

Accelerating CCS Technologies

3rd ACT knowledge sharing workshop 13 November 2018

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What ACT is about

Since the industrial era the level of carbon dioxide (CO₂) released into the atmosphere has increased significantly, and it is well documented that burning fossil fuels emits CO₂ with serious and negative impact on the climate. Carbon Capture, Utilization and Storage (CCUS) is part of a portfolio of technologies to combat climate change. CCUS can help mitigate CO₂ emissions from electricity production and is a prerequisite for reducing CO₂ emissions from industry such as steel, cement, chemicals and petrochemical refining.

ACT will be **A**ccelerating **C**CCUS **T**echnologies by making available funds for transnational research and innovation activities. CCUS will have an important role to play to make the transition to a low-carbon economy happen.

The CCS technology involves **capturing** CO₂ from large CO₂ emission point sources, such as fossil fuelled power plants and large, energy intensive industrial plants, compressing it for **transportation** and then injecting it deep into a rock formation at a carefully selected and safe site, where it is permanently **stored**. In addition, CCUS projects where innovative and cost reducing **utilisation** of CO₂ is also in scope for ACT.



Figure 1: Geological storage of CO₂

ACT is an international initiative based on the Horizon 2020 European Commission funding scheme. Nine European countries started this collaboration in 2015. The first Call for projects took place in 2016. Since then, ACT has expanded its collaboration beyond Europe, with USA now included in the consortium.

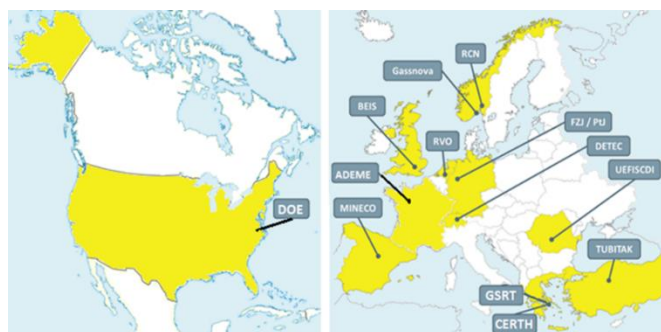


Figure 2: Partners of ACT

The ACT partners are France (ADEME), Greece (GSRT and CERTH), Germany (Jülich, FZJ/PtJ), The Netherlands (RVO), Norway (RCN and Gassnova), Romania (UEFISCDI), Spain (MINECO-AEI), Switzerland (DETEC) Turkey (TUBITAK), United Kingdom (BEIS) and United States of America (DoE).

The ACT calls ask for RD&D projects that can lead to deployment of CCUS in Europe. Project proposals with high industrial relevance and industrial involvement will be prioritised. ACT is coordinated by The Research Council of Norway (RCN).

Executive summary

After the 1st and the 2nd knowledge sharing workshop which took place 14 November 2016 in Lausanne (Switzerland) and 24 October 2017 in Bucharest (Romania), respectively, the ACT consortium organized the 3rd workshop 13 November 2018 in Niederaußem, Germany at the facilities of RWE (*Rheinisch-Westfälisches Elektrizitätswerk* power plant). This workshop was dedicated to get updating from the 8 funded projects and focus on three main objectives:

1. Reach-out

- How does the project contribute to accelerating CCS by reach-out to industry, to decision makers, to the public, to the scientific community?
- How do you communicate?
- What do you know or measure about the effectiveness of your communication?

2. Collaboration within the project

- How do you collaborate/communicate in your transnational project?
- What works well, what could be improved?

3. Synergies with other ACT projects

- Are there any results?
- Should this be taken forward?

The topic of the workshop was **presentation of the 8 ACT funded projects, CCU programs in the USA and the Energy Research Program in Germany. The workshop also included a tour through the facilities of the RWE Plant (Annex 1 - the agenda).**

The 8 coordinators from the ACT-funded projects were present and provided information and updates of their progress and results achieved so far. The European Commission was represented by our project officer Vassilios Kougionas and The German Ministry of Economics and Energy was presented by Johannes Kerner (**Annex 2 – participant list**).

