

PROGRAMME

2<sup>ND</sup> INTERNATIONAL CONFERENCE ON

# NEGATIVE CO<sub>2</sub> EMISSIONS

GOTHENBURG, SWEDEN  
JUNE 14-17, 2022

IEA Bioenergy

ENERGY  
A CHALMERS  
AREA OF ADVANCE

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**van Vuuren, Detlef**

Utrecht University, The Netherlands

**Wilcox, Jennifer**

Colorado School of Mines, US

## Dear friends,

It is with great pleasure we once again welcome you to Gothenburg and the 2nd International Conference on Negative CO<sub>2</sub> emissions. Approximately 275 on-site participants, as well as more than 40 digital ones, are joining the conference to enjoy a four-day program, including keynote lectures, panel discussions, and social events aimed at making new friends and promoting collaboration.

We would like to express our sincere gratitude to everyone who contributed to making this conference possible. We want to acknowledge the scientific committee and supporting colleagues for valuable efforts in the reviewing of abstracts.

Furthermore, we would like to express our gratitude towards our sponsors, and we would especially like to acknowledge Chalmers Energy Area of Advance, the Division of Energy Technology, and our gold sponsor Carbon Direct.

Thank you for participating at the 2nd International Conference on Negative CO<sub>2</sub> emissions. Together, let us make it a conference to remember.

Carl Linderholm

Anders Lyngfelt

Amir H Soleimani Salim

	<b>Tuesday</b> June 14	<b>Wednesday</b> June 15	<b>Thursday</b> June 16	<b>Friday</b> June 17
07:45				
08:30	Breakfast & registration	Keynote	Keynote	Keynote
09:10	Welcome	Keynote	Keynote	Keynote
09:30	Keynote	Keynote	Keynote	Keynote
09:50	Keynote	Keynote	6 A    6 B    6 C	Keynote
10:10	Keynote	Keynote	6 A    6 B    6 C	Keynote
10:30	Keynote	Break	Break	Break
10:50 /11:00*	Break			
11:20	1 A    1 B    1 C	3 A    3 B    3 C    3 D	7 A    7 B    7 C    7 D	9 A    9 B    9 C    9 D
11:40				
12:00				
12:20			Poster session 2	
12:40	Lunch	Lunch	Lunch	Lunch
14:00	2 A    2 B    2 C	4 A    4 B    4 C    4 D	8 A    8 B    8 C    8 D	10 A    10 B    10 C    10 D
14:20				
14:40				
15:00	Poster session 1		Break	
15:20 /15:30**	Break	Break	Keynote	Panel 3
15:50	Keynote	5 A    5 B    5 C    5 D	Keynote	
16:10			Panel 2	
16:30	Panel 1			
16:50				
17:10				
18:30	Reception by the city of Gothenburg at Börsen	Liseberg	Conference Dinner at Chalmers	

\*10:50 on Tuesday, 11:00 Wednesday, Thursday and Friday

\*\*15:20 on Tuesday and Wednesday, 15:30 on Thursday

## Keynote speakers

### Keynote 1



EU and Negative Emissions, the Path Forward

Tuesday, June 14, 9:30

#### Christian Holzleitner

Head of Unit for Land economy and carbon removals, Directorate-General for Climate Action, European Commission

Christian Holzleitner is currently Head of Unit responsible for Land economy and Carbon removals at the European Commission's Directorate-General for Climate Action. Previously, he worked as Head of Unit for Finance for Innovation and Land Use and assistant to the Director-General for Climate Action covering all issues related to EU and international climate policy; and at the Directorate-General for Competition in the area of State aid for services of general economic interest in the postal, transport, and health sectors.

Before joining the European Commission, Christian worked as senior manager with KPMG Germany on international transfer pricing.

Christian is an economist and holds a PhD from the University of Linz (Austria).

### Keynote 2



Negative CO<sub>2</sub> Emissions – Bringing it all Back Home or Tangled up in Blue

Tuesday, June 14, 10:10

#### Anders Lyngfelt

Professor, Chalmers University of Technology

Lyngfelt has been working for 24 years on the development of Chemical-Looping Combustion (CLC), a novel principle of combustion using oxygen carrier particles that transfer oxygen from combustion air to fuel. The particles circulate between two fluidized-beds - an air reactor and a fuel reactor - the air reactor being very similar to a normal circulating fluidized-bed boiler used for burning solid fuels. The unique advantage with this process is that the process inherently delivers the combustion products, CO<sub>2</sub> and steam/water, in a separate stream. Thus, CO<sub>2</sub> can be

captured without the need of a very costly and energy intensive gas separation step.

Lyngfelt's group were first to demonstrate successful CLC operation for gaseous, solid and liquid fuels and they have more than 4000 h of operational experience in four pilots and are arguably world-leading in this field. The cost for CO<sub>2</sub> capture with CLC has been estimated to 16-26 €/tonne CO<sub>2</sub>.

Lyngfelt is the author/co-author of more than 200 reviewed scientific publications. Lyngfelt was in the 2019 Web of Science lists of "highly cited researchers" and he was ranked as the 2nd most productive and cited researcher in Sweden in the area of physics and technology (Fokus, 2019). The journal Energy & Fuel (American Chemical Society) will have a Special Issue in 2022 to honour Lyngfelt, in their new series Pioneers in Energy Research.

### Keynote 3



The role of the land use sector in mitigation: do we need to revisit 'direct human induced'?

Tuesday, June 14, 15:50

#### Gert-Jan Nabuurs

Professor, Wageningen University and Research

Gert-Jan Nabuurs is professor European forest resources at Wageningen University, Netherlands. His background is in European scale forest resource analyses and forest management under climate change. His work has both scientific aspects as well as large outreach to the forest sector. He combines forest sector and forest management knowledge with climate change field. He started the work with the EFISCEN model, the European forest resource, forest management and carbon balance model. Applications are in wood availability, effects of forest management, climate change impacts and CO<sub>2</sub> sequestration.

Further he was Coordinating Lead Author (CLA) of the Agriculture and Forestry chapter in the IPCC 6AR. He was also CLA in the IPCC Good Practice Guidance for Greenhouse reporting in the land use sector in 2003 and CLA for Forestry in 4AR. He was Assistant Director of the European Forest Institute in Finland from 2009-2012. He leads the Dutch forest climate pilots under the Climate Accord, a 2.3 M€/y program with 38 partners from Dutch sector. Results are published in 200+ publications and outreach and media event. Furthermore he is involved in four EU projects on forest and climate change and forest restoration.

## Keynote speakers

## Keynote 4



Potential and limits of agricultural soil management for negative emissions

Wednesday, June 15, 8:30

### Jean-François Soussana

Dr., National Research Institute for Agriculture, Food and Environment, Paris, France

Since March 2017, Dr. Soussana is the Vice-President for international policy of INRAE (INRA, prior to 2020). He obtained his PhD in plant physiology at USTL Montpellier in 1986 after an agricultural engineer degree and was by INRA as junior scientist. After becoming senior scientist, he was the director of the grassland ecosystems research laboratory from 2000 to 2009. From 2010 to 2017, he became Scientific Director for Environment.

Dr. Soussana is member of the IPCC since 2018. He has contributed as Lead Author to three assessment reports (Working Group II contribution) and to the Special Report on Climate Change and Land adopted in 2019. He is a member of the French Climate Change Committee and of the newly established EU Scientific Advisory board on Climate Change. He co-chairs the Integrative Research Group of the Global Research Alliance on agricultural greenhouse gases (60 countries) and the joint programming of research on agriculture, food security and climate change (FACCE JPI, 21 countries). He is vice-chair of the Scientific and Technical Committee of the “4 per 1000. Soils for Food Security and Climate” initiative launched at COP21. He coordinated European (EC FP5, FP7 and H2020) research projects on climate change, soils and agriculture.

He has published 175 research papers in international journals. He is a highly cited researcher (Cross-Fields, Clarivate Analytics, 2018). Honours: Shared Nobel Prize for Peace in 2007 with all IPCC co-authors; shared Gerbier-Mumm prize of WMO; gold medal of the French academy for agriculture; commander of the French order of agricultural merit; knight of the Legion of Honour (France).

## Keynote 5



Biochar use in agriculture, urban landscapes and building materials: An underestimated NET with benefits and economic prospects

Wednesday, June 15, 9:10

### Claudia Kammann

Professor, Dpt. of Applied Ecology, Hochschule Geisenheim University

Dr. Kammann, born 1967, studied biology in 1988-1995 at the Universities of Bayreuth and Kiel, Germany, followed by biogeochemical PhD studies at Justus Liebig University of Giessen, Germany, where she graduated in 2001. Her initial research focus was on the effects of rising atmospheric CO<sub>2</sub> concentrations on greenhouse gas emissions of N<sub>2</sub>O and CH<sub>4</sub> using a FACE platform (FACE = free air CO<sub>2</sub> enrichment). Postdoc research in Gießen, Ireland and New Zealand along those, now confirmed, positive feedback mechanisms that accelerate global warming spurred C. Kammann's interest in biochar as an (agricultural) CDR technique.

