

Conference on CO₂-based Fuels & Chemicals **2023**

19–20 April • Cologne (Germany)

Conference Journal

Innovation Award
Sponsor

YNCORIS
Industrial Services

Bronze Sponsors

GIG KARASEK
A Member of Dr. Aichhorn Group

SULZER

Beer on Tap Sponsor

BOREALIS

OMV

Award Co-Organiser

**CO₂ VALUE
EUROPE**

Organiser

nova Institute
for Ecology and Innovation

Contact

Dominik Vogt
Conference Manager
+49 151 – 19 52 47 30
dominik.vogt@nova-institut.de



co2-chemistry.eu



Table of Contents

Introduction	4
Conference Team, Venue & Accommodation, Entrance Fee	5
Message from the Minister	6
Exhibition	7
nova-Institute	8
nova-Institute's New Report on CO ₂ Utilisation	10
Program Day 1, 19 April 2023	15
Nominees of the Innovation Award 2023	19
Winners of the Innovation Award 2022	24
Program Day 2, 20 April 2023	26
Valuable Quotes on CO ₂ -based Fuels and Chemicals	30
Media Partners & Partners	32
Renewable Carbon Initiative	33



Free WiFi

Network ID

nova-Conference

Password

#2023CCU



Join at Sli.do for
real time questions
and comments

#2023CCU



Twitter

#2023CCU



Conference Program

Day 1

19 April 2023,
9:30–18:15 (CET)

P.15

Session 1:

Innovation, Strategy and Policy

Session 2:

Carbon Capture and Green
Hydrogen Production

Session 3:

Power-to-X

Session 4:

Presentations of the Nominees for
the “Best CO₂ Utilisation 2023”

Day 2

20 April 2023,
9:00–17:30 (CET)

P.26

Session 1:

Power-to-Fuels

Session 2:

CO₂-to-Polymers and Materials

Session 3:

CO₂-to-Chemicals and Minerals

Parallel Session:

Advanced Research in CCU

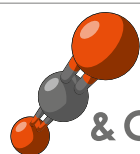
SAVE THE DATE

**CO₂-based Fuels
and Chemicals
Conference 2024**

**17 – 18
APRIL
2024**



co2-chemistry.eu



Conference on CO₂-based Fuels & Chemicals 2023

19–20 April • Cologne (Germany)

Dear Participants,

Welcome to the now 11th edition of our “Conference on CO₂-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 CO₂-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 CO₂ 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 electrolyzers 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 CO₂-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 CO₂ 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? CO₂ 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 CO₂ and we have the chance to actively shape this path together.

Yours sincerely

Michael Carus
CEO



Dr Pia Skoczinski
Program



Achim Raschka
Program





Your Conference Team



Michael Carus
CEO
michael.carus@nova-institut.de



Dušica Banduka
Zoom & Speaker Management
+49 173 – 899 39 47
dusica.banduka@nova-institut.de



Brigitte Hellwig
Representative of the
nova-Institute at booth no. 6
brigitte.hellwig@nova-institut.de



Vanessa Kleinpeter
Contact & Registration
+49 2233 – 460 14 00
+49 170 – 595 96 47
vanessa.kleinpeter@nova-institut.de



Jutta Millich
Media & Partnerships
+49 561 – 50 35 80 44
jutta.millich@nova-institut.de



Guido Müller
Sponsoring
+49 151 – 41 42 30 19
guido.mueller@nova-institut.de



Dr Pia Skoczinski
Program
pia.skoczinski@nova-institut.de



Achim Raschka
Program
achim.raschka@nova-institut.de



Dominik Vogt
Conference Manager
+49 151 – 19 52 47 30
dominik.vogt@nova-institut.de

Registration



co2-chemistry.eu/registration

Venue & Accommodation



Maternushaus

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

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

Recommended Hotels

co2-chemistry.eu/venue

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 CO₂-based Fuels and Chemicals 2023



©Land NRW/R. Sondermann

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.