The workshop was very well organised by Heiko Gerhauser, Annette Weiß and Wolfgang Körner from PtJ/Jülich) in close collaboration with Peter Moser and Ferdinand Steffens from RWE.

Presentations are available at <http://www.act-ccs.eu/library/>

Opening of the workshop

The first part of the workshop was dedicated to welcoming and opening of the workshop, but also to a short introduction from people of RWE explaining their facilities and their CCUS developments.

Peter Moser at RWE talked about the importance of CCUS technology in a conventional power plant to reduce emissions, save energy and storage efficiently.

A total of 2.4 billion tons of approved deposit reserves support Germany's long-term supply with energy and resources.

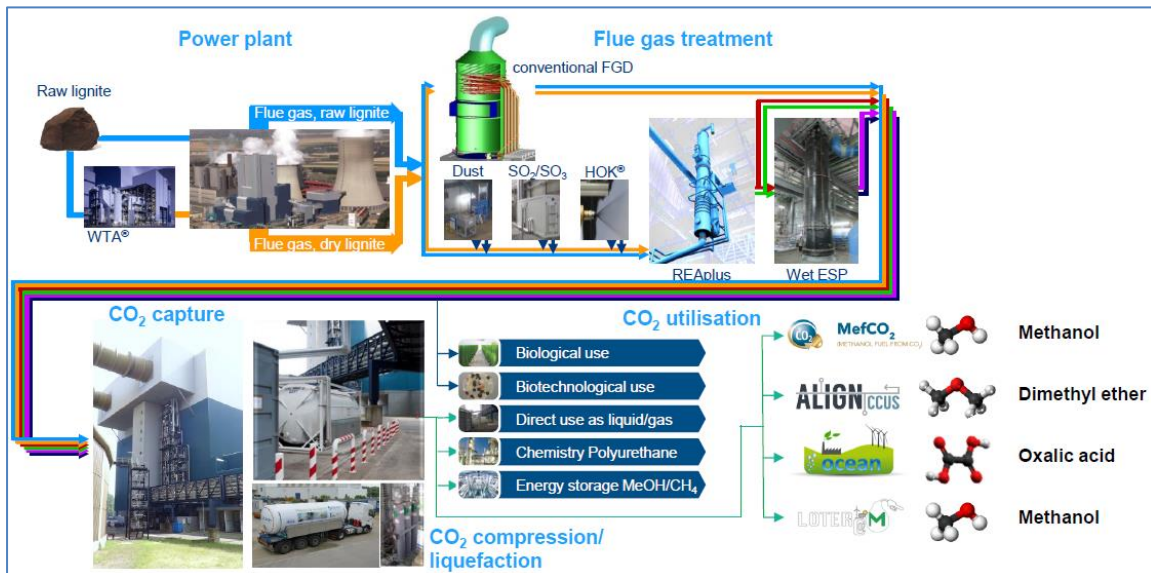


Peter said that conventional power plants are needed for decades before sufficient energy storage capacity is operational. He emphasized that CCU can help reduce emissions and store energy.

RWE wants to reduce CO₂ emissions by 40-50% by 2030, said **Ferdinand Steffens** at RWE.

RWE’s lignite roadmap is in line with the energy transition, ensures supply and provides a reliable framework for all stakeholders. RWE stated that R&D is facing the current challenges of the future in the Energy sector:

1. Power plant technology for flexible operation
2. Alternative use of lignite and biomass
3. Flue gas cleaning and utilization of CO₂ (the goals of this workshop)
4. Quality assurance and Materials



CCU and sector coupling projects at RWE Power

Primary energy consumption and fluctuating power production from wind and photovoltaics. All sectors need to contribute to the CO₂ reduction. Conventional power plants will be needed for decades before sufficient energy storage capacity is operational; CCUS can help to reduce the CO₂ emissions and to store energy.

Ragnhild Rønneberg (ACT coordinator, RCN, Norway) addressed a warm welcomed to all participants and thanked the people from PtJ and RWE for hosting the workshop. A warm welcome was also addressed to our project officer Vassilios Kaugionas from the EC and the new partner from the USA, DoE.