In 2014, C. Kammann enrolled at Geisenheim University as a professor for climate change impact research for special crops. She authored or co-authored 85 peer-reviewed publications (H-Index 44). Her research activities range from biochar-based C-sink fertilizer development to implementation of Agri-Photovoltaics. Her passion lies in developing innovative adaptation-mitigation NE strategies for sustainable and climate-resilient agroecosystems and urban areas that deliver win-win benefits for real-world implementation.

## Keynote 6



Insights on negative emissions from long-term scenario analysis and the latest IPCC report

Wednesday, June 15, 9:50

### Detlef van Vuuren

Professor, Utrecht University, and Senior researcher at PBL Netherlands Environmental Assessment Agency

Detlef van Vuuren (1970) is a professor in Integrated Assessment of Global Environmental Change at the Faculty of Geosciences, Utrecht University and senior researcher at the PBL Netherlands Environmental Assessment Agency leading the IMAGE integrated assessment modeling team. He has published more than 420 articles in refereed

journals and has been a (coordinating) lead author on assessments by IPCC, IPBES and UNEP-GEO. Among other things, Van Vuuren worked on the long-term socio-economic scenarios used by the climate research community and IPCC to look into mitigation strategies. Carbon dioxide removal strategies can play an important role in reaching net-zero greenhouse gas emissions in these strategies.

### Keynote 7



An overview of the DAC technology field, a deep dive into solid sorbent DAC, and a question

Thursday, June 16, 8:30

### Mijndert van der Spek

Ass. Prof., Research Centre for Carbon Solutions, Heriot Watt University

Mijndert van der Spek is an Associate Professor of Chemical Engineering at Heriot Watt University. Mijndert's research focuses on developing the methods and tools to assess the strengths and weaknesses of prospective climate change mitigation technologies and systems. This includes CO capture and storage, CO<sub>2</sub> utilisation, and carbon dioxide removal using (solid sorbent based) direct air capture. His work includes i) technology and system modelling, design and integration, ii) techno-economic-environmental assessment, with special focus on net-zero-CO<sub>2</sub> systems, and iii) advanced uncertainty analysis, e.g., by combining quantitative with qualitative uncertainty analysis methods. He is driven by improving the ways we undertake such assessments, to make them most useable and relevant to policy and decisionmakers in government and industry.

### Keynote 8



Potential, uncertainties and co-benefits in CDR: the case of ocean alkalinity enhancement

Thursday, June 16, 9:10

### Stefano Caserini

Adjunct Professor, Politecnico di Milano, Italy

Stefano has a Master degree in Environmental Engineering and Ph.D. in Sanitary Engineering. He is adjunct professor of Mitigation of Climate Change at the Politecnico di Milano,

and is the project manager of the Desarc-Maresanus Project (DEcreasing Seawater Acidification Removing Carbon).

Stefano is also involved in the dissemination of scientific knowledge on climate change, he has published six books (the last titled "Sex and the climate") and is the founder and coordinator of Climalteranti.it, one of the main Italian blog on climate change, and Co-Director of the scientific journal "Ingegneria dell'Ambiente" (Engineering of the Environment).

### Keynote 9



Explaining the IPCC AR6 approach on Carbon Dioxide Removal

Thursday, June 16, 15:30

### Oliver Geden

Dr., German Institute for International and Security Affairs (SWP)

Oliver Geden is Senior Fellow at the German Institute for International and Security Affairs (SWP) and a Research Associate at the University of Oxford's Institute for Science, Innovation and Society (InSIS). Geden's work focuses on European and global climate policy, particularly the governance and politics of carbon dioxide removal. Geden has been a Visiting Scholar at the International Institute for Applied Systems Analysis (IIASA), the Max Planck Institute for Meteorology (MPI-M) and the Swiss Federal Institute of Technology (ETH), among others. During his time at SWP, he has been seconded to the policy planning units of both the German Federal Foreign Office and German Federal Ministry for Economic Affairs and Energy. Geden is a lead author for the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (AR6 Working Group III on mitigation) as well as a member of the Core Writing Team for the IPCC AR6 Synthesis Report.

## Keynote speakers

### Keynote 10



Status and prospects of technologies for bioenergy with CCS

Friday, June 17, 8:30

#### Mai Bui

Dr., Centre for Environmental Policy, Imperial College London, UK  
Centre for Process Systems Engineering, Imperial College London, UK

Dr Mai Bui is a Senior Research Associate at the Centre for Environmental Policy in Imperial College London. She is a Senior Research and Insight Manager at UK Research and Innovation (UKRI) for the Industrial Decarbonisation Challenge. She is also on the Advisory Board for Puro.earth, which aims to create a voluntary carbon removal market, and is a member of the CCUS Early Career Professionals Forum, part of BEIS in the UK. She has worked on several projects funded by Research Councils UK on CO<sub>2</sub> capture and storage (CCS) in the context of different applications, including power, industry and CO<sub>2</sub> removal, mainly BECCS and DAC.

Mai has over 10 years of first-hand experience in designing experimental test campaigns for flexible operation at pilot and demonstration plants, including CSIRO's pilot plant at the Loy Yang power station (Australia) and the CO<sub>2</sub> capture facility at TCM (Mongstad, Norway). She has expertise in developing chemical process modelling tools and surrogate models to simulate CO<sub>2</sub> capture and clean energy processes. In 2021, Mai and her co-authors were awarded the Junior Moulton Medal by the IChemE for their research on CO<sub>2</sub> capture technology development. Since completing her PhD in 2016, Mai has published an edited book on CCS, 25 journal papers, a book chapter and technical reports. She is currently finalising an edited book with Professor Niall Mac Dowell on "Greenhouse Gas Removal Technologies", which is expected to be published by the RSC in August 2022.

### Keynote 11



Storage of CO<sub>2</sub> against climate change

Friday, June 17, 9:10

#### Stuart Haszeldine

Professor of Carbon Capture and Storage, University of Edinburgh, UK

Professor Stuart Haszeldine is a geologist and environmental scientist at the University of Edinburgh. His research focuses on energy and environment, working in the overlapping space between Academia, Business, Government, and public communication. CCS work started around 2004, and he is the world's first Professor of CCS. Current research focuses on Net Zero with Carbon Take Back Obligation for storage, greatly decreased hydrocarbon production, and hydrogen storage to decarbonise methane. He has advised UK and Scottish Governments for many years. and co-leads UKCCSRC and CO<sub>2</sub>RE academic networks in the UK. He is a Fellow of the Royal Society of Edinburgh, other awards include Order of the British Empire, and William Smith Medal of the Geological Society.

### Keynote 12



Integrating negative emissions into emissions trading markets

Friday, June 17, 9:50

#### Wilfried Rickels

Dr, Kiel Institute for the World Economy, Germany

Dr. Wilfried Rickels directs the Global Commons and Climate Policy Research Center at the Kiel Institute for the World Economy. His primary research interests are the analysis of climate change mitigation with a focus on the role of negative CO<sub>2</sub> emission technologies and solar radiation management and the measurement of sustainable (marine and maritime) development. Accordingly, he applies integrated assessment models and develops composite indicators, respectively. He is member of the Scientific Society of German-speaking Environmental and Resource Economists (AUROE). His academic career includes research sojourns at UC San Diego (School of International Relations and Pacific Studies), UC Berkeley (Department of Agricultural and Resource Economics), and UC Santa Barbara (Bren School of Environmental Science and Management).