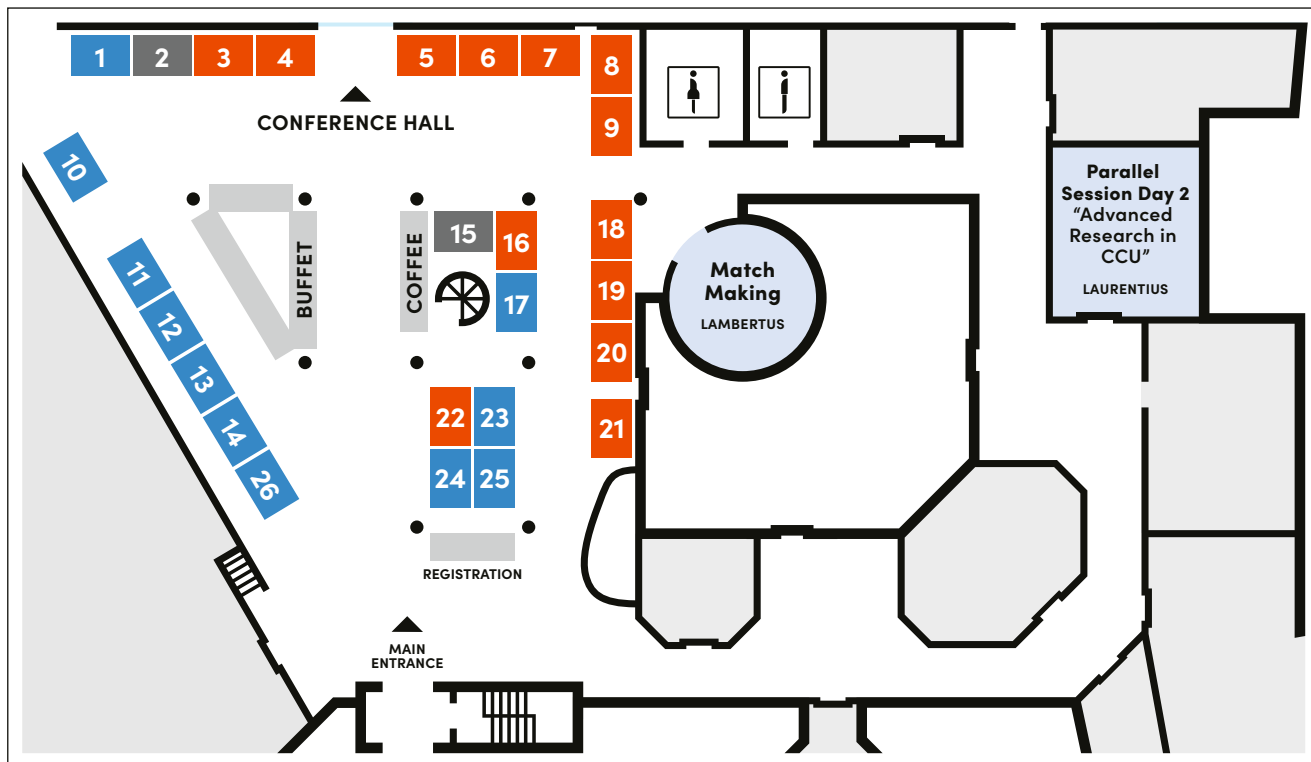
The chemical industry has the unique opportunity to benefit from the creative reuse of unavoidable quantities of carbon dioxide. By utilising CO₂ to produce synthetic fuels or chemicals, the industry will not only contribute to a significant reduction of greenhouse gas emissions. It will also manage 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 CO₂-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)**
- Booth 07 **ReCarbn (NL)**
- Booth 08 **Media Table**
- Booth 09 **Sulzer (CH)**
- Booth 16 **Endress+Hauser (DE)**
- Booth 18 **Matchmaking**
- Booth 19 **Poster Session**
The poster session will take place during the lunch break (13:10–14:40) of the second day 20th of April with a few minutes presentation
- Booth 20 **Innovation Award "Best CO₂ Utilisation 2023"**
- Booth 21 **Innovation Award "Best CO₂ Utilisation 2023"**
- Booth 22 **NANOGAP (ES)**



Book your booth:
co2-chemistry.eu/exhibition-booking

Status: 30 March 2023
 More exhibitors expected:
co2-chemistry.eu/exhibitors

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

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 CO₂ 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.



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

Our subjects include feedstock, technologies and markets, economy and policy, sustainability, communication and strategy development.

Multidisciplinary and international team of 45 scientists.

nova-Institut GmbH

Leyboldstraße 16
50354 Hürth, Germany
T +49 2233 - 460 14 00
contact@nova-institut.de

www.nova-institute.eu
www.renewable-carbon.eu
F +49 2233 - 460 14 01



Concentrating the Essentials

GIG Karasek offers cutting-edge CO₂ electrochemical utilization technology for converting captured CO₂ 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 CO₂ 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 - CO₂ 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 (CO₂) as a Renewable Carbon Feedstock – more than 1.3 million tonnes capacity for CO₂-based products already exist and are expected to at least quadruple by 2030

New report on CO₂ 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 CO₂ 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 CO₂ (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 CO₂ 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 CO₂ 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.