The coordinator established that **ACT was born as a response to the Call for proposals by EC in 2015 on “Low Carbon Technologies”:**

“It is important to develop and bring to market affordable, cost-effective and resource-efficient technology solutions to decarbonise the energy system in a sustainable way, secure energy supply and complete the energy internal market.

A strong international collaboration is needed for a successful implementation of CCUS as climate measure, said Ragnhild.

A brief description of ACT since the transnational call was launched in June 2016; the evaluation process, decision for funding and a brief overview of the 8 projects was presented. It is of great value that all ACT countries are involved in one or more projects, meaning that a fair distribution of the projects between countries being reached and also that political awareness, supporting R&D in the CCUS field, can be achieved.



- This is the 3rd knowledge sharing workshop, and these workshops allow to identify and address issues within and outside Europe that can be of importance for acceleration of CCS in a global scale and stimulate to transnational cooperation.

1 st call. Projects funded, 2017-2020		ACT, M €	Norway	Netherlands	UK	Germany	Romania	Switzerland	Spain	Turkey
Project	Activities									
ALIGN	Chain integration, clusters	14,5	x	X	x	x	x			
ELEGANCY	Chain integration, hydrogen	8,9	X	x	x	x		x		
PRE-ACT	CO2 storage, pressure handling	4,5	X	x	x	x				
ACORN	Full chain CCS / infrastructure	2,0	x	x	X					
DETECT	CO2 storage, risk assessment	2,0		X	x	x				
ECOBASE	CO2-EOR SouthEast Europe	1,2	X	x			x			x
GASTECH	Gas switching technology	1,7	X	x			x	x	x	x
3D-CAPS	3D printed sorbents	1,5	x	X			x			

• Total budget for 8 projects: € 50 M
 • ACT supporting: € 36 M

bold X = lead country
 more info at www.act-ccs.eu

1st Call for proposals, June 2016	2nd call for proposals, June 2018
<ul style="list-style-type: none"> • 10 partners from 9 countries cooperate • 8 new projects decided for funding in 2017 • Project period 3 years • 36 M€ from ACT – of which 12,2 M€ from the EC 	<ul style="list-style-type: none"> • 13 partners from 12 countries • Budget of 22-30 M€ • 47 pre-proposals, requesting 112M€ • Invitation to submit full proposal 1 March 2019

The ACT second call was launched in June 2018, 13 partners from 12 countries with a total budget of 22-30M€. The feedback to the applicants on who will be invited to second stage, will be carried out before 30 November.

ACT will fund new projects in the CCUS sector in 2019 and the 3rd call is planned in 2020.

Presentation of funded projects

Ragnhild (RCN, Norway) was facilitating the session until lunch and Heiko Gerhauer chaired the afternoon session. The projects were asked to present their work packages, partners, objectives, results and updates since the 2nd sharing workshop in Romania in October 2017.

ALIGN

This project was presented by **Tom Mikunda** (TNO, NL). ALIGN is a full chain integrated project addressing specific issues across the CCUS chain for six European industrial regions, enabling large scale transition and cost-effective implementation of CCUS by 2025. The reach the overall of ALIGN, the project encompasses several focused, but interlinked objectives

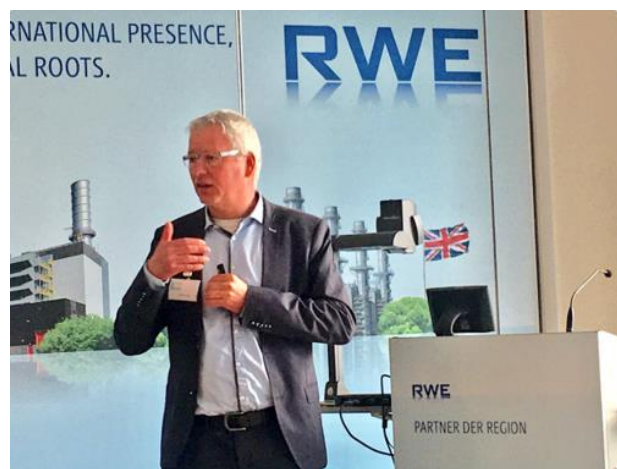
1. Capture
2. Transport
3. Storage
4. Utilization
5. Society

Key figures:

- ✓ 31 partners (GE, NO, RO, UK, NL)
- ✓ Approx. 23 M Euro project budget
- ✓ Sept 1st 2017-Sept 1st 2020
- ✓ 100 deliverables in the project

Why ALIGN CCUS?