## Tuesday, June 14

	RunAn	Palmstedt	Scania
07:45 - 9:10	Breakfast & Registration		
09:10 -09:30	Welcome C. Linderholm		
09:30 -10:10	<b>Keynote</b> EU and Negative Emissions Christian Holzleitner		
10:10 -10:50	<b>Keynote</b> Negative CO <sub>2</sub> Emissions - How? Anders Lyngfelt		
10:50 -11:20	Break		
11:20 -12:40	<b>1 A</b> CC1: Policy	<b>1 B</b> CC2: National strategies	<b>1 C</b> Direct Air Capture
12:40	<b>Lunch</b> The Tuesday lunch will be sponsored by Carbon Direct		
14:00 -15:00	<b>2 A</b> BECCS: Postcombustion	<b>2 B</b> Biospheric storage. Forests	<b>2 C</b> CC2: Integration of NETs
15:00 -15:20	Poster session 1		
15:20 -15:50	Break		
15:50 -16:30	<b>Keynote</b> Forest Resources Gert-Jan Nabuurs		
16:30 -17:10	Panel 1		
18:30	Reception by the city of Gothenburg at Börsen		

	BECCS		Cross-Cutting 1 (CC1): Policy, Financing and Public support		Direct Air Capture and Other NETs
	Biospheric storage		Cross-Cutting 2 (CC2), National Strategies, Technology Assessments and Integration of NETs		Modelling

## Wednesday, June 15

	RunAn	Palmstedt	Scania	G. Dahlén
	<b>Keynote</b> Soil Management Jean-F. Soussana			
08:30 -10:30	<b>Keynote</b> Biochar Claudia Kammann			
	<b>Keynote</b> Modelling Detlef van Vuuren			
10:30 -11:00	<b>Break</b>			
11:00 -12:40	<b>3 A</b> Biospheric Storage: Soil	<b>3 B</b> BECCS: Industry	<b>3 C</b> CC1: Public Support	<b>3 D</b> Nordic BECCS Session: Industry meets research
12:40	<b>Lunch</b>			
14:00 -15:20	<b>4 A</b> Modelling	<b>4 B</b> CC1: Policy	<b>4 C</b> CC2: National Strategies	<b>4 D</b> Nordic BECCS Session: Continued
15:20 -15:50	<b>Break</b>			
15:50 -17:30	<b>5 A</b> CC2: Technology Assessments	<b>5 B</b> Modelling	<b>5 C</b> CC1: Policy	<b>5 D</b> Nordic BECCS Session: Continued
18:30	Liseberg - Tickets will be dsitributed on Wednesday.			

	BECCS		Cross-Cutting 1 (CC1): Policy, Financing and Public support		Direct Air Capture and Other NETs
	Biospheric storage		Cross-Cutting 2 (CC2), National Strategies, Technology Assessments and Integration of NETs		Modelling

## Thursday, June 16

	RunAn	Palmstedt	Scania	G. Dahlén
08:30 -09:50	<b>Keynote</b> Direct Air Capture Mijndert van der Spek			
	<b>Keynote</b> Ocean Alkalization Stefano Caserini			
09:50 -10:30	<b>6 A</b> CC1: Policy	<b>6 B</b> CC2: Technology Assessments	<b>6 C</b> Biospheric storage	<b>6 C</b> BECCS
10:30 -11:00	Break			
11:00 -12:20	<b>7 A</b> CC2: Integration of NETs	<b>7 B</b> Modelling	<b>7 C</b> CC2: Technology Assessments	<b>7 D</b> Other NETs
12:20 -12:40	Poster session 2			
12:40 -14:00	Lunch			
14:00 -15:00	<b>8 A</b> BECCS: Power plants	<b>8 B</b> CC1: Policy	<b>8 C</b> BECCS: CLC	<b>8 D</b> CC2: Technology Assessments
15:00 -15:30	Break			
15:30 -16:10	<b>Keynote</b> WP3 report Oliver Geden			
16:10 -16:50	Panel 2			
18:30	Conference Dinner at Chalmers			



BECCS

Cross-Cutting 1 (CC1): Policy,  
Financing and Public supportDirect Air Capture and  
Other NETs

Biospheric storage

Cross-Cutting 2 (CC2), National  
Strategies, Technology Assessments  
and Integration of NETs

Modelling

## Friday, June 17

	RunAn	Palmstedt	Scania	G. Dahlén
	<b>Keynote</b> CO <sub>2</sub> Capture Technologies Mai Bui			
08:30 -10:30	<b>Keynote</b> CO <sub>2</sub> Storage Stuart Haszeldine			
	<b>Keynote</b> Policy / Incentives Wilfried Rickels			
10:30 -11:00	<b>Break</b>			
11:00 -12:40	<b>9 A</b> CC1: Financing	<b>9 B</b> CC2: Technology Assessments	<b>9 C</b> Enhanced Weathering	<b>9 D</b> BECCS: Industry
12:40 -14:00	<b>Lunch</b>			
14:00 -15:00	<b>10 A</b> CC1: Policy	<b>10 B</b> Direct Air Capture	<b>10 C</b> BECCS: CLC	<b>10 D</b> CC2: Technology Assessments
15:00 -15:40	<b>Panel 3</b>			

-  BECCS
-  Cross-Cutting 1 (CC1): Policy, Financing and Public support
-  Direct Air Capture and Other NETs
-  Biospheric storage
-  Cross-Cutting 2 (CC2), National Strategies, Technology Assessments and Integration of NETs
-  Modelling

**1A****CC1: Policy**

Tuesday, June 14, 11:20-12:40

## INVITED PRESENTATION:

**The path to market for CDR**

Wilfried Maas, Carbon Direct

**UNFCCC must confront the political economy of net-negative emissions**

Aniruddh Mohan, Oliver Geden, Mathias Fridahl, Holly Jean Buck and Glen P. Peters

**Integrating Carbon Dioxide Removal into European Emissions Trading**

Wilfried Rickels, Alexander Proelß, Oliver Geden, Julian Burhenne and Mathias Fridahl

**CO<sub>2</sub> removal and 1.5°C: Sharing the Gains from Inter-regional Cooperation using a Game-Theoretic Approach**

Solène Chiquier, Emma Jagu, Niall Mac Dowell and Olivier Massol

**1B****CC2: National strategies**

Tuesday, June 14, 11:20-12:40

**Establishing a large-scale Greenhouse Gas Removal sector in the United Kingdom by 2030: First mover dilemmas**

Mark Workman, Devon Platt, Uday Reddivari, Bianca Valmarana, Steve Hall and Rob Ganpatsingh

**Governing-by-aspiration? Assessing the nature and implications of including negative emission technologies (NETs) in country long-term climate strategies**

Heather Jacobs, Aarti Gupta and Ina Möller

**The role of BECCS in providing negative emissions in Sweden under competing interests for forest-based biomass**

Johanna Beiron, Sebastian Karlsson, Henrik Skoglund, Elin Svensson and Fredrik Normann

**Net-zero CO<sub>2</sub> Germany - A retrospect from the year 2050**

Nadine Mengis, Aram Kalhori, Sonja Simon, Carina Harpprecht, Lars Baetcke, Enric Prats-Salvado, Cornelia SchmidtHattenberger, Angela Stevenson, Christian Dold, Juliane El Zohb, Malgorzata Borchers, Daniela Thrän, Klaas Korte, Erik Gawel, Tobias Dolch, Dominik

Heß, Christopher Yeates, Terese Thoni, Till Markus, Eva Schill, Mengzhu Xia, Fiona Köhnke, Andreas Oschlies, Johannes Förster, Knut Görl, Martin Dornheim, Torsten Brinkmann, Silke Beck, David Bruhn, Zhan Li, Bettina Steuri, Michael Herbst, Torsten Sachs, Nathalie Monnerie, Thomas Pregger, Daniela Jacob and Roland Dittmeyer

**1C****Direct Air Capture**

Tuesday, June 14, 11:20-12:40

**Understanding environmental trade-offs and resource demand of direct air capture technologies through comparative life-cycle**

Kavya Madhu, Stefan Pauliuk, Sumukha Dhathri and Felix Creutzig

**Direct Air Capture of CO<sub>2</sub> Under Realistic Conditions: A Sorbent Focused Study for the Case of Cold Climates**

Guanhe Rim, Fanhe Kong, Cornelia Rosu, Pranjali Priyadarshini, Mingyu Song, Matthew J. Realf, Ryan P. Lively and Christopher W. Jones

**Bipolar membrane electro dialysis for direct air capture processes**

Francesco Sabatino, Matteo Gazzani, Fausto Gallucci and Martin Van Sint Annaland

**Multiple Greenhouse gases Mitigation (MGM): Process concepts to co-remove CH<sub>4</sub> and CO<sub>2</sub> from air**

Devesh Sathya Sri Sairam Sirigina, Aditya Goel and Shareq Mohd Nazir

**2A****BECCS: Postcombustion**

Tuesday, June 14, 14:00-15:00

**Influence of carbon dioxide source concentrations on the specific energy demand of negative emission technologies using a multi-stage solid sorbent process**

Florian Zerobin and Tobias Pröll

**Adsorption performance of activated hydrochar in a thermogravimetric fluidized bed**

Gregor Tondl, Christoph Kroiß, Tobias Pröll and Christoph Pfeifer

**Negative CO<sub>2</sub> Emissions in the Lime Production Using an Indirectly Heated Carbonate Looping Process**

Martin Greco-Coppi, Carina Hofmann, Jochen Ströhle and Bernd Epple

*For author affiliations see author list at end of program*

**2B****Biospheric storage: Forests**

Tuesday, June 14, 14:00-15:00

**Potentials and Challenges of Land-based Negative Emissions – Global Multi-Purpose Afforestation**

Florian Kraxner, Dmitry Shchepashchenko, Sabine Fuss, Andrey Krasovskiy, Piera Patrizio, Sylvain Leduc, Anatoly Shvidenko, Georg Kindermann, Ping Yowargana, Bintang Yuwono, Woo-Kyun Lee, Moonil Kim and Göran Berndes