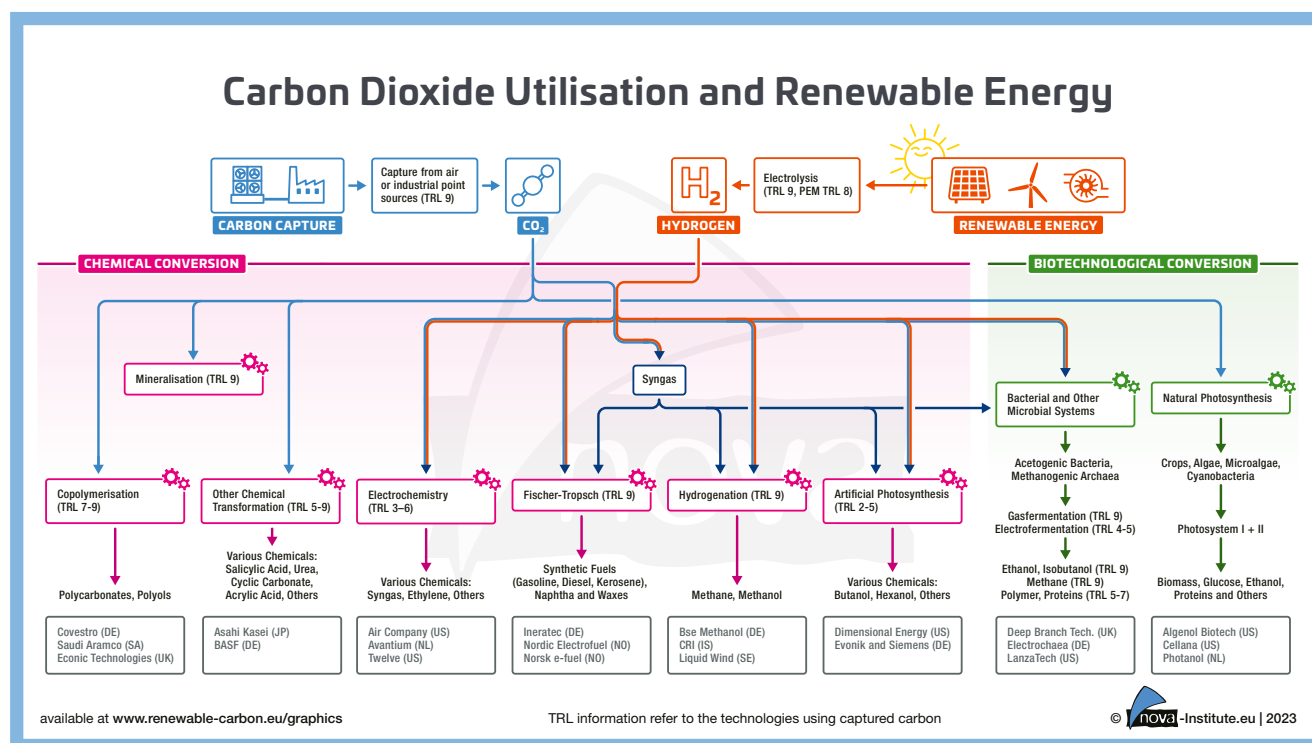


Figure 1: Carbon Dioxide Utilisation and Renewable Energy



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, CO₂ 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, CO₂ can be converted by chemical, biotechnological and electrochemical pathways into chemicals, advanced fuels, polymers, proteins or minerals.

Conventional chemical conversion of CO₂ has been used since decades at the commercial level for the production of chemicals such as salicylic acid, urea, ethylene and propylene carbonate. CO₂ 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 CO₂ transformation, the most promising currently being the CO₂ 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 CO₂-based syngas, it is able to produce sustainable CO₂-based hydrocarbons such as kerosene, diesel and naphtha and waxes. A strong activity is seen for CO₂-based kerosene, the most important Sustainable Aviation Fuel (SAF). Also, CO₂-based polycarbonates, polyurethanes (PU) and polyethylene (PE) are available on the market. Finally, CO₂ 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 CO₂-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 CO₂ 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:
CO₂-based products: 2022 production capacity and 2030 outlooks



A current total production capacity of novel CO₂-based products of ca. 1.3 Mt/a in 2022 is observed. The production capacity in 2022 is dominated by the production of CO₂-based aromatic polycarbonates, ethanol from captured CO/CO₂, aliphatic polycarbonate and methanol. The capacity outlook by 2030 for CO₂-based products will probably exceed 6 Mt/a of CO₂-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 CO₂ 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 CO₂, 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 that use CO₂ as a feedstock? What are the trends in the coming years in CO₂ 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 CO₂ 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.