- ✓ Testing at world class research facilities
- ✓ Multidisciplinary teams
- ✓ Exceptional industrial commitment
- ✓ Demonstration of FOAK full CCU chain.



It is a well-integrated project with 6 WPs: ALIGN combine the results from each of these objectives.

WP1: Capture (emission, control, solvent management, dynamics and control, cost reduction). In this WP1 the test was carried out at RWE in Niderraußem by HWU, TNO and RWE.

Future work: Long term campaign at RWE with CESAR-1, test campaigns at TCM, Tiller and PACT, and emissions measurements at other locations.

WP2: Transport. Removing technical barriers to large-scale CO₂ Transport. Investigate safe and efficient injections conditions for batch-wise....

WP3: Storage: Standardizing storage readiness. Large-scale storage networks. SRL numbers. We have looked different cluster for storage around Europe, collaborating with the others ACT projects funded. Future work: the reuse of infrastructure for CO₂ Storage and legal issues

WP4: Re use: CCU demonstration construction, engine adaption....

WP5: Targeted CCUS activities in industrial cluster. Future work: include the other industrial areas; take these results to develop an action plan.

WP6: Society: Seek cooperation on national level, with other ACT/H2020 research programs.

They have improved their dissemination by twitter and YouTube channel. Webinars, interviews, articles etc.

Objectives	Results
Reach Out	<p>The project enables large scale transition and cost-effective implementation of CCUS by 2025</p> <ul style="list-style-type: none"> ✓ Testing at world class research facilities ✓ Multidisciplinary teams ✓ Exceptional industrial commitment ✓ Demonstration of FOAK full CCU chain <p>Communication: Targeted CCUS activities in industrial cluster. Future work: include the other industrial areas; take these results to develop an action plan They have improved their dissemination by twitter and YouTube channel. Webinars, interviews, articles etc</p>
Collaboration	
Synergies	

ELEGANCY

This project was presented by **Svend Munkejord** (Sintef, Norway). **ELEGANCY** stands for Enabling a Low Carbon Economy via Hydrogen and CCS.

Key information: Primary objective is to fast-track the decarbonisation of Europe's energy system by exploiting the synergies between the low-carbon technologies: CCS and H2.

- ✓ Duration: 2017-08-31 to 2020-08-31
- ✓ Preliminary budget: 15.599K€ from 2017-2020
- ✓ Partners: NO (Sintef, AdeB, AKSO, Gassco), UK (ICL, BGS, SDL, Scottish Enterprise, INEOS), CH (ETH, PSI, etc), NL (ECN, TNO, UU) DE (RUB, Uniper energy Storage etc), GERG, Swerea-MEFOS from outside the consortium.



Elegancy projects aims:

1. Decarbonization of heating and transport based on an existing fuel and infrastructure
2. A commercial model for industrial CCS
3. Opportunity to broaden awareness of CCS

Svend outline the context of the project

- The low carbon economy needs H2
- Needs for CCS
- Combining H2-CCS offers and existing opportunity.

WP1: H2 supply chain including H2/CO2 separation. ETH led. Enable efficient H2 production and CO2 capture at different plant sizes. The various ways to increase the efficiency and productivity of natural gas/biogas reforming was also presented.

WP2: CO2 transport, injection and storage. SINTEF led. Develop an accurate property model for CO2-brine in the presence of impurities. Mature and validate tools for the safe, efficient and cost effective design and operation of CO2 pipelines and injection wells.

WP3: Business case development. AdeB led (taken over by the University of Oslo). Business case development. It will assess the regulatory background

WP4: H2-CCS chain tool and evaluation methodologies for integrated chainS. ICL led. Develop a roadmap for decarbonising the Rotterdam industry

WP5: Case studies including social acceptance, environmental aspects and CCS-H market considerations.

WP6: Project management, network building and dissemination.

Svend put in common the objectives for each country in the interest in this project, linked by the strategies in their countries.

