2009, the service provided by nova-Institute has evolved to include CO_2-based and recycling enterprises as well. Today, more than 20,000 company profiles are downloaded every year. They represent large and small corporations, trade associations, agencies, engineering and research institutions as well as certification bodies.

Submit your 2-page company profile free of charge at:
renewable-carbon.eu/companies/join/registration

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RENEWABLE CARBON COMPANIES

nova Institute for Ecology and Innovation

Valuable Quotes

ArcelorMittal (BE)
Wim Van der Stricht
"Steel and Chemicals, the beginning of a beautiful friendship."

Avantium (NL)
Sophie van Vreeswijk
"An explanation how to increase circularity by the conversion of CO_2 from waste streams to formic acid within the WaterProof project."

Borealis (AT)
Floris Buijzen
"Borealis will present our developments and developed applications in the field of carbon circularity with a focus on using renewable feedstocks (including atmospheric CO_2) to produce sustainable polyolefins."

CO_2 Value Europe (BE)
Anastasios Perimenis
"Bringing together the CCU community to develop a Roadmap establishing the role of CCU in the transition to a sustainable circular economy."

Econic Technologies (UK)
Liz Manning
"The current status of CO_2 containing polyols and their application to produce sustainable polyurethane materials."

FUNDITEC (ES)
Marcelo Echeverri
"He will talk about the results obtained on the conversion of CO_2 to useful bio-based building blocks employing novel heterogeneous catalysts based on porous organic polymers, designed to enhance both the affinity to CO_2 and the metal binding within the porous polymer structure."

Institut für Future Fuels,
Deutsches Zentrum für Luft- und Raumfahrt (DLR) (DE)
Enric Prats-Salvado
"We describe and analyze a novel approach to capture CO_2 from the atmosphere using solar energy."

ETH Zurich (CH)
Nicoletta Brazzola & Katrin Sievert
"In this presentation, we first evaluate the potential for cost reductions in direct air capture and then assess the needs and barriers this technology faces when used either as a method for carbon removal or for CO_2 utilization, such as for the production of synthetic fuels and chemicals."

Fraunhofer ICT (DE)
Verena Süß
"The direct synthesis of ethanol from CO_2 is an important element for a sustainable future."

Fraunhofer Institute for Interfacial Engineering and Biotechnology (DE)
Christine Rasche
"We need to think about new ways to combine technologies to leverage the whole potential of CO_2-utilization."

GIG Karasek (AT)
Mohammad Rezaei
"Accelerating the transition to a decarbonized and defossilized future in industrial production through the development of a stacked electrolysis system for the electrochemical conversion of CO_2 into essential chemicals and fuels."

IFPEN (FR)
Catherine Laroche
"IFPEN is now developing a CO_2 conversion process into syngas using reversed water gas shift process, allowing a global integration of proprietary processes from CO_2 capture to synthetic paraffinic fuels production."

Institute for Sustainable Futures,
University of Technology Sydney (AU)
Maartje Feenstra
"Sustainable carbon is a (at the moment) limited resource that must be carefully developed and monitored, especially with its crucial role in sustainable scenarios for hard-to-abate sectors such as aviation."

LanzaTech (US)
Babette Pettersen
"LanzaTech has developed a comprehensive synthetic biology capability for gas fermenting bacteria for the direct production of over 100 alternative chemical outputs using a gas fermentation process, including Isopropyl alcohol (IPA), Monoethylene Glycol (MEG), Acetone and most recently, Ethylene, from carbon captured from industrial emissions."

Nordic Electrofuel (NO)
Gunnar Holen
"Construction of one of the world's first commercial E-fuels plants."

Phytonix (US)
Bruce Dannenberg
"I will speak about Phytonix and Cyanomega technologies for carbon dioxide utilization via photosynthetic conversion to higher alcohols and fatty acids to address the climate crises and create a circular carbon economy."

