

Presentations 8 February – Plenary

- Per-Olof Granström, ZEP
- <u>Mark Ackiewicz, U.S. Department of Energy Office</u> of Carbon Management Technologies
- Rune Volla, The Research Council of Norway
- <u>Aage Stangeland, The Research Council of Norway</u>
- <u>Mark Ackiewicz, U.S. Department of Energy Office</u> of Carbon Management Technologies

Per-Olof Granström

EU DIRECTOR

Strong positive momentum for CCUS in the EU

Per-Olof Granström is EU Director at CCSA/Zero Emissions Platform. He has previously held various positions in the European energy sector, such as Secretary General of EDSO, Vice Chairman of the Global Smart Grid Federation, Director of European Affairs at Vattenfall, Executive Vice President at Swedenergy and Vice President/Director of trade at Nord Pool – the Nordic Power Exchange.



#CLIMITSUMMIT2023 7–9 February







Content

Strong positive momentum for CCUS

CLIMIT SUMMIT 2023 8 January 20232

Per-Olof Granström, Zero Emissions Platform



Zero Emissions Platform



- Adviser to the European Union on the deployment of CCS and CCU
- European Technology and Innovation Platform under the SET-Plan
- Broad membership base Oil&Gas, Industry, Utilities, Equipment suppliers, Research, Trade unions, Environmental NGOs
- Go-to organisation to liaise with the European Institutions – good cooperation with Member State governments
- Coordination with other initiatives on national, European and international level ...



ZEP and the SET-Plan Implementation plan working group on CCUS

- Close coordination
- One governance structure
- One work programme



Europe-wide CO2 infrastructure – the beginnings





A very busy CCUS policy agenda ...





CCUS Funding...





The Green Deal Industrial Plan – crucial new basis for investment and innovation



Predictable and simplified regulatory environment (Net-Zero Industry Act)

- 2030 goals for clean technology, one-stop-shop on permitting
- European standards, regulatory sandboxes...
- Supply chain energy, critical raw materials...

Faster access to sufficient funding

- Relaxing state aid rules
- REPowerEU, InvestEU, Innovation Fund, TEN-E/TEN-T,
 'Sovereignty fund' simplification/frontloading

Skills to make the transition happen

Open trade for resilient supply chains



Strong positive momentum for CCUS – it is urgent – the 2020s are crucial!



Enabling policy framework – making it economically feasible to invest in all parts along the CCUS value chain

Strong continued support for CCUS R&I through Horizon Europe and partnerships

Coherent and coordinated EU and national funding programs

An EU strategy for CCS and CCU

Markets for net-zero products – where real climate impact is reflected in the price

Thank you for your attention!

Per-Olof Granström, Zero Emissions Platform



Mark Ackiewicz

DIRECTOR, OFFICE OF CARBON MANAGEMENT TECHNOLOGIES

Update on Recent Carbon Management Developments in the United States

Mr. Mark Ackiewicz is the Director for the U.S. Department of Energy Office of Carbon Management Technologies. In this role, Mark is responsible for planning, management, and administration of the Office's RDD&D portfolio.



#CLIMITSUMMIT2023 7–9 February







<u>Content</u>



Update on Carbon Management Developments in the United States

Mark Ackiewicz

DIRECTOR, OFFICE OF CARBON MANAGEMENT TECHNOLOGIES U.S. Department of Energy

February 8, 2023



A Vision for Carbon Management



A carbon management framework that will guide FECM's engagement with offices across the Department, Federal agencies, tribal and international governments, industry, non-governmental organizations, and communities

Priorities: Justice, labor, and international and domestic partnerships

Advancing Justice, Labor, and Engagement

Advancing Carbon Management Approaches Toward Deep Decarbonization

Priorities: Point-source carbon capture (PSC), carbon dioxide conversion, carbon dioxide removal (CDR), and reliable carbon transport and storage

Advancing Technologies that Lead to Sustainable Energy Resource

Priorities: Hydrogen with carbon management, domestic critical minerals (CM) production, and methane mitigation