- a) As the ALIGN project said, decarbonizing the Dutch economy is one of the objectives and the strategic lines.
- b) Enabling Swiss CO₂ -Free transport by H₂ and CCS.
- c) Decarbonization of UK cities and industrial clusters.
- d) Adapting gas infrastructure to H₂ and CCS in Germany
- e) The Norwegian full-scale CCS chain and synergies with H₂ production.

Svend also reported on the collaboration with other ACT projects as ALIGN and DETECT.

Objectives	Results
Reach Out	ELEGANCY aims to fast-track Europe's energy system by combining CCS and H ₂ <ul style="list-style-type: none"> • By overcoming specific scientific, technological and economic/legal barriers • By undertaking five national case studies adapted to the conditions in the partner countries. • Analysis of the potential for H₂utilization in Norway performed • H₂ utilization in the following sectors analyzed: <ul style="list-style-type: none"> • Transportation: land and sea • Industry: H₂as fuel for high temperature heat supply, reducing agent in metal industry • Power: H₂as fuel for gas turbines for offshore applications
Collaboration	At and between the various levels; researcher / task / WP / project <ul style="list-style-type: none"> •Using the most efficient communication; phone / e-mail / skype / physical meeting
Synergies	ALIGN-CCUS <ul style="list-style-type: none"> • Regular contact, particularly in the Netherlands and the UK • Work programmes designed to be complementary • DETECT • Dialogue regarding Mt Terri experiments and modelling • ALIGN-CCUS/ACORN/ELEGANCY/ECOBASE • Social science teleconference

Pre-ACT

The project was presented by **Peder Eliasson** (Sintef, Norway). Storage project. The goal is to identify and address main storage related challenges for accelerated deployment of CCS in collaboration with industry. Crucial challenge: Capacity, confidence and cost.

Key figures:

- ✓ Budget 5.2 M Euro aprox
- ✓ Duration 1/9 2017 – 31/08 2020
- ✓ Partners: Sintef, BGS, GFZ etc

Pre-ACT: Pressure control and conformance management for safe and efficient CO₂ storage. Pressure driven support and guidelines/ recommendations that enable to establish safe and efficient monitoring system.



WP1: Pre-injection modelling: Inject CO₂ over the pressure (control, and modelling with lab work). Pressure modelling, Hypersaline discharge. During the presentation Peder mentioned that Pre-ACT has won an award in the ARCHER Competition in the UK 2018 for a video of such modelling created by PML. In WP1 they also include some geomechanical experiments.

WP2: Novel monitoring concepts. Led by Germany GFZ. Their objectives are establishing novel concepts for quantitative monitoring of pore pressure and saturation. Minimize cost by using passive-active monitoring strategy and provide input for real time conformance verification in WP3. Rock physic inversion was also developed in this WP.

WP3: Conformance verification. The objectives are to develop and evaluate approaches for verification of site conformance.

WP4: Decision making.

WP5: Workflow demonstration. It is ready to start up soon.

WP6: Management. Very limited at the moment.

Objectives	Results
Reach Out	Answering to industry needs (specific questions asked by industry) <ul style="list-style-type: none"> • Involvement of NPD (in workshop and in WP1/WP5 work) • Public web page • Webinar series (not yet started) • Common outreach efforts with Svelvik Field Lab • Publications and presentations (EAGE, NSG, GHGT, SEG, EAGE Utrecht) • Measure of effectiveness not considered
Collaboration	Leader group meeting sat the beginning of each quarter. •Status reports from each WP and input for traffic light report <ul style="list-style-type: none"> • General information exchange and planning of upcoming quarters • Monthly meetings for each WP (for coordination of WP tasks) • Task specific meetings and workshops • Annual meeting • Using an "eRoom" for data/information sharing • SharePoint available, but currently only used by SINTEF.

Synergies	<p>Until now, limited synergy with other ACT projects.</p> <ul style="list-style-type: none"> • However, colleagues from ALIGN, ELEGANCY, and DETECT will participate in Pre-ACT workshop on monitoring and conformance verification next week in Utrecht. • Common lunch with ECOBASE project in Utrecht. • Good potential for exchange with ALIGN, due to some overlapping personnel. • Pre-ACT may participate in final meeting of ACORN. • A few new ACT projects are interested (if granted) in collaborating with Pre-ACT.
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CCUS in the United States of America

Our goal is to reduce costs of carbon capture by at least 50% through technology development, said **John Litynski** from US-DoE. He presented the US Policy incentives for CCUS, the big opportunity by the 45Q tax credits. The technology push through R&D and market pull through financial incentives are important issues.