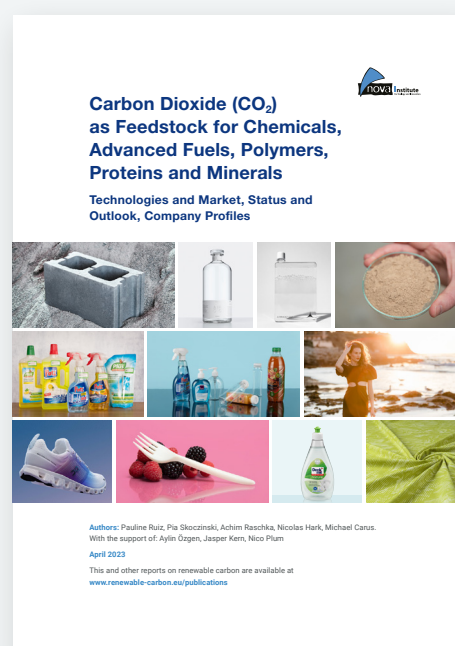
Additionally, don't miss the presentation of Pauline Ruiz on the 2nd day of the conference at 11:00: "CO₂ Utilisation for Chemicals and Materials – An Overview on Technologies, Key Players, Markets and Trends". She will provide a comprehensive overview of the main findings of the report, focusing on 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

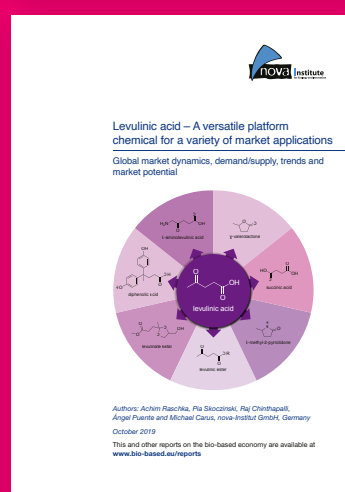
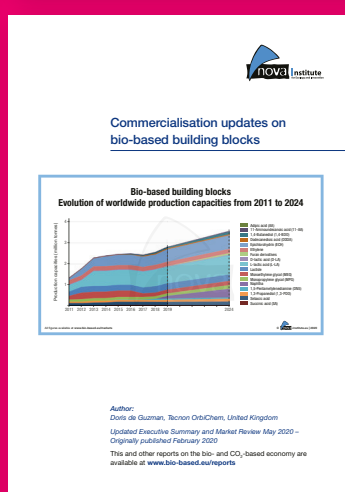
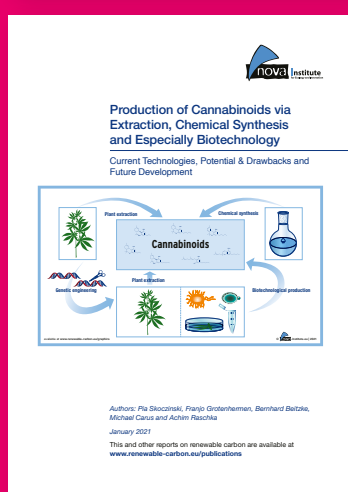
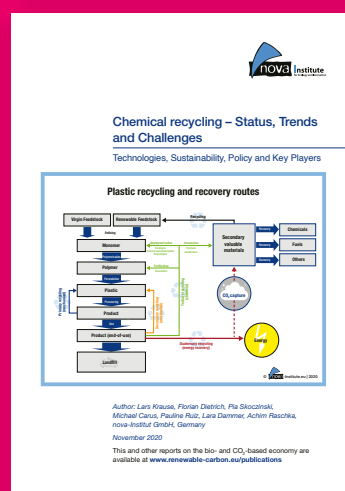
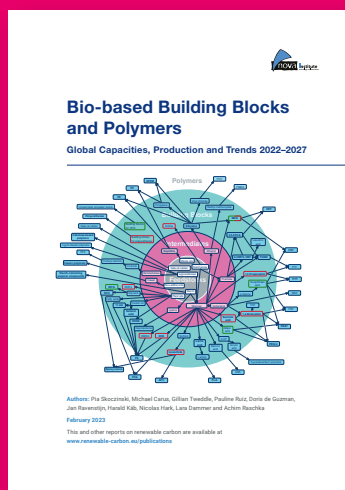
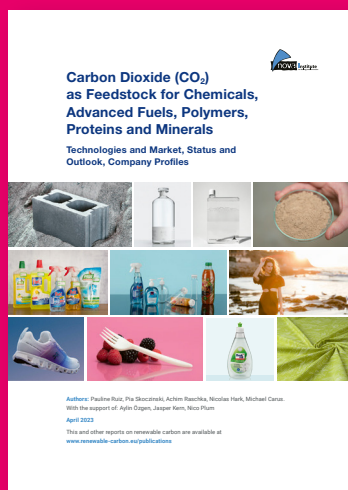
Kähler, F., Porc, O., Carus, M. 2023: RCI Report: Carbon Flows. Compilation of supply and demand of fossil and renewable carbon on a global and European level. Renewable Carbon Initiative, February 2023 (Ed.), Download at www.renewable-carbon-initiative.com



renewable-carbon.eu/publications

nova Market and Trend Reports on Renewable Carbon

The Best Available on Bio- and CO₂-based Polymers & Building Blocks and Chemical Recycling



renewable-carbon.eu/publications

Capturing green opportunities

Carbon capture and storage or utilization (CCS/CCU) is a key strategy that businesses can adopt to reduce their CO₂ emissions. By selecting the right technologies, pressing climate change mitigation targets can be met while benefitting from new revenue streams.