**New nation-scale forests: climate silver bullet or ecological upgrade?**

Joshua Rees-Garbutt, Thomas Burke, Tom Bradfer-Lawrence, Alan Blackburn, Rob H. Field and Tommaso Jucker

**Potential Global Sequestration of Atmospheric Carbon Dioxide by Semi-Arid Forestation**

Murray Moinester, Joel Kronfeld and Rafat Qubaja

**2C****CC2: Integration of NETs**

Tuesday, June 14, 14:00-15:00

**Historical impacts of bioenergy production on Negative CO<sub>2</sub> Emissions of Finland and Sweden**

Pekka Kauppi, Laura Sokka and Jean-Daniel Bontemps

**The Use of Zirconia and Ceria in Copper-Based Catalysts for Power-to-Methanol Synthesis at Atmospheric Pressure**

George J. Fulham and Ewa J. Marek

**Bacteria-induced mineralisation for enhanced removal of CO<sub>2</sub>**

Aya Ennaciri, Alexandra Clarà Saracho and Ewa Marek

**3A****Biospheric Storage: Soil**

Wednesday, June 15, 11:00-12:40

**New method to explore the potential for carbon removal through soil carbon sequestration in agriculture**

Andreas Rehn, Göran Berndes, Christel Cederberg and Oskar Englund

**Revisiting biochar decomposition data and long-term stability estimates: a transparent and reproducible analysis**

Elias S. Azzi, Helena Söderqvist, Harald Cederlund, Erik Karlton and Cecilia Sundberg

**Land-neutral negative emissions through biochar sequestration**

Constanze Werner, Wolfgang Lucht, Dieter Gerten and Claudia Kammann

**Supporting the “4 per 1000” initiative with compost and biochar for carbon sequestration – a case study for Austria**

Klaus Mikula, Tobias Pröll, Gerhard Soja and Christoph Pfeifer

**Novel organic NP(K)-char fertilizers performed equal to, or better as, conventional fertilizers in a pot trial while reducing environmental costs**

Carolyn-Monika Görres, Claudia Kammann and Thomas Appel

**3B****BECCS: Industry**

Wednesday, June 15, 11:00-12:40

**A preliminary assessment of negative CO<sub>2</sub> emissions in the European waste sector**

Laura Herraiz, Dan Su, Hasan Muslemani, Iain Struthers, Camilla Thomson, Hannah Chalmers and Mathieu Lucquiaud

**Achieving Net Zero emissions: The oil and gas industry is a major component of the solution**

Astley Hastings and Pete Smith

**Negative CO<sub>2</sub> emission of Waste-to-Energy plants with Carbon capture technology -Potentials and Key considerations**

Dan Su, Laura Herraiz, Hasan Muslemani, Mathieu Lucquiaud, Camilla Thomson and Hannah Chalmers

**Results of an expert survey on policy expectations on BECCS technology**

Lara-Sophie Wähling, Tobias Heimann and Mathias Fridahl

**Unlocking CO<sub>2</sub> infrastructure deployment: The impact of carbon removal accounting**

Emma Jagu and Olivier Massol

**3C****CC1: Public Support**

Wednesday, June 15, 11:00-12:40

**Geoengineering on Twitter: Analysing sentiments, emotions and conspiracies about controversial technologies**

Finn Müller-Hansen, Tim Repke, Max Callaghan, Elina Brutschin, Sarah Lück, Chad M. Baum, Sean Low, Cameron Roberts, William F. Lamb, Keywan Riahi, Benjamin K. Sovacoola and Jan C. Minx

**Communicating carbon removal**

Rob Bellamy and Kaitlin T. Raimi

**Localized governance of carbon removal in Small Island Developing States**

Harry Hilser, Emily Cox, Andrea Draiby, Cheyenne Moreau, Lia Hiraldo, Nathan Walworth and Lewis Winks

**Taking it outside: Exploring social opposition to 21 early-stage experiments in radical climate interventions**

Sean Low, Chad M. Baum and Benjamin K. Sovacool

**Lay person perceptions of marine carbon dioxide removal**

Siri Veland and Christine Merk

**3D****Nordic BECCS Session: Industry meets research**

Wednesday, June 15, 11:00-12:40

**Bio-CCS potential in Sweden / The Industrial Leap**

Karolina Unger, Klimpo / Isabella Gustafsson Ismodes, Swedish Energy Agency

**Chemical-Looping Combustion – Avoiding the Large Energy and Cost Penalty of BECCS**

Anders Lyngfelt

**Bio-CCS inland in Sweden**

Erik Tellgren, Växjö Energi

**Methods for Characterization of Solvent Strength and CO<sub>2</sub> Loading of Potassium Carbonate Absorption Solvents**

Nima Mirzaei, Matteo Tagliavini and Matthaus U. Babler

**BECCS in Stockholm 2026**

Erik Rylander, Stockholm Exergi

**4A****Modelling**

Wednesday, June 15, 14:00-15:20

**Considering risk and uncertainty in pathways of Carbon Dioxide Removal**

Sabine Fuss, Felix Creutzig, María Quirina Rodriguez Mendez

**Coupled Model Simulations of Carbon Dioxide Removal via Ocean Alkalinity Enhancement and Large-scale Afforestation and Reforestation**

Hao-Wei Wey, Neha Mehendale, Tronje P. Kemena, David Keller and Andreas Oschlies

**Why global cooperation will be needed to achieve carbon dioxide removal at the Paris Agreement's scale**

Solene Chiquier, Mathilde Fajardy and Niall Mac Dowell

**Negative CO<sub>2</sub> emissions to keep the Paris Agreement targets reachable**

Thomas Bossy, Thomas Gasser, Philippe Ciais, Katsumasa Tanaka and Franck Lecocq

**4B****CC1: Policy**

Wednesday, June 15, 14:00-15:20

**Towards Indicators for a Negative Emissions Climate Stabilisation Index: Problems and Prospects**

Mathias Fridahl, Anders Hansson and Simon Haikola

**Navigating Hype and Opportunity in Governing Marine Carbon Removal**

Miranda Boettcher, Kerryn Brent, Holly Jean Buck, Sean Low, Duncan McLaren and Nadine Mengis

**Lessons from renewable energy diffusion for carbon dioxide removal development**

Anthony E. Chavez

**Greenhouse gas removal policies: What roles do (Swedish) farmers play?**

Charlotte Flodin

**4C****CC2: National Strategies**

Wednesday, June 15, 14:00-15:20

**Assessing negative CO<sub>2</sub> emissions potential at national level, constrained by the Paris temperature goals: case study of Ireland**

Barry McMullin, Paul Price, Aideen O'dochartaigh, Mike Jones, Alwynne Mcgeever, Paul Rice

**Reluctant removers: National carbon removal strategies in net-zero laggards**

Jose Maria Valenzuela, Peter Healey, Javier Lezaun and Tim Kruger

**The role of CCS clusters in the UK as protective spaces for establishing CCS and BECCS infrastructure to deliver 'net zero'**

Clair Gough and Sarah Mander

**Potentials of Greenhouse Gas Removal in Switzerland**

Cyril Brunner and Reto Knutti

**4D****Nordic BECCS Session: Continued**

Wednesday, June 15, 14:00-15:20

**Comparative life cycle assessment of bioenergy systems with and without carbon dioxide removal**

Lisa Zakrisson, Elias S. Azzi and Cecilia Sundberg

**Bio-CCS plans at Stora Enso**

Conny Johansson, Stora Enso

**Energy efficient CO<sub>2</sub> capture to achieve negative emissions from pulp and paper industry**

Matilda Palmér, Abhishek Subramani, Rahul Anantharaman and Shareq Mohd Nazir

**The first commercial Bio-CCS plant is in Rakkestad**

Fredrik Häger, Carbon Centric

**5A****CC2: Technology Assessments**

Wednesday, June 15, 15:50-17:30

**Towards a common assessment framework for carbon dioxide removal measures**

Julia Pongratz, Sabine Fuss, Oliver Geden, Felix Havermann, Christian Hoiss, Elmar Kriegler, Hela

Mehrtens, Jan Minx, Andreas Oeschli, Diana Rechid, Stefan Schaefer, Jessica Strefler and Helmuth Trischler

**Identifying frontier opportunities and priority projects in carbon dioxide removal using roadmapping techniques**

Mijndert van der Spek, Silvan Aeschlimann, Cara Nichole Maesano, Karen Strassel, Daniel Pike, James Campbell, Spyros Fonteinis, Veronica Furey, Olivia Hawrot, Lukas Küng, Fergus Mcilwaine, Charithea Charalambous, John Young, Susana Garcia and Phil Renforth