Promethean Particles (UK)
Selina Ambrose
"Promethean Particles presents the scalable and cost-effective manufacture of Metal Organic Frameworks (MOFs), a novel class of solid sorbent which can allow energy-efficient carbon capture at industrial scale for utilisation and storage."

RWTH Aachen (DE)
Jan Thiel
"This presentation will explain thermoplastic polyurethanes and their processing into elastic yarns as a potential example of successful CCU in the textile world."

Sulzer Chemtech (CH)
Cecilia Mondelli
"We are jointly developing with Blue Planet an innovative process to capture and permanently lock CO_2 in carbon-negative concrete to address one hard-to-abate emitter and take us one step closer to the net-zero target."

TNO (NL)
Elena Perez-Gallent
"Several process intensification strategies can be applied to electrochemical-based technologies in order to increase the overall performance of CO_2 conversion processes, as well as the economic profitability of the complete system."

Twelve (US)
Nicholas Flanders
"Nicholas will share Twelve's latest updates on its novel carbon transformation technology and applications."

University of Michigan (US)
Volker Sick
"Potential for market volume, CO_2 utilization amount, and product lifetime that is categorized in two simple tracks will help build the CCU industry."

VITO (BE)
Heleen De Wever
"We produced a range of polyhydroxybutyrate/valerate (PHB/V) biopolymers on methanol and performed a first extensive characterization."

VITO (BE)
Deepak Pant
"Electrochemical conversion of CO_2 provides a rapid and efficient approach to convert CO_2 into C1 products such as carbon monoxide and formic acid which can be then further converted to C2-C6 compounds using microbial and/or enzymatic routes."

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CLIB networking biotechnology creating sustainability

clib-cluster.de

GLOBAL CO2 INITIATIVE UNIVERSITY OF MICHIGAN

globalco2initiative.org

IBB Netzwerk GmbH

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kunststoffland-nrw.de

PLASTICS EUROPE Enabling a sustainable future

plasticseurope.org

RENEWABLE CARBON INITIATIVE CO_2

renewable-carbon-initiative.com

VOLTA CHEM

voltachem.com

THE RENEWABLE CARBON INITIATIVE

Shape the Future of the Chemical and Material Industry

Circular Economy

Renewable Carbon Initiative (RCI) was founded in September 2020. RCI members are committed to create a sustainable, fossil-free future for the chemical and material industry.

Why join RCI?

RCI is an organisation for all companies working in and on sustainable chemicals and materials – renewable chemicals, plastics, composites, fibres and other products can be produced either from biomass, directly via CO_2 utilisation, or recycling.

RCI members profit from a unique network of pioneers in the sustainable chemical industry creating a common voice for the renewable carbon economy.

RCI offers its Members

- Advocacy
- Scientific background reports
- Position papers
- Networking
- Working groups

MEMBERS

ADM · Alfa Laval · ALPLA · avantium · BASF · Beiersdorf · BioBTX · Borealis · Braskem · Clariant · clariter · Cosun Beet Company · Covation Bio · covestro · Dow · Econic · Evonik · Firmenich · FKuR · futerro · geno · Givaudan · Greenlyte Carbon Technologies · Peter Greven · Henkel · H&R · IBB Netzwerk · iff · IKT Stuttgart · ITA RWTH Aachen University · kemira · kuraray · LanzaTech · LEGO · Leibniz-Institut für Verbundwerkstoffe · Lenzing · Lubrizol · MANE · Neste · NORCE · nova · PCC · reckitt · SCGC · SHV Energy · Stahl · Stepan · Südzucker Group · Sulzer · SUNCOAL · symrise · TripleW · TÜV Austria · uniper · UPM Biofore Beyond Fossils · VAUDE · Verbio · WACKER

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More Members, Partners and Information
www.renewable-carbon-initiative.com
Contact: **verena.roberts@nova-institut.de**
#renewablecarbon

See you next year

CO_2-based Fuels and Chemicals Conference 2024

17–18 April • Cologne (Germany)

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