Sulzer Chemtech offers cost-effective solutions for solvent-based CO₂ absorption, which maximize the amount of CO₂ captured and minimize the energy consumption. To successfully overcome technical and economic challenges of this capture application, we specifically developed the structured packing MellapakCC™. This packing is currently applied in several leading CCS/CCU facilities worldwide, delivering considerable process advantages.

By partnering with Sulzer Chemtech – a mass transfer specialist with extensive experience in separation technology for carbon capture – businesses can implement tailored solutions that maximize their return on investment (ROI). With highly effective CCS/CCU facilities, decarbonization becomes an undertaking that can enhance sustainability and competitiveness at the same time. For more information: www.sulzer.com/chemtech





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
CO₂ Value Europe (BE)
A European Roadmap for Carbon Capture
and Utilisation (CCU)

10:30

Stephen McCord
University of Michigan (US)
Track 2 CO₂-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

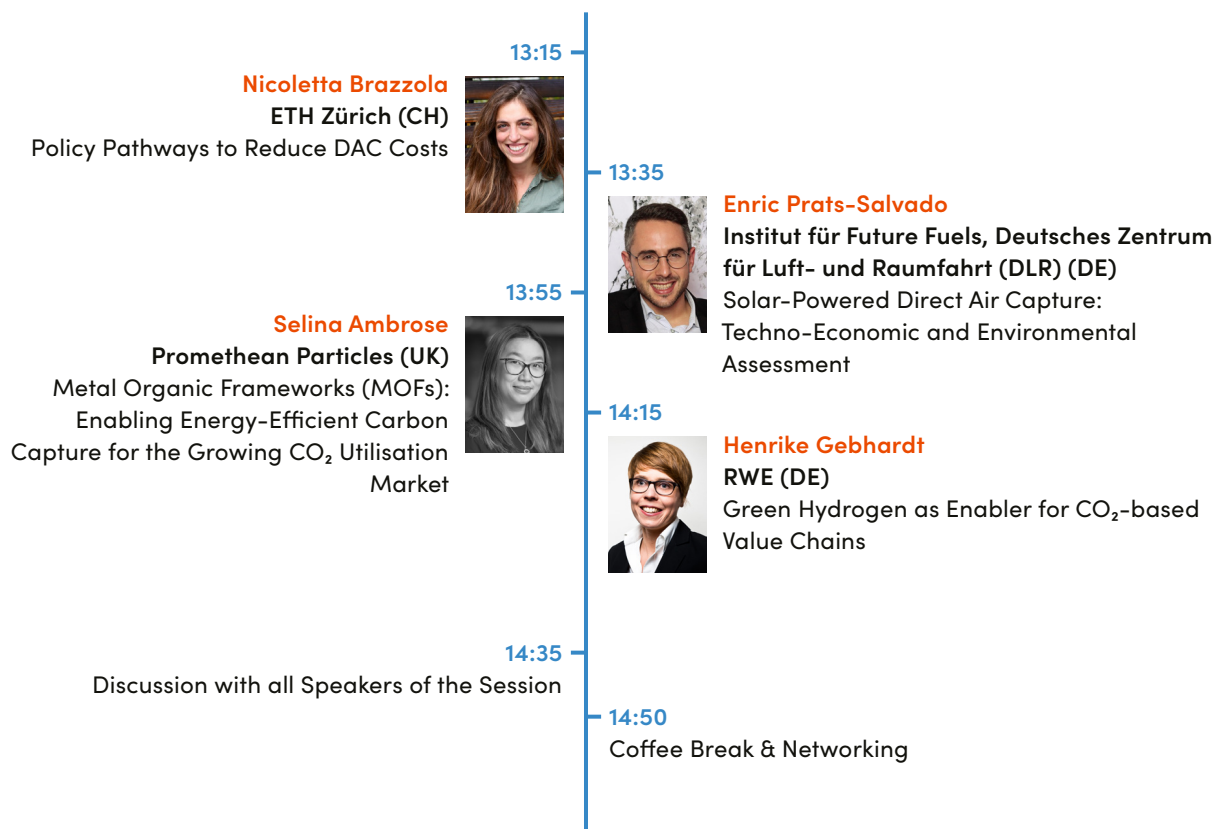
11:45

Lunch & Networking



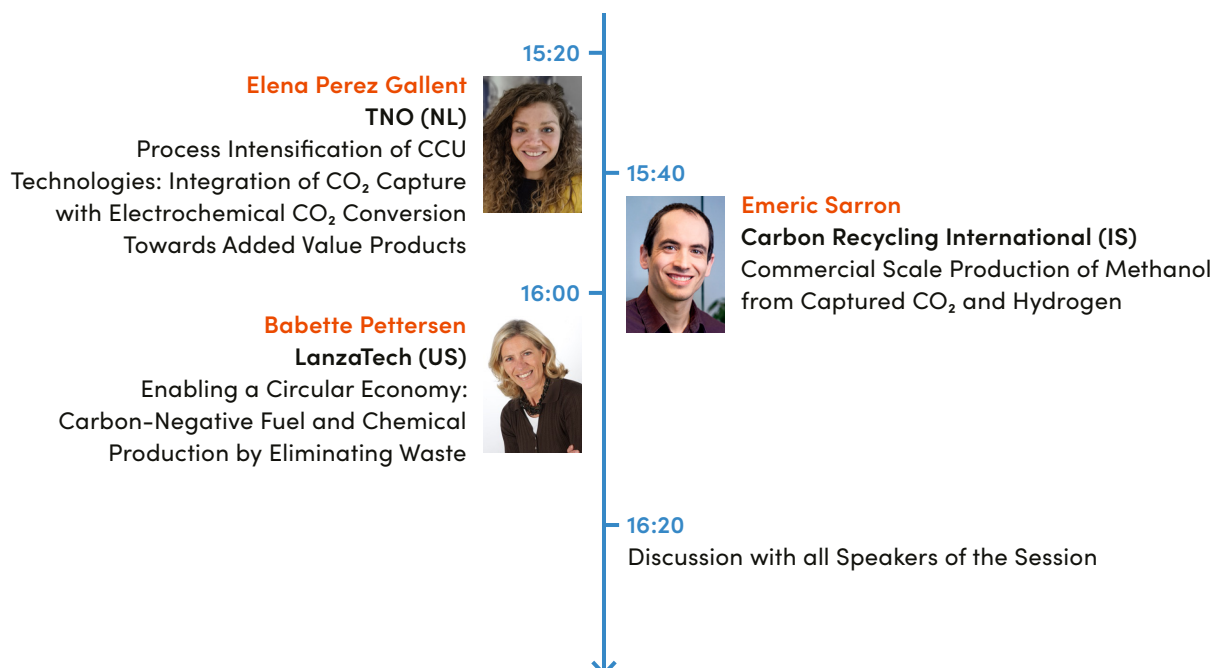
Carbon Capture and Green Hydrogen Production

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