**The Global State of Carbon Dioxide Removal: A Global Status Report & Data Platform**

Jan C Minx, Oliver Geden, Gregory Nemet and Stephen M Smith

**Feasibility assessment of carbon dioxide removal in Germany – comprehensive evaluation of selected options**

Malgorzata Borchers, Johannes Förster, Nadine Mengis, Daniela Thrän, Terese Thoni, Silke Beck, Klaas Korte, Erik Gawel, Till Markus, Romina Schaller, Yaxuan Chi, Nicolaus Dahmen, Roland Dittmeyer, Tobias Dolch, Christian Dold, Michael Herbst, Dominik Heß, Aram Kalhori, Ketil Koop-Jakobsen, Zhan Li, Andreas Oeschli, Thorsten Reusch, Imke Rhoden, Torsten Sachs, Cornelia Schmidt-Hattenberger, Angela Stevenson, Jiajun Wu and Christopher Yeates

**Analysis of production routes for silicon carbide using air as carbon source empowering negative emissions**

Andreas Mühlbauer, Dominik Keiner, Tansu Galimova and Christian Breyer

**5B****Modelling**

Wednesday, June 15, 15:50-17:10

**Alternative carbon price trajectories can avoid excessive carbon removal**

Jessica Strefler, Elmar Kriegler, Nico Bauer, Gunnar Luderer, Robert C. Pietzcker, Anastasis Giannousakis and Ottmar Edenhofer

**Trade-offs in different net-zero target formulations**

Anne Merfort, Jessica Strefler, Elmar Kriegler, Nico Bauer and Gunnar Luderer

**Harnessing forest biomass to combat wildfires, generate negative emission electricity, and provide key ecosystem service benefits**

Caspar Donnison, Robert Holland, Malcolm North, Roger Bales, Lindsay-Marie Armstrong, Felix Eigenbrod and Gail Taylor

## Taking Stock of Carbon Dioxide Removal Governance in Emerging Economies: Developments in Brazil, China, India and Russia

Felix Schenuit, Elina Brutschin, Oliver Geden and Keywan Riahi

### 5C

#### CC1: Policy

Wednesday, June 15, 15:50-17:10

### Anticipatory Regulation: Lessons from Fracking and insights for Greenhouse Gas Removal Innovation and Governance

Miriam Aczela, Richard Heap, Mark Workman, Steve Hall and Harry Armstrong

### Governance Principles for Policy Instrument Design Targeting Carbon Dioxide Removal

Matthias Honegger, Christian Baatz, Samuel Eberenz, Antonia Holland-Cunz, Axel Michaelowa, Benno Pokorny, Matthias Poralla and Malte Winkler

### The Implications of Scalable Removal of Carbon Dioxide at Less than \$100 per Tonne

Tim Kruger

### Role of climate policies in deep decarbonization of pulp and paper industry

Satu Lipiäinen, Eeva-Lotta Apajalahti and Esa Vakkilainen

### 5D

#### Nordic BECCS Session: Continued

Wednesday, June 15, 15:50-17:10

### BECCS with combined heat and power: assessing the energy penalty

Kåre Gustafsson, Ramiar Sadegh-Vaziri, Stefan Gronkvist, Fabian Levihn and Cecilia Sundberg

### Intermediate CO<sub>2</sub> storage – A shared Infrastructure in the Port of Gothenburg

Alexandra Angelbratt, Cinfracap / Göteborg Energi

### Panel Discussion: How can the Nordic countries best contribute to Negative Emissions?

**Introduction:** Isabella Gustafsson Ismodes, Swedish Energy Agency

**Moderators:** Karolina Unger and Anders Lyngfelt

**Panel:** Isabella Gustafsson Ismodes, Erik Tellgren, Erik Rylander, Conny Johansson, Fredrik Häger and Alexandra Angelbratt

### 6A

#### CC1: Policy

Thursday, June 16, 09:50-10:30

### Stakeholder perception of NETPs: The effects of discussion and framing

Lucrezia Nava, Celina Scott-Buechler and David Reiner

### Coming to GRIPs with NETs Discourse : Implications of Discursive Structures for Emerging Governance of Negative Emissions Technologies in the UK

Miranda Boettcher

### 6B

#### CC2: Technology Assessments

Thursday, June 16, 09:50-10:30

### Hydrogen from biomass with CCS – A carbon-negative transport fuel?

Christian Bauer, Cristina Antonini, Karin Treyer, Emanuele Moioli, Tilman Schildhauer, Mijndert van der Spek, Anne Streb and Marco Mazzotti

### Biochar-bioenergy systems: climate impact of biochar from cookstoves

Cecilia Sundberg and Joséphine Demay

### 6C

#### Biospheric Storage / BECCS

Thursday, June 16, 09:50-10:30

### Greenhouse Gas Removal by Accelerated Peat Formation

Mirjam Röder and Alberto Almena

### Carbon dioxide removal potential of bioenergy with carbon capture and storage (BECCS): how operational choices can affect reaching negative emission targets

Alberto Almena-Ruiz, Patricia Thornley, Katie Chong and Mirjam Röder

**7A****CC2: Integration of NETs**

Thursday, June 16, 11:00-12:20

**Reassessing the need for NETs: the legitimacy of alternative climate target pathways**

Lieske Voget-Kleschin, Christian Baatz, Clare Heyward, Detlef Van Vuuren and Nadine Mengis

**Rethinking Net-Zero systems, spaces, and societies: "Hard" versus "soft" alternatives for nature-based and engineered carbon removal**

Sean Low, Chad M. Baum and Benjamin K. Sovacool

**What does it take to go net-zero-CO<sub>2</sub>? A life cycle assessment on long-term storage of intermittent renewables with chemical energy carriers**

Jan Bernard Wevers, Li Shen, Mijndert van der Spek

**Methane mitigation achievement, including agriculture, is crucial to limiting dependence on uncertain carbon dioxide removal in national carbon budgeting equitably meeting Paris goals**

Paul R Price, Barry McMullin and Aideen O'dochartaigh

**7B****Modelling**

Thursday, June 16, 11:00-12:20

**Managing variable renewables with biomass in the European electricity system: Emission targets and investment preferences**

Mariliis Lehtveer and Mathias Fridahl

**Direct-contact condensation from vapour- gas mixture in a spray ejector condenser for negative CO<sub>2</sub> power plant**

Dariusz Mikielewicz, Milad Amiri and Jaroslaw Mikielewicz

**Implications of carbon storage on the choice of renewable fuel options**

Markus Millinger, Philip Tafarte, Matthias Jordan, Kathleen Meisel and Daniela Thrän

**Comparing negative emissions and complete CO<sub>2</sub> utilization in biomethane production**

Daria Katla, Lucio Rodrigo Alejo Vargas, Shareq Mohd Nazir and Anna Skorek-Osikowska

**7C****CC2: Technology Assessments**

Thursday, June 16, 11:00-12:20

**AI for creating a living evidence map of the science of carbon dioxide removal**

Jan C Minx, Max Callaghan, Tim Repke, Sarah Lück, Finn Müller-Hansen, William Lamb, Sabine Fuss, Felix Creutzig, Gregory Nemet, Cameron Roberts, Benjamin Sovacool, Chad Baum, Sean Low, Keywan Riahi, Benjamin Mitterrutzner, Stephen Smith, Cameron Hepburn, Oliver Geden, Felix Chenuit and Jo House

**Towards the establishment of common guidelines for life cycle assessment of carbon dioxide removal technologies**

Tom Terlouw, Christian Bauer and Marco Mazzotti

**Multi-criteria assessment of negative-emissions technologies**

Oscar Rueda, José M. Mogollón, Arnold Tukker and Laura Scherer

**Determining our climate policy future: Expert predictions about negative emissions and solar radiation management pathways**

Benjamin K. Sovacool, Chad M. Baum and Sean Low

**7D****Other NETs**

Thursday, June 16, 11:00-12:20

**Potential, constraints and environmental impacts of ocean liming as a large-scale option for removing atmospheric CO<sub>2</sub> and counteracting seawater acidification**

Stefano Caserini, Francesco Campo, Serena De Marco and Mario Grosso

**A Unified Assessment Framework for Proposed Methods of Marine CDR**

Gregor Rehder, Christian Baatz, Oliver Geden, David Keller, Nele MatzLück, Christine Merk, Teresa Maria Morganti, Andreas Oschlies, Wilfried Rickels, Erik Van Doorn, Lieske Voget-Kleschin, Wanxuan Yao and the Asmasys Science Team

**Demonstration of brine-based atmospheric CO<sub>2</sub> removal**

Corey Myers, Takao Nakagaki and Yoshiaki Miho

**The effect of basalt, concrete fines and steel slag on biomass, nutrient cycling and heavy metal contamination of Zea mays**