John showed the major demonstration projects:

- Air products facility in Texas
- Petra Nova CCS in Texas
- ADM Ethanol Facility in Illinois (IL)

The USA is investing in CCUS from 2003 trying to reduce the cost of capture, to develop viable carbon utilization alternatives and reduce the risk of geologic storage.

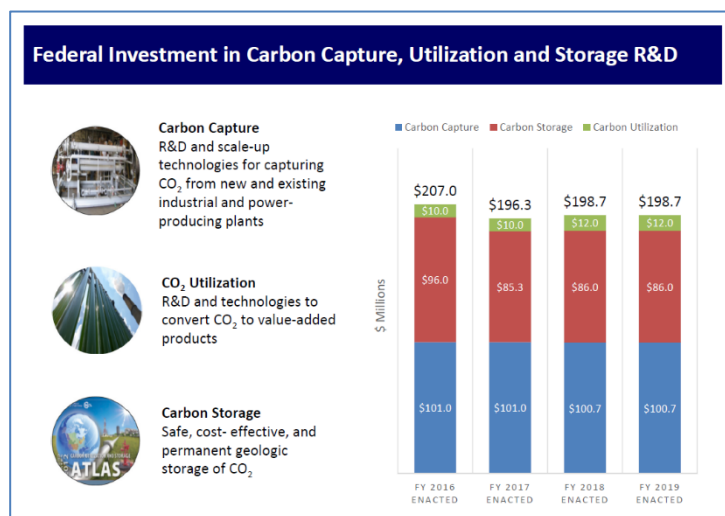


One of the most important programs in DoE is the Carbon Capture Simulation Initiative for Industry Impact (CCSI2), in which 2 projects were highlighted.

1. Membrane Technology Research.
2. Ion Engineering.

DoE has a Carbon program with 6 key challenges and different initiatives. John expressed his thanks on behalf of US-DoE for having become a partner of ACT, an initiative of great value to US.

- Thank you, Norway, and TCM that we can use your facilities, where 5 projects (RTI, SRI, TDA, Flour and MTR) are going to be tested the next years, said John before ending his presentation.



7th Energy Research Program, German Ministry of Economics and Energy

The status of the energy transition and R&D needs in Germany was presented by **Johannes Kerner**. The "Energiewende" fosters investments and the Energy transition is a driver of innovation in Germany, Johannes said.

He showed how Germany achieves in terms of climate (%reduce greenhouse gas), renewable energy (% gross electricity consumption) and energy efficiency and stated that the energy transitions is having positive effects at various levels of the economy (as net job creation) Geographical situation of Energy in Germany.

CCS is rather controversial in Germany as storage is practically forbidden. However, CCUS research is possible and wanted.



TOUR OF POWER PLANT at RWE

RWE Power is Germany's biggest power producer and a leading player in the extraction of energy raw materials. Their core business consists of low-cost, environmentally sound, safe and reliable generation of electricity and heat as well as fossil fuel extraction.

In a prototype plant, RWE Power is bringing lignite predrying according to the fluidized-bed process – a proprietary development – to commercial market maturity. The object is to raise the efficiency of lignite-based power generation by a further four percentage points. Also at the BoA*-1 unit, the high-performance flue-gas desulphurization system (FGD, or REA in German) REAplus is being built; the research project, costing € 5.5 million, is designed to open up opportunities for further emission reductions.



The CO₂-scrubbing pilot plant will soon be trialing the capture of carbon dioxide from the flue gas. RWE's algae project, which is unique worldwide, is investigating possibilities for binding captured CO₂ in plant substances and making this usable. RWE Power is concentrating these pioneering activities at its old-established power-plant site at Niederaußem/ Germany, turning it into a "Coal Innovation Centre". In 2003, Niederaußem saw the commissioning of the world's most modern lignite-fired power-plant unit, which goes by the name of "BoA 1".