Content

Several Newly Enacted Laws Significantly Expanding Carbon Management Investments (highlights, not comprehensive)

- Bipartisan Infrastructure Law (BIL) enacted November 15, 2021
 - Over \$12 billion in Carbon Management
 - \$8 billion for Hydrogen Hubs
 - \$500 million for Industrial Emissions Reduction Technology Development Program
 - \$50 million to the U.S. Environmental Protection Agency for states to attain class VI primacy (geologic storage permitting)
- CHIPS and Science Act enacted August 9, 2022; Authorizes:
 - \$1 billion for carbon dioxide removal
 - \$200 million for alternative fuels
 - \$600 million for clean energy industrial technologies
- Inflation Reduction Act (IRA) enacted August 16, 2022
 - \$5.812 billion for Advanced Industrial Facilities Deployment
 - Tax credit enhancements 45Q carbon capture, 45V hydrogen



BIL Carbon Management Provisions

Carbon Dioxide Removal - Direct Air Capture Regional Direct Air Capture Hubs: \$3.5 billion DAC Technology Prize Competition: \$115 million **Carbon Capture, Utilization and Storage (CCUS)** Integrated CCUS Demos: \$2.537 billion Carbon Capture Large Pilots: \$937 million

Carbon Dioxide Utilization and Storage Carbon Storage Validation and Testing: \$2.5 billion Carbon Utilization Program: \$310 million Carbon Dioxide Transportation Infrastructure Finance and Innovation Program Account (CIFIA) Loan Programs and Future Growth Grants: \$2.1 billion

Front-End Engineering Design Studies Carbon Capture Technology Program (Transport Infrastructure): \$100 million



BIL Implementation

Provision	FOA/Loan Notice of Intent Issued	FOA/Prize Release	FOA/Prize Close	Project Selections
Carbon Storage Validation and Testing	04/29/2022	09/21/2022	11/30/2022	~03/13/2023
Carbon Capture FEED (Transport)	07/13/2022	09/22/2022	11/28/2022	March 2023
CCS Integrated Demos	07/13/2022	09/22/2022	12/05/2022	~ 03/31/2023
Regional Direct Air Capture Hubs	05/13/2022	12/13/2022	03/13/2023	~ 06/30/2023
Direct Air Capture Prizes	N/A	12/13/2022	Varies	Varies
Carbon Utilization Procurement Grants	12/13/2022	TBD – Q2 FY2023	TBD	TBD
Carbon Capture Large Pilots	TBD	TBD	TBD	TBD
Hydrogen Hubs		09/22/2022	04/07/2023	Fall 2023
Carbon Dioxide Transportation Infrastructure Finance and Innovation (CIFIA) program (loan program)	10/6/2022	N/A	N/A	N/A
Industrial Emissions Reduction (BIL) and Advanced Industrial Facilities (IRA)	12/22/2022	TBD	TBD	TBD

Inflation Reduction Act – "45Q" Carbon Capture Tax Credit Modifications

	Old	New
Commence Construction	January 1, 2026	January 1, 2033
DAC Facility	100,000 metric tons/year*	1,000 metric tons/year
Electric Generator	500,000 metric tons/year*	18,750 metric tons/year
All other facilities	100,000 metric tons/year*	12,500 metric tons/year
Saline Storage Credit	\$50/metric ton	<pre>\$85/metric ton (industry and power); \$180/metric ton (DAC)</pre>
EOR and Conversion Credit	\$35/metric ton	\$60/metric ton (industry and power); \$130/metric ton (DAC)

* Non-EOR Conversion facilities were previously 25,000 metric tons/year regardless of facility/source.