Jet Rijnders, Arthur Vienne and Sara Vicca

**8A****BECCS: Power Plants**

Thursday, June 16, 14:00-15:00

**BECCS at Drax – delivering BECCS in the UK and scaling up globally**

Angela Hepworth, Drax Group

**Energy and exergy analysis of negative CO<sub>2</sub> emission gas power plant operation using thermodynamic modelling results of the cycle**

Paweł Madejski, Ivar S. Ertesvåg, Paweł Ziółkowski and Dariusz Mikielwicz

**Thermodynamic, ecological, and economic analysis of negative CO<sub>2</sub> emission power plant using gasified sewage sludge**

Paweł Ziółkowski, Halina Pawlak-Kruczek, Paweł Madejski, Przemysław Bukowski, Tomasz Ochrymiuk, Kamil Stasiak, Milad Amiri, Lukasz Niedzwiecki and Dariusz Mikielwicz

**8B****CC1: Policy**

Thursday, June 16, 14:00-15:00

**Why global cooperation will be needed to achieve carbon dioxide removal at the Paris Agreement's scale**

Solene Chiquier, Mathilde Fajardy and Niall Mac Dowell

**Responsible incentivisation of NETs: designing sustainable national GGR policies in a fragmented and polycentric governance system**

Peter Healey, Javier Lezaun, Tim Kruger, Rob Bellamy and James Palmer

**Stakeholder Perceptions of Carbon Dioxide Removal in Europe: Assessing Social License to Operate**

Celina Scott-Buechler, Lucrezia Nava and David Reiner

**8C****BECCS: CLC**

Thursday, June 16, 14:00-15:00

**The preparation of aerogel supported copper oxide for methane chemical looping combustion (CLC) process**

A Davood Karami, Sanaz Daneshmand and Nader Mahinpey

**Energy use of biogas with CO<sub>2</sub> capture through chemical looping combustion with Cu-and Fe-based oxygen carriers**

Arturo Cabello, Teresa Mendiara, María Teresa Izquierdo and Alberto Abad

**Chemical looping combustion of biomass with CO<sub>2</sub> capture: experimental results at the 20 kW<sub>th</sub> scale**

Alberto Abad, Raúl Pérez-Vega, Óscar Condori, Luis F. De Diego, Francisco García-Labiano, María T. Izquierdo and Juan Adánez

**8D****CC2: Technology Assessments**

Thursday, June 16, 14:00-15:00

**Sustainability assessment of marine negative emissions technologies and practices**

Selene Cobo and Gonzalo Guillén-Gosálbez

**Techno-economic assessment of atmospheric CO<sub>2</sub>-based carbon fibre production****enabling negative emissions**

Dominik Keiner, Andreas Mühlbauer, Gabriel Lopez and Christian Breyer

**Can Shipping Contribute to Negative CO<sub>2</sub> Emissions?**

Fayas Malik Kanchiralla, Selma Brynolf, Elin Malmgren and Maria Grahn

**9A****CC1: Financing**

Friday, June 17, 11:00-12:40

**CO<sub>2</sub> Emitter Liability using Atmospheric CO<sub>2</sub> Removal Deposits for Financing of Future Negative Emissions**

Anders Lyngfelt and Mathias Fridahl

**A Food Climate Impact Liability for the Financing of Negative Emissions**

Emma Moberg, Anders Lyngfelt and Mathias Fridahl

**Designing reverse auctions for bioenergy with carbon capture and storage (BECCS) in theory and practice**

Liv Lundberg and Mathias Fridahl

**On the distributional effects of financing negative emission technologies**

Pietro Andreoni, Johannes Emmerling and Massimo Tavoni

*For author affiliations see author list at end of program*

### Getting to Neutral: Options for Negative Carbon Emissions in California

Roger D. Aines, Sarah E. Baker, Joshua K. Stolaroff, George Peridas, Jennifer Wilcox, Hannah M. Goldstein, Simon H. Pang, Felicia R. Lucci, Wenqin Li, Eric W. Slessarev, Jennifer Pett-Ridge, Frederick J. Ryerson, Jeffrey L. Wagoner, Whitney Kirkendall, Daniel L. Sanchez, Bodie Cabiyo, Joffre Baker, Sean McCoy, Sam Uden, Ron Runnebaum, Peter C. Psarras, H el ene Pilorg e, Noah McQueen, Daniel Maynard and Colin McCormick

**9B**

### CC2: Technology Assessments

Friday, June 17, 11:00-12:40

#### Limits to Paris compatibility of CO<sub>2</sub> capture and utilization

Kiane de Kleijne, Steef V. Hanssen, Lester van Dinteren, Mark A.J. Huijbregts, Rosalie van Zelm and Heleen de Coninck

#### The life cycle environmental effectiveness of negative emission technologies for carbon sequestration

Jasmin Cooper, Luke Dubey and Adam Hawkes

#### Climate protection or privilege? A whole systems justice milieu of twenty negative emissions and solar geoengineering technologies

Benjamin K. Sovacool, Chad M. Baum and Sean Low

#### Assessing NETs Beyond Feasibility

Lieske Voget-Kleschin, Lukas Tank, Frederike Neuber, Antonia Holland-Cunz and Christian Baatz

#### Stakeholder assessment of the feasibility of negative emission supply chains

Diarmaid Clery, Johanna Forster, Irene Lorenoni, Clair Gough, Jason Chilvers and Naomi Vaughan

**9C**

### Enhanced Weathering

Friday, June 17, 11:00-12:40

#### Carbon dioxide removal from enhanced weathering by ecosystem responses to powdered rock

Daniel Goll, Philippe Ciais, Katsumasa Tanaka, Thorben Amann, Jens Hartmann, Sara Vicca, Ivan Janssens, Josep Penuelas, Michael Obersteiner, Jinfeng Chang, Wei Li, Sibel Elker and Wolfgang Buermann

#### Ambient Metal Oxide Carbonation Enhancement via Agitation

Maxwell Pisciotta, Daniel Nothhaft, Noah Mcqueen, Samuel Layding, Zoe Lu and Peter Psarras

### Riverine Response to, and Limitations on, Enhanced Weathering for Negative Emissions in the UK

Harrington, K, Hilton, R.G, and Henderson, G.M

#### Characterising rates and chemistry of silicate and carbonate dissolution in agricultural soil cores to assess the potential of enhanced weathering

Frances Buckingham, Phil Renforth, Phil Holdship and Gideon Henderson

#### Is the climate change mitigation effect of enhanced silicate weathering governed by biological processes?

Sara Vicca, Daniel Goll, Mathilde Hagens, Jens Hartmann, Ivan A. Janssens, Anna Neubeck, Josep Penuelas, Silvia Poblador, Jet Rijnders, Jordi Sardans, Eric Struyf, Philipp Swoboda, Jan Willem van Groenigen, Arthur Vienne and Erik Verbruggen

**9D**

### BECCS: Industry

Friday, June 17, 11:00-12:40

#### Novel BECCS implementation integrating chemical looping combustion with oxygen uncoupling and a kraft pulp mill cogeneration plant

Jussi Saari, Petteri Peltola, Katja Kuparinen, Juha Kaikko, Ekaterina Sermyagina and Esa Vakkilainen

#### Estimations of the theoretical CO<sub>2</sub> storage capacity of the Paran a Basin: Optimal site selection of suitable reservoirs for BECCS systems coupled to natural gas production

Stephanie San Mart n Ca nas, Nath alia Weber, Haline De Vasconcellos Rocha, Richardson M. Abraham-A, Colombo Celso Gaeta Tassinari and Julio Romano Meneghini

#### Carbon negative biofuels production: Techno-economic analysis of a pyrolysis-hydrodeoxygenation process integrated with biomass gasification and CO<sub>2</sub> capture and storage

Lucio Rodrigo Alejo Vargas, Shivani Ramprasad Jambur, Pontus Bokinge, Elin Svensson, Rolf Ljunggren, Simon Harvey, Klas Engvall and Shareq Mohd Nazir

#### Boundary conditions for economical implementation of BECCS in the Nordic pulp and paper industry

Katja Kuparinen, Satu Lipi inen, Esa Vakkilainen and Timo Laukkanen

#### Negative CO<sub>2</sub> emission urea synthesis

Lucio Rodrigo Alejo Vargas, Rahul Anantharaman, Simon Roussanaly and Shareq Mohd Nazir

**10A****CC1: Policy**

Friday, June 17, 14:00-15:00

**Scale up of Carbon Removal: comparing growth rates in the literature to plans, policies, scenarios, and analogous technologies**

Gregory Nemet, Jenna Greene, Finn Müller-Hansen and Jan Minx

**The UK net-zero target: Insights into procedural justice for greenhouse gas removal**

Patricia O'Beirne, Francesca Battersby, Amy Mallett, Miriam Aczel, Karen Makuch, Mark Workman, and Richard Heap

**Governing carbon dioxide removal from the ground up**

Rob Bellamy, Oliver Geden, Mathias Fridahl, Emily Cox and James Palmer

**10B****Direct Air Capture**

Friday, June 17, 14:00-15:00

**A comparative exergy-based assessment of direct air capture technologies**

Hoseinpoori, S., Pallarès, D., Johnsson, F. and Thunman, H.