All ongoing research projects are building up on this station and its technology. So RWE Power is gaining not only technological experience, but also valuable insights into practical operations that can be ported to other projects and plants.

* BoA is a German abbreviation standing for “lignite-fired power station with optimized plant engineering”



All the ACT Team and the coordinators of funded projects during the tour at the facilities of RWE power plant



After the exiting tour – we continued with the project presentations.

ECO BASE

EcoBase was presented by **Anders Nermoen** (IRIS, Norway). Establishing CO₂ enhanced oil recovery Business advantages in South Eastern Europe. Anders opened his presentation by stating that the technology is ready, and CCS is just a decision away.

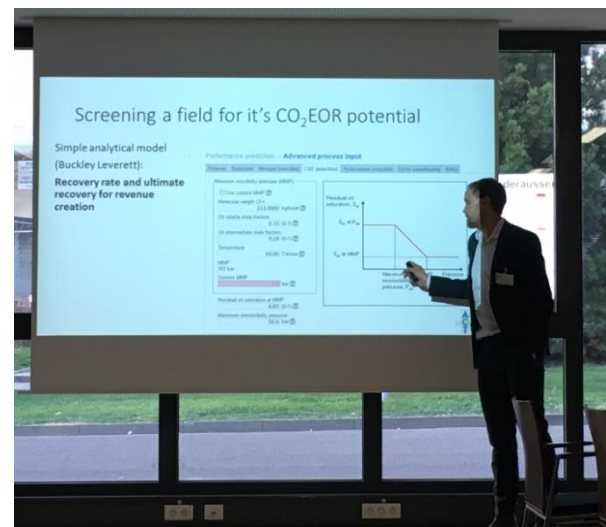
The concept behind the EcoBase project was presented. CO₂ EOR has the most significant commercial potential among utilization methods leading to permanent storage.

The objective of ECO-BASE is to develop a detailed and integrated roadmap for CCUS, including EORStore, in SE Europe.

Anders gave us the prior obstacles that they met in CCUS sector: legal issues and social acceptance. He also mentioned what are the incentives that have to be clarified: CO₂ emission cost, taxation and additional revenues.

Inside the project ECO-BASE some sub projects were included:

1. Map CCUS potential in Turkey and Romania
2. Create business cases
3. Knowledge sharing
4. Public awareness



Objectives	Results
Reach Out	ECO-Base meetings Dissemination and outreach <ul style="list-style-type: none"> • A website ecobase-project.eu • Newsletters • Annual publication report • Courses • Sulcis summer school EOR workshop 2018-2020 • Course in Romania (combined with project meeting) 2019 • Course in Turkey (combined with project meeting) 2020
Collaboration	Several Meetings
Synergies	Coordinated effort to social sciences (by ALIGN with ACORN, ELEGANCY, ECOBASE) <ul style="list-style-type: none"> • CO2-EOR optimization coordinated with WP4 ENOS H2020 • Learnings from ENOS journalist event on CO2GeoNet OpenForum2018 (more to follow) • A number of new proposals that has considerably synergy with ECOBASE (both in ACT, Norway/EEA Grants, H2020)

ACORN

This project was presented by **Hazel Robertson** (Pale Blue Dot Energy) and **Philippa Parmiter** (SCCS).

ACORN is about: World class CO2 stores, Pipeline reuse, Low Cost CO2 and CO2 from H2 production hub.

Overcoming hurdles to CCS, create a specification for an ultra-low cost, scalable project – starting with CO2 capture and storage from the St. Fergus gas terminal in Scotland, said Hazel and Phillipa.

They presented a map in the north of UK explaining the overall and the overview of the project. It's a breakthrough project corresponding to the smallest viable full chain industrial CCS project. Existing emissions and 3 existing redundant pipelines allow carrying gas and storing it in the captain aquifer which has good petro-physical characteristics



Key figures:

- ✓ 19 months and 2,9M€.
- ✓ The goal of the project is to create a specification for an ultra-low cost, integrated CCS hub that can be scaled up at marginal cost.
- ✓ Evolve the Acorn development opportunity from the proof of concept TRL3/4 to the pre-FEED stage TRL 5/6.