Notes: New Modifications allows up to 5 years for direct pay (up to 12 years certain entities)



Inflation Reduction Act – "45V" Clean H₂ Production Tax Credit

Commence Construction	January 1, 2033
kg of CO ₂ per kg of H ₂	Credit Value (\$/kg)
4 to 2.5	0.60
2.5 to 1.5	0.75
1.5 to 0.45	1.00
0.45 to 0	3.00

Clean hydrogen: lifecycle greenhouse gas emissions rate of no greater than 4 kilograms of CO₂ equivalent ("CO₂e") gas per kilogram of hydrogen.

As an alternative to the Clean Hydrogen Production Credit, taxpayers may elect the Section 48 Investment Tax Credit (the "**ITC**") with respect to clean hydrogen production facilities, receiving an ITC of up to 30% depending on the carbon intensity of the production process.

The Clean Hydrogen Production Credit is not available, however, for clean hydrogen produced at a facility that also includes carbon capture equipment for which the Section 45Q carbon capture tax credit is allowed to any taxpayer.





H₂ with Carbon Management Conversion of carbon-based feedstocks to H2 coupled with carbon management

Carbon Dioxide Removal Removal of atmospheric CO₂ and durable store



Carbon Utilization Conversion of CO₂ to valueadded products



Carbon Storage

Safe, cost- effective, and permanent geologic storage of CO₂



Carbon Capture

U.S. DEPARTMENT OF

Capturing CO₂ from new and existing industrial and power plants

Fossil Energy and

Carbon Management



Carbon Negative Shot: Key Performance Elements

Carbon Negative Shot's key performance elements will guide a responsible industry that is responsive to the climate crisis, such that multiple true, durable removal pathways can be deployed at their most affordable cost at the scale required to address the climate crisis.



Robust accounting of full life cycle emissions

High-quality, durable storage with costs demonstrated for MRV for at least 100 years

Enables necessary gigaton-scale removal



Hydrogen Energy Earthshot Initiative (HEEI)



1 Dollar



1 Kilogram



1 Decade

ENERGY.GO	SCIENCE & INNOVATION ENERGY ECONOMY SECURITY & SAFETY 🔞 SAVE ENERGY, SAVE MONEY Q
	Department of Energy
2	Secretary Granholm Launches Hydrogen Energy Earthshot to Accelerate Breakthroughs Toward a Net-Zero Economy
f	Home » Secretary Granholm Launches Hydrogen Energy Earthshot to Accelerate Breakthroughs Toward a Net-Zero Economy
У	First Energy Earthshot Aims to Slash the Cost of Clean Hydrogen by 80% to \$1 per Kilogram in One Decade
in	WASHINGTON, D.C. – Secretary of Energy Jennifer M. Granholm today launched the U.S. Department
Р	of Energy's (DOE) Energy Earthshots Initiative, to accelerate breakthroughs of more abundant, affordable, and reliable clean energy solutions within the decade. The first Energy Earthshot— Hydrogen Shot—seeks to reduce the cost of clean hydrogen by 80% to \$1 per kilogram in one



Energy.gerategov

DOE's Carbon Matchmaker

A partnering and teaming tool for DOE carbon management funding opportunities, mirroring DOE's H2 Matchmaker.

Carbon Matchmaker is an online information resource to connect users across the carbon capture, utilization, and storage (CCUS) and carbon dioxide removal (CDR) supply chains.

Carbon Matchmaker will:

- Enable a teaming mechanism to support geographically diverse CCUS/CDR projects across the United States.
- Increase awareness and facilitate development of regional carbon management hubs, including alongside hydrogen hub development where relevant.
- Provide community, industry, and technology development stakeholders domestically and internationally with carbon dioxide supply and demand maps for current and planned projects.
- Highlight past and currently funded DOE carbon management projects in a geospatial map.

https://www.energy.gov/fecm/carbon-matchmaker





energy.gov/fecm

DOE Annual Carbon Management Meeting

- Held annually in Pittsburgh, PA, typically in August
- 2022 event: Over 700 registrants
- DOE-funded carbon management projects present
- Includes other Federal agencies, international, etc.
- Excellent opportunities to network and build relationships
- 2022 Event Proceedings: <u>https://netl.doe.gov/events/conference-proceedings</u>

• 2023 Event: August 28-September 1, 2023 in Pittsburgh, PA





DIRECTOR, DEPARTMENT FOR ENERGY AND ENERGY TRANSITION

Large-scale deployment of CCS depends on comprehensive R&D

Rune Volla is the Director of the Department for Energy and Energy Transition at the Research Council of Norway (RCN). The department covers research and innovation in the whole energy field; renewable energy, energy efficiency and security, energy infrastructure, carbon capture usage and storage and oil and gas.