**Projecting future costs of direct air capture using component-based experience curves**

Katrin Sievert, Tobias S. Schmidt and Bjarne Steffen

**Minimising the cost of direct air capture with intelligent policy design and technology deployment**

John Young, Noah McQueen, Charithea Charalambous, Spyros Foteinis, Olivia Hawrot, Manuel Ojeda, Hélène Pilorgé, John Andresen, Susana Garcia, Peter Psarras, Phil Renforth, Mijndert van der Spek

**10C****BECCS – CLC**

Friday, June 17, 14:00-15:00

**Assessment of negative CO<sub>2</sub> emissions for chemical looping combustion of waste-derived fuels**

Philipp Mohn, Paul Dieringer, Falah Alobaid, Jochen Ströhle and Bernd Epple

**Investigating the chemical looping gasification of biomass for syngas production during continuous operation in 1.5 kW<sub>th</sub> to 100 kW<sub>th</sub> units**

Amir H. Soleimanisalim, Carl Johan Linderholm, Oscar Condori, Iván Samprón, Luis F. de Diego, Francisco García-Labiano, Alberto Abad, Juan Adánez and Tobias Mattison

**Online Measurements of Alkali Species in a Lab-Scale Reactor while Simulating Chemical Looping Combustion of Biomass**

Viktor Andersson, Amir H Soleimanisalim, Xiangrui Kong, Henrik Leion, Tobias Mattisson and Jan B. C. Pettersson

**10D****CC2: Technology Assessments**

Friday, June 17, 14:00-15:00

**Mapping public appraisals of carbon dioxide removal**

Rob Bellamy

**Techno-economic evaluation of buffered accelerated weathering of limestone as a CO<sub>2</sub> capture and storage option**

Selene Varliero, Stefano Caserini, Giovanni Cappello, Guido Raos, Francesco Campo, Serena De Marco and Mario Grosso

**Costs and Benefits of Afforestation with Renewable Electricity Based Desalination: Case Study for Egypt**

Upeksha Caldera, Mai ElSayed, Arman Aghahosseini and Christian Breyer

## Panels

### Panel I

Availability of biomass/biogenic residues for BECCS

Tuesday, 16:30-17:10

**Discussion:** Primary production as well as present total extraction of biomass are large, 220 and 20-30 Gt CO<sub>2</sub> respectively, but how much could be used for BECCS? Can extraction increase? Social, environmental and economical constraints. Competition and/or synergies with other uses of biomass.

**Moderator:** Annette Cowie

**Panelists:** Gert-Jan Nabuurs, Göran Berndes, Florian Kraxner, Philippe Ciais

### Panel II

Assessing and Enabling Carbon Dioxide Removal: implications of the latest IPCC Report

Thursday, 16:10-16:50

**Discussion:** What approach is used for categorising CDR and assessing potential? What is missing in the report, and why? What is needed to upscale deployment of CDR, including in policymaking? How might the IPCC's role in global and national CDR debates change? What new assessments will be needed to support CDR deployment in the coming years?

**Moderators:** Steve Smith and Göran Berndes

**Panelists:** Oliver Geden, Detlef van Vuuren, Annette Cowie, David Keller, Glen Peters, Sabine Fuss and Jan Minx

### Panel III

Incentivizing Negative Emissions. How? Who pays?

Friday, 15:00-15:40

**Discussion:** Will our children face an insoluble problem – sharing the bill for gigantic negative emissions? Or should we solve this now? Carbon takeback obligations or takeback deposits? Negative emissions in a cap-and-trade system – avoiding a corresponding increase in fossil CO<sub>2</sub>. Balancing and designing support for negative emissions having widely different characteristics. Need for long-term support.

**Moderator:** Glen Peters

**Panelists:** Sabine Fuss, Oliver Geden, Thomas Sterner, Roger D. Aines and Anders Lyngfelt

## Prerecorded presentations

Can be accessed via the conference homepage



### Biospheric Storage

**Contribution of Miscanthus x giganteus BECCS to IPCC climate requirements for global warming to remain under 2°C**

Anita Shepherd and Astley FS Hastings



### Cross-Cutting 1: Policy

**Carbon Dioxide Removal: Climbing up the EU Climate Policy Agenda**

Felix Schenuit and Oliver Geden

**The emerging field of German CDR policy: Mapping actors and positions**

Miranda Boettcher and Felix Schenuit



### Cross-Cutting 2: National Strategies

**GGR developments in the UK and their role in Net Zero**

Cathy Johnson, Ed Keyser and Theresa Redding



### Direct Air Capture

**CO<sub>2</sub>-Driven Geothermal Utilization for Direct Air CO<sub>2</sub> Capture**

Martina Leveni and Jeffrey M. Bielicki

**Direct air capture of CO<sub>2</sub> using an amine-based liquid process-an overview**

Ali Kiani, Ali Pourkhesalian, David Grillmeier, Will Conway, Kangkang Li, Robert Bennett, Graeme Puxty and Paul Feron



### Modelling

**The reduction of CO<sub>2</sub>e emissions in the transportation sector: plug-in electric vehicles and biofuels**

Jose R. Moreira, Sergio A. Pacca and Jose Goldemberg

**Pathways of Methane Control to Address Climate Change**

Qingrun Yang and Jeffrey M. Bielicki

## Poster Presentations

Sorted by the surname of the first author.

1. **Smarter ways to capture carbon dioxide – exploring alternatives for small to medium scale carbon capture in Kraft pulp mills**  
Adrian Lefvert and Stefan Grönkvist
2. **CDRmare Research Mission of the German Marine Research Alliance (DAM) »Marine carbon sinks in decarbonisation pathways«**  
Andreas Oschlies, Gregor Rehder and Christiane Schelten
3. **Seeing like a carbon budget manager: The promise and peril of using carbon removal as budgeting tools**  
Asayama, Shinichiro
4. **What are the different styles of calcite precipitation within a hyperalkalineleachate? A sedimentological Anthropocene case study**  
Bastianini, L.; Renforth, P.; Rogerson, M.; Mercedes-Martín R.; Prior, T.J.; Mayes, W.M.
5. **Exploring Negative Emission Potentials within Planetary Boundaries: Limits and Opportunities of BECCS, PyCCS and Reforestation**  
Braun, Johanna; Werner, Constanze; Lucht, Wolfgang; Gerten, Dieter
6. **Techno-economic analysis of a chemical looping combustion process with CO<sub>2</sub> utilization for biogas generated from livestock farming and agro-industrial waste**  
Cabello, Arturo; Abad, Alberto; Mendiara, Teresa; Gayán, Pilar
7. **Carbon neutral communities: model for integrating climate action into developmental planning-a case study from south India**  
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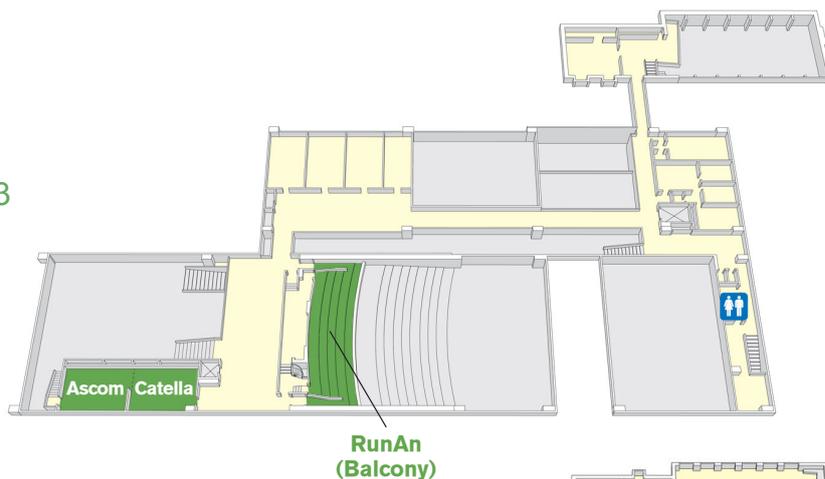
Gdańsk University of Technology, Faculty of Mechanical Engineering and Ship Technology, Poland