Power-to-X

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





Presentations of the Nominees for the “Best CO₂ Utilisation 2023”

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

Michael Carus nova-Institute (DE) Innovation Award Introduction		Anastasios Perimenis CO ₂ Value Europe (BE) Innovating to Make CCU Products Part of our Everyday Life	
Michael Mitsakos Arkeon (AT) Arkeon		Thomas Mairegger Rohrdorfer (DE) AURORA – The Sunrise by Electrochemically-produced Formic acid from Cement-based CO ₂	
Rahul Shendure CarbonBuilt (US) CarbonBuilt: Ultra-low Carbon Concrete		Marc Vocht DITF Denkendorf (DE) CellCO ₂	
Babette Pettersen LanzaTech (US) CleanCloud together with On, Technip Energies and Borealis		Andrew Symes OXCCU Tech (UK) OXCCU	
Online Voting		Martin Lindmeyer YNCORIS (DE) Innovation Award Ceremony	
Networking with Local Beer (Sponsored by Borealis)		Gala Dinner	

ENGINEERING A SUSTAINABLE FUTURE

**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

www.yncoris.com

YNCORIS
Industrial Services



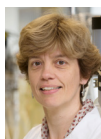
Innovation Award

"Best CO₂ 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
CO₂ Value Europe (BE)



Haralabos Zorbas
IBB Netzwerk (DE)



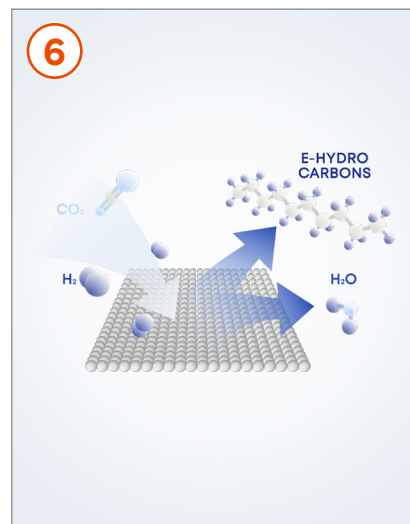
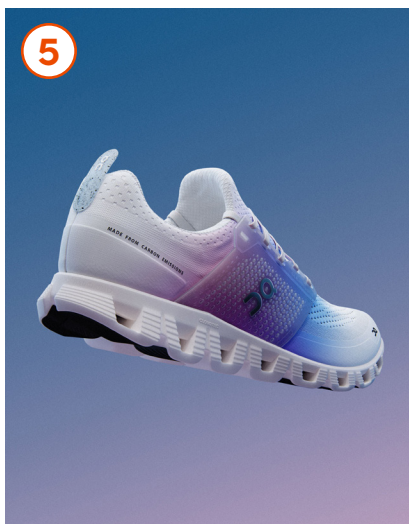
Martin Lindmeyer
Yncoris (DE)