#CLIMITSUMMIT2023 7–9 February







<u>Content</u>

Large-scale deployment of CCS depends on comprehensive R&D

Rune Volla The Research Council of Norway



We aim to realize the best possible research and innovation

- We promote a society where research is created, used and shared and contributes to the sustainable solutions the world needs.
- We ensure that the best research and innovation projects are financed.



Funding mechanisms within CCS at the Research Council

- CLIMIT
- Research Centres (FME):
- Green Platform
- Research Infrastructure (ECCSEL)
- International cooperation
 - ACT Accelerating CCS Technologies
 - CETP Clean Energy Transition Platform



<u>Content</u>

М

Forskningssenter for miljøvennlig

Norwegian Centre for Environmentfriendly Energy Research

energi

Forskningsrådet

M

Norwegian Centre for Environment-friendly Energy Research (FME)

24 FMEs financed by the Research Council since 2009



- 2009 2017: Eight technological centres
- 2011 2019: Three social science centres
- 2016 2024: Eight technological centres
- 2019 2027: Two social science centres
- 2021 2029: One wind energy centre
- 2022 2030: Two hydrogen centres
- 2023: New call for applications
- Annual financial support from the Research Council: NOK 240 Million (2022)





FME NCCS (Norwegian CCS Research Center) represented by director Mona Mølnvik and chairman of the board Tord Lien.

Collaboration between funding agencies

- Green Growth agreement signed 17 January 2022 by the Research Council, Innovation Norway, ENOVA, and SIVA
- All forms of cooperation when
 - it contributes to the aims and objectives of the parties
 - it provides added value beyond what the parties could have achieved alone
 - a common goal is established
- Operationalisation
 - CLIMIT (The Research Council and Gassnova)
 - Calls for applications (Pilot-E and Green Platform)
 - HEILO Hydrogen
 - HEILO Offshore Wind and HEILO CCS to be announced this spring





The way forward for CO₂ capture and storage includes continued focus on research and innovation

- R&D in parallel with full-scale demonstration
- Deploying CCS is an iterative process with research and demonstration in parallel
- Cooperation academia and industry
- From basic to applied research
- International RD&D projects
- Combine social science and technical research

The CLIMIT program will play a key role



Empowering ideas for a better-world

We promote a society where research is created, used and shared and contributes to the sustainable solutions the world needs.

Content

Aage Stangeland

SPECIAL ADVISER

ACT & CETP: How International Collaboration Fosters CCUS Research and Innovation

Aage is coordinating activities within CCS at the Research Council of Norway. The main responsibility is the national program for RD&D within CCS, CLIMIT. He is also following up on international cooperation within CCS.



#CLIMITSUMMIT2023 7–9 February







ACT & CETP: How International Collaboration Fosters CCUS Research and Innovation

Aage Stangeland The Research Council of Norway

Content



ACT – Accelerating CCS Technologies

This is ACT

Content

- Funding agencies from Europe, India, Canada and USA, coordinated by the Research Council of Norway
- Aims to accelerate and mature CCUS technologies
- Makes funds available for R&D and innovation projects.