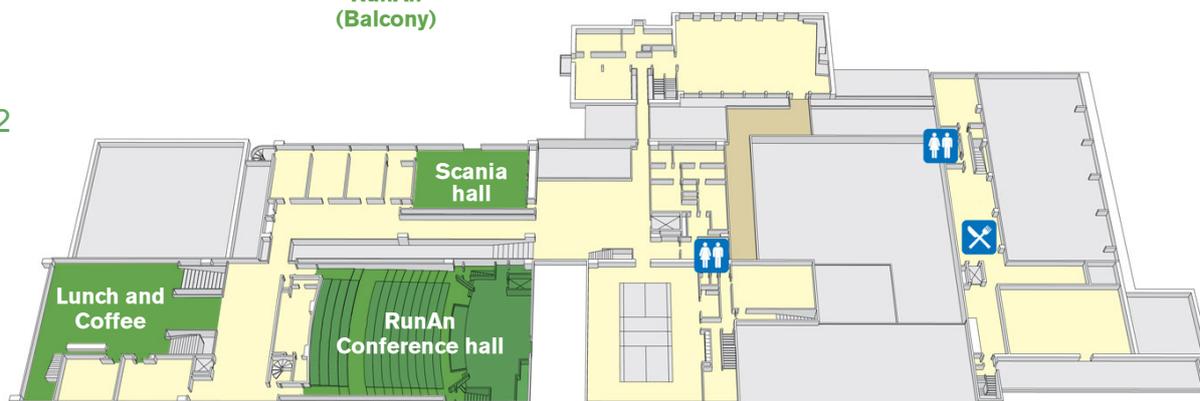




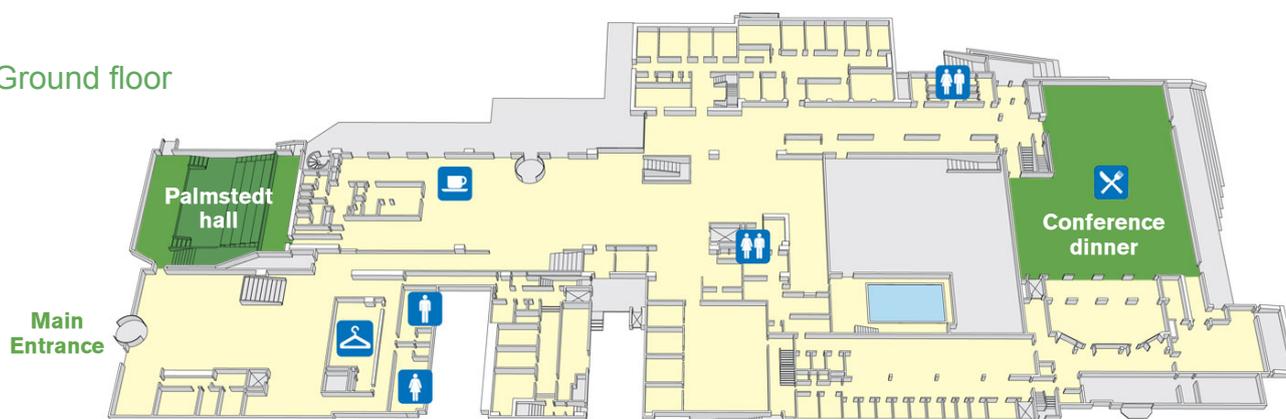
Level 3



Level 2



Ground floor



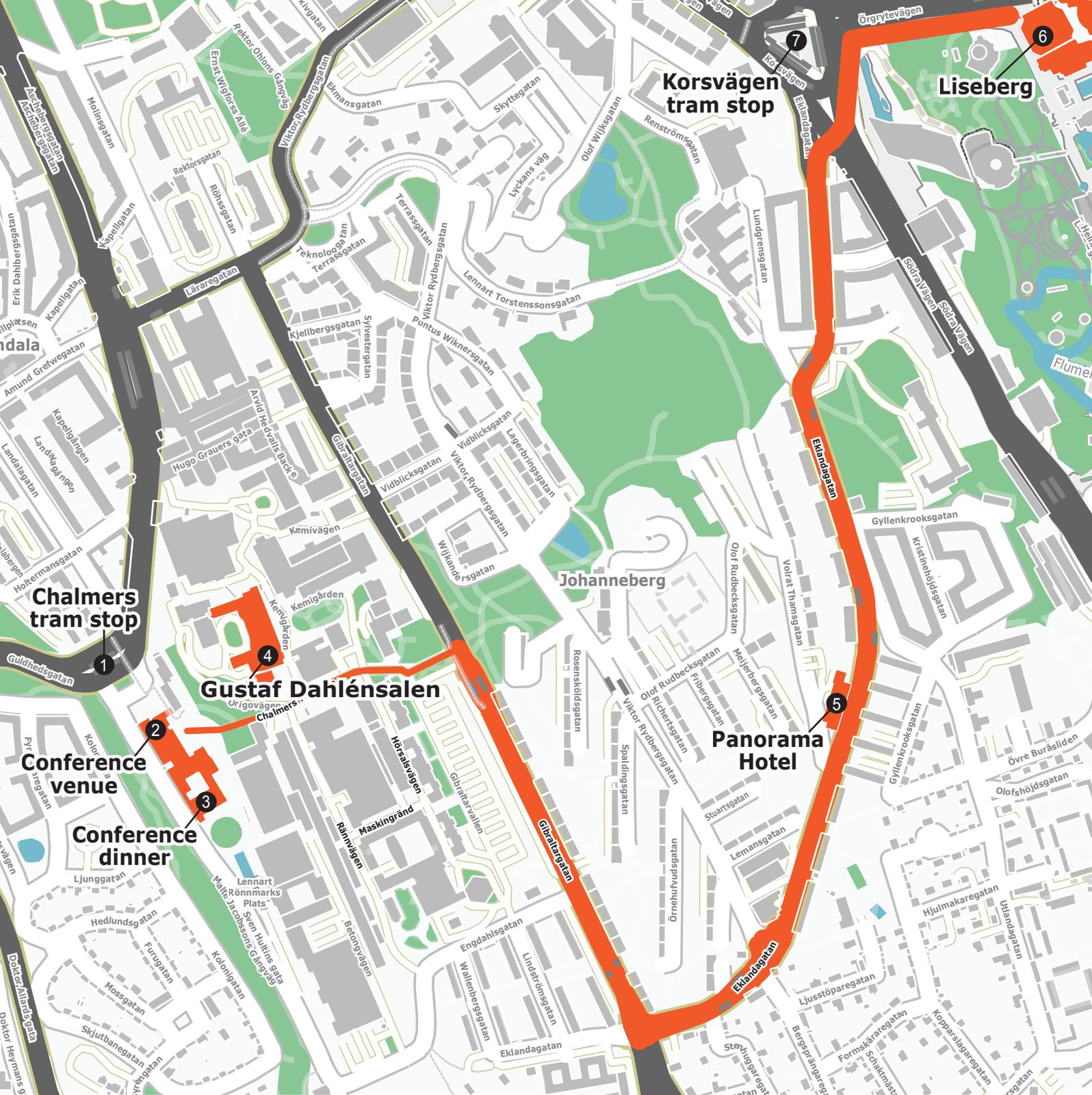
## Venue

The 2st International Conference on Negative CO<sub>2</sub> emissions will be held at Chalmers University of Technology in Gothenburg, Sweden. The conference venue is the Chalmers Student Union Building (Chalmers Kårhus) at campus Johanneberg. The venue is within walking distance (15-20 min) from Hotel Panorama and for those who prefer using public transport; the Chalmers bus and tram stop is located close by.

## Public transportation

If you want to use Gothenburg's public transport system, please have a look at the website of the operator Västtrafik for detailed information. It is also possible to rent bikes on a 30-minute basis for short rides in the center of Gothenburg. Look at the website of "Styr och Ställ" for more information.

Airport shuttle buses ("Flygbussarna") offer transfer between Göteborg Landvetter Airport and Gothenburg City - e.g. Korsvägen, see map - with departures approximately every 15 minutes.



2 Chalmers conference venue



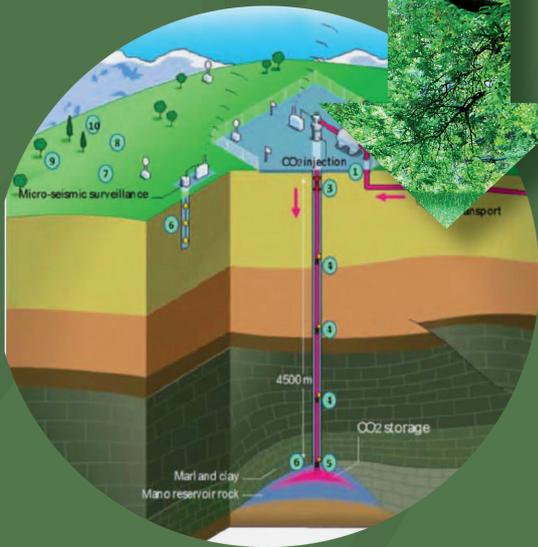
5 Panorama Hotel



4 Gustaf Dahlénsalen



6 Liseberg



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