Christian Schweitzer
bse Engineering Leipzig (DE)



Nominees of the Innovation Award



Organiser



Award
Sponsor

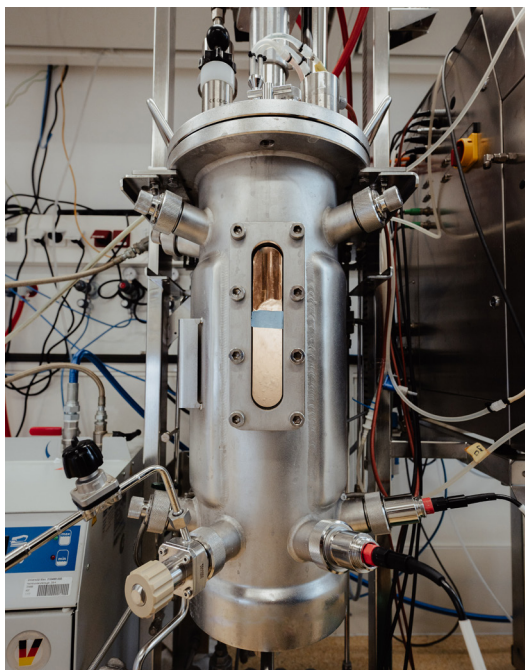


Award
Co-Organiser



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 CO₂ 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 CO₂ Rohrdorfer (DE)



Formic acid is electrochemically produced from cement-based CO₂ 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 CO₂ capture plant in a cement company and a one-of-a-kind CO₂ 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 CO₂ 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 CO₂ is captured from on-site waste biomass incineration or emerging Direct Air Capture (DAC) technologies to cure (harden) the mix into concrete, storing the CO₂ permanently. Because CO₂ 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

CellCO₂ DITF Denkendorf (DE)



The CellCO₂ is a CO₂ 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 CO₂. 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.

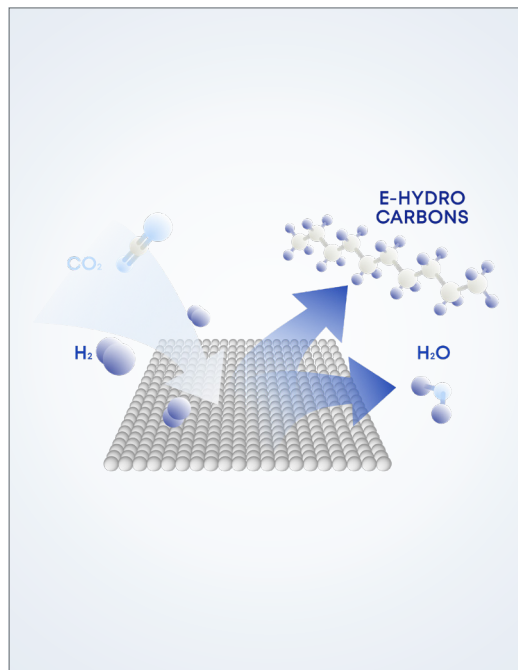
More information:

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 CO₂ 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 CO₂ Utilisation 2022”



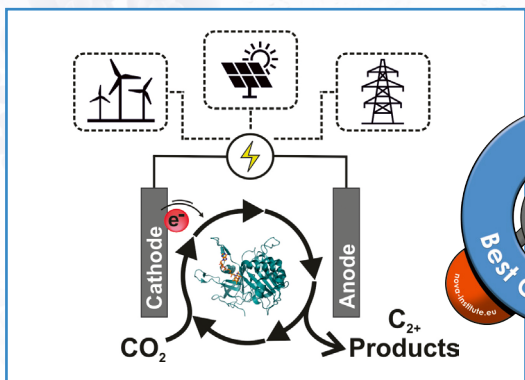
CleanO₂ Soap

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.

Captivated?