www.act-ccs.eu

Co-funded by the European Commission within the Horizon 2020



Status for the ACT calls

ACT has funded 39 projects with a total of € 108 M

Content

2017 ACT1	2019 ACT2	2021 ACT3	2022 ACT4	ACT Open Call
 Funding agencies	• Funding agencies from 11 countries	 Funding agencies	 Funding agencies	 Funding agencies
from 9 countries		from 15 countries	from 5 countries	from 4 countries
 Eight new projects started in 2017 	 12 new projects	 13 new projects	 6 new projects	 Targeting
	started in 2019	starting late 2021	starting late 2021	industrial projects
• € 35 M from ACT of which € 11 M from EC	• € 32 M from ACT	• € 29 M from ACT	• € 12 M from ACT	• The Call is open for applications!

www.act-ccs.eu

35





Project example: **ALIGN**CCUS

ALIGN addressed specific issues across the CCUS chain, enabling large-scale, cost-effective implementation of CCUS by 2025.



Content

ALIGN delivered actionable blueprints in ERA-NET ACT countries:

- Teesside and Grangemouth (UK)
- Rotterdam (NL)
- North Rhine-Westphalia (DE)
- Grenland (NO)
- Oltenia (RO)

www.act-ccs.eu

The blueprints should be usable for other industrial clusters.

Co-funded by the European Commission within the Horizon 2020



Project example: Pre-ACT



Results

- Developed workflows for preinjection modelling, monitoring, conformance verification, and decision making.
- Project results of high interest for operators planning full-scale CO₂ storage.

Content







www.act-ccs.eu

Effects of increased international cooperation

- Efficient flow of knowledge, competence, and data across borders.
- Higher budgets for RD&I within CCUS than would have been the case without ACT.
- Alignment of national RD&I strategies.

Content

- The projects funded by ACT have closed knowledge gaps.
- Results created by ACT funded projects are to a large extent available for international researchers, industrial stakeholders, and decision makers.







www.act-ccs.eu

ACT Impacts

- Larger projects with higher impact than what would have been possible with only national projects.
- Well-functioning RD&I collaboration across borders.
- Strong relations between academia and industry.
- International cooperation already in the research phase increases chances for transnational large-scale implementation of CCUS.
- Results from ACT projects are relevant for the European Strategic Energy Plan (SET-plan) and for Mission Innovation.

www.act-ccs.eu

• Important contributions to dissemination of key messages beyond the scientific community.

Content









The new Big Thing: Clean Energy Transition Partnership (CETP)



Clean Energy Transition Partnership (CETP)

CETP Management



CCUS &

renewable

fuels



Zero emission power



Heating & cooling



Energy systems



Regional energy systems



Industrial

energy

systems



Buildings

CETP call for applications 2022

CETP will have annual calls for applications

CETP Call 2022

- Due date for pre-proposals September 2022
- Due date for full application 27 March 2023
- New projects will be announced this summer
- Funding agencies from 30 countries
- Call budget: € 143 M

CETP Call 2023

- The call will be published this summer
- Due date for pre-proposals autumn 2023
- Details will be available at the CETP
 website: <u>https://cetpartnership.eu/</u>



EUROPEAN PARTNERSHIP

Content

Mark Ackiewicz

DIRECTOR, OFFICE OF CARBON MANAGEMENT TECHNOLOGIES

Mission Innovation

Mr. Mark Ackiewicz is the Director for the U.S. Department of Energy Office of Carbon Management Technologies. In this role, Mark is responsible for planning, management, and administration of the Office's RDD&D portfolio.



#CLIMITSUMMIT2023 7–9 February







Content



Content

Carbon Dioxide Removal (CDR) Mission

Mark Ackiewicz, Mission Director U.S. Department of Energy

CLIMIT Sum mit, February 8,2023



About the Mission

Launched at COP-26, Scotland November 2021

Coalition:

- Co-leads Canada, Saudi Arabia, United States
- Members Australia, EC, India, Japan, Norway, United Kingdom

Always open for additionalmembers



Goal:

"100 in 10" – Enable CDR technologies to a chieve a net reduction of 100 m illion metric tons of CO_2 per year globally by 2030.

Content

Scope



Technological CDR approaches, including:

- Direct Air Capture (DAC)
- Enhanced mineralization
- Biomass with carbon removal and storage (BiCRS)

Emphasis on secure CO_2 storage and conversion into long-lived products.