CarbinX & Carbonate Sales

carbinx@cleano2.ca

carbinx.com

Consumer Product Sales

soap@cleano2.ca

cleano2.ca



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 CO₂ Capture to E-Fuels Production,
Integration is Key



9:30

Gunnar Hølen
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



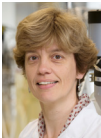

10:30

Coffee Break & Networking



CO₂-to-Polymers and Materials

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

Pauline Ruiz nova-Institute (DE) CO ₂ Utilisation for Chemicals and Materials – An Overview on Technologies, Key Players, Markets and Trends		11:00	
		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	
		12:20	Floris Buijzen Borealis (AT) Turning Carbon Emissions into Running Shoes
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



Room Laurentius, no online transmission

CO₂-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
CO₂-based Chemicals – Chances
and Risks
- 15:00**
- Bruce Dannenberg**
Phytonix Corporation and
Cyanomega Corporation (US)
Carbon Dioxide Utilization Via
Photosynthetic Conversion to Higher
Alcohols and Fatty Acids to Address
the Climate Crises and Create a
Circular Carbon Economy: From
Laboratory to Commercialization
- 15:20**
- Cecilia Mondelli**
Sulzer Chemtech (CH)
CO₂ Capture meets Mineralization
in the Liquid Phase for a Sustainable
Construction Industry
- 15:40**
- Discussion with all Speakers of the Session

Parallel Session: Advanced Research in CCU

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

- 14:40**
- Sophie van Vreeswijk**
Avantium (NL)
Circular Utilisation of CO₂ from
Waste Water in the WaterProof
Project
- 15:00**
- Marcelo Echeverri**
Fundacion para el Desarrollo y la
Innovacion Tecnologica (FUNDITEC)
(ES)
Valuable Chemicals from CO₂ and
Renewable Feedstocks, a Polyimine-
based Heterogeneous Catalysts
Approach
- 15:20**
- Verena Süß**
Fraunhofer ICT (DE)
Synthesis of Ethanol from
CO₂ and H₂
- 15:40**
- Discussion with all Speakers of the Session

16:00
Coffee Break

- 16:30**
- Mohammad Rezaei**
GIG Karasek (AT)
Electrochemical CO₂ 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



The brightest stars of Renewable Materials

Bio-based, CO₂-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



Call for Innovation

Vote for the "Renewable Material of the Year 2023" at the Event

Organiser



Award Sponsor



Platin Sponsor



Gold Sponsors



COVATION BIO

HMF 中科国生
GS BIOTECH



NESTE

sappi

SUGAR ENERGY

TÜV AUSTRIA

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 CO₂-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



renewable-carbon.eu/companies



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 CO₂ 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 CO₂) to produce sustainable polyolefins."

CO₂ 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 CO₂ 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 CO₂ to useful bio-based building blocks employing novel heterogeneous catalysts based on porous organic polymers, designed to enhance both the affinity to CO₂ 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 CO₂ 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 CO₂ utilization, such as for the production of synthetic fuels and chemicals."

Fraunhofer ICT (DE)

Verena Süß

"The direct synthesis of ethanol from CO₂ 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 CO₂-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 CO₂ into essential chemicals and fuels."

IFPEN (FR)

Catherine Laroche

"IFPEN is now developing a CO₂ conversion process into syngas using reversed water gas shift process, allowing a global integration of proprietary processes from CO₂ 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 Hølen

"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 CO₂ 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 CO₂ 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, CO₂ 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 CO₂ provides a rapid and efficient approach to convert CO₂ 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."



**ADVANCED
RECYCLING**
Conference 2023

advanced-recycling.eu

28–29 Nov
2023

Save the Date



Premium Partner



co2value.eu

Media Partners



advancedbiofuelsusa.info



bioplasticsmagazine.com



biobasedpress.eu



chemindigest.com



chemanager-online.com



mdpi.com/journal/energies



energytechreview.com



fuelsandlubes.com



onlinelibrary.wiley.com



greenchemicalsblog.com



plasticker.de



goingpublic.de/lifesciences



heise.de/tr



renewable-carbon.eu/news

Partners



bioenergie.de



bcnp.com



bigc-initiative.eu



carmen-ev.de



clib-cluster.de



globalco2initiative.org



ibbnetzwerk-gmbh.com



in4climate.nrw



kunststoffland-nrw.de



plasticseurope.org



renewable-carbon-initiative.com



voltachem.com

THE RENEWABLE CARBON INITIATIVE

Shape the Future of the Chemical and Material Industry



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 CO₂ 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



PARTNERS



JOIN NOW

Become a part of the Renewable Carbon Initiative (RCI) and shape the future of the chemical and material industry
www.renewable-carbon-initiative.com/membership/application

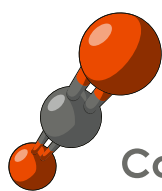
More Members, Partners and Information
www.renewable-carbon-initiative.com
Contact: verena.roberts@nova-institut.de
[#renewablecarbon](https://twitter.com/renewablecarbon)







See you next year



**CO₂-based Fuels
and Chemicals
Conference 2024**

17–18 April • Cologne (Germany)