MICDR Activities to Date



- Several workshops Life Cycle Analysis, Roadmapping and Action Plan, BiCRS webinar
- Released Roadmap and Action Plan at Global Clean Energy Action Forum (GCEAF) in September 2022
- Released BiCRS Technical Track Scope of Work
- Increasing presence at other events (COP 27)



Roadmap Priority R&D Directions



(4)

TechnicalTrack	Top Innovation Priorities	
Direct Air Capture with Storage	Energy use Material performance CO ₂ capture and desorption kinetics Environmental impacts and siting	AUGUST 2022 IST EDITION CARBO REMOV
Enhanced Mineralization	Minera lization kinetics Energy use, land use, and environmental impacts	ROAD GAPS ANALY
Biom ass with Carbon Removal and Storage	Biom ass feed stocks (e.g., optimizing or advancing our understanding of opportunities with various feed stocks) System logistics (e.g., evaluating biom ass availability, value chains, and ensuring that processing occurs close to biom ass sources) Utilization	
Cross-cutting	Life cycle analysis Techno-economic analysis Measurement, monitoring, and verification	

CARBON DIOXIDE EMOVAL TECHNOLOGY **OADMAP: INNOVATION APS AND LANDSCAPE** NALYSIS

CARBON DIOXIDE REMOVAL

Content

Action Plan: Outcomes and Actions

Outcome # 1: Enhanced understanding of local and global CDR potential

LCA case studies CDR resource mapping

Outcom e # 2: Advancement of Research and Development (R&D) for CDR (*Possible future actions*): Joint R&D funding call

Global CDR Community Testing Sites

Outcome # 3: Global demonstrations and pilot-scale tests

CDR La unchpad: Pilot-scale/demo projects

Crosscutting Activities (*Possible future actions*):

International Guidelines and Common Approaches Joint prize competition Collaboration with other MI Initiatives





COP27 high level take a ways for CDR



- Increasing recognition globally of role that CDR will play as a climate solution
- Not much progress on Article 6
- Many side events with CDR
- Mission Innovation CDR Launchpad eventa success!



MICDR La unchpad

- First-wave members include Canada, the European Commission, Japan, Norway, the United Kingdom, and the United States.
- Launchpad members commit to:
 - Build at least one, 1,000+ tonne CO₂ per year CDR project by 2025
 - Share data and information from the projects, with the aim to improve databases for life cycle analysis (LCA), technoeconomic analysis and regulatory requirements
 - Provide in-kind support to: Advance robust measurement, reporting, and verification (MRV) efforts for CDR projects by supporting a new "CDR MRV working group"





Mission Innovation CDR La unchpad side event



- Ministers and senior representatives from six countries participated
 - Hosted by Denmark
- Remarks and paneldiscussion
- Sparked interest from additional countries
- Build momentum for sprint
- Media:
 - Video recording a vailable on MI website
 - MI Secretariat Press Release
 - Socialmedia, blogs, news outlets



MICDR Priorities for 2023



- Build upon Roadmap and Action Plan Progress to Date
- 2. Tracking progress
 - Develop/refine KPIs (input and outputs)
- 3. Maxim izing opportunities for collaboration
 - Take advantage of synergies between Missions
 - Identify opportunities for private sector engagement
- 4. Maintaining momentum
 - Launch new MRV Working Group
 - Initiate new sprint(s) and/or report meaningful progress on existing sprint(s)
 - Maintaining politicalengagement



Upcoming Events

MI Annual Gathering

- March 20-23, 2023 in Rio de Janeiro, Brazil.
- Opportunity to:(a) report on progress and flag challenges to senior MI officials;(b) network with other Missions, CEM initiatives;(c) share best practices

8th Mission Innovation Ministerial / 14th Clean Energy Ministerial

- July 21, 2023 in Goa, India
- Opportunity for Ministers to announce new initiatives and report on progress.

COP28

• Continue to amplify mission