Subsurface:

- Storage Site Selection- East Mey
- Geomechanical Rock testing
- Storage development plan

ACORN has linkage with other ACT projects sharing their results and value. This project ends in January 2019 and they will have their "final conference" in London 21-22 January.

Objectives	Results
Reach Out	Social Media & Webinar Impacts on twitter Public engagement (Unearthed: Explore the world at your feet) <ul style="list-style-type: none"> • GHGT papers and videos • Accelerating CCUS: A Global • Conference to Progress CCUS (Edinburgh 28 / 29 November 2018) • Social acceptance study – Just Transition workshops and interviews • Increasing interest in Scotland – especially trade unions and NGOs • Potential for CCS – balancing skills within O&G industries with climate mitigation imperatives • Awareness of CCS is low within Scotland just transition movement • Positioning CCS within a just transition framing – ‘just transition’ can mean different things to different organizations
Collaboration	Communication <ul style="list-style-type: none"> • Weekly calls – Team lead • Monthly 2-day collaborative meetings • Small sub-groups on specific deliverables • Quarterly meetings • What worked well • <i>Internal comms</i> – subsurface meetings • Skype for Business – screen share, messenger • SharePoint – go-to place for: contacts, roles, calendar, files. Built in version control, collaborative documents. • One-Note – notes, collaborative work area • Could be improved • Collaborative document working • File structure awareness up front
Synergies	Workshop social science research across ACT <ul style="list-style-type: none"> • Sharing information • Avoiding duplication • Stakeholder management • Sharing value • Webinar software • Knowledge sharing between • SCCS partners and UK projects • ALIGN/Acorn discussion • Lyell Centre – co-location of BGS/HWU/SCCS

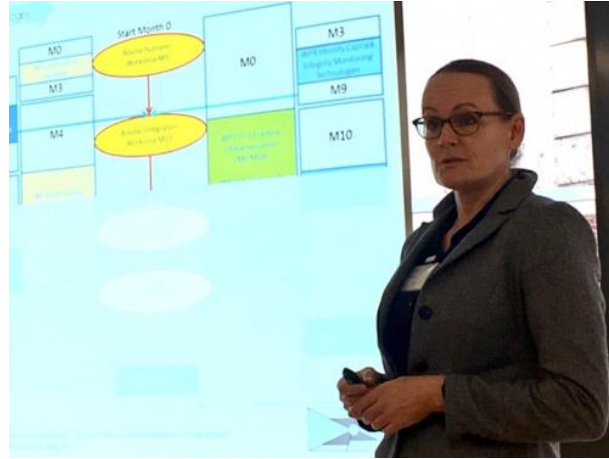
DETECT

Marcella Dean (Shell, NL) started her presentation by saying that the project is a focused small project which will evaluate risks of leakage across faults and fractured caprock, to better inform operators, regulators and their stakeholders in their risk mitigation strategies.

The collaborators involved were presented (e.g. HW for the modelling, Aachen University for the laboratory work, Risktec solution).

Key targets:

- ✓ Laboratory experiments: Determine the impact of reservoir stress changes, chemical reaction and swelling clays on fracture flow properties.
- ✓ Project structure was focused upon presenting the WPs. There are interconnections between different elements.



Determining the risk of CO₂ leakage along fractures of the primary rocks. The project is about storage and risk assessment with 5 WPs.

- ✓ **WP1: Management**
- ✓ **WP2: Fracture Flow, Mineralization, Clay Swelling.**
- ✓ **WP3: Fracture Characterization and Modelling.**
- ✓ **WP4: Containment Monitoring for Caprock Integrity.**
- ✓ **WP5: Qualitative and Quantitative Risk Assessment.**

Marcella explain in more detail the WP and the update result that they have at this moment with some improvements that they need to carry out the project completely.

Objectives	Results
Reach Out	Workshops/Meetings <ul style="list-style-type: none"> • September 14th, 2017: Kick-off meeting September 14th, 2017 at Shell Technology Centre Amsterdam • November 14th, 2017: 1stbowtie/Integration workshop in at Risktec in Manchester • April 17-18, 2018: 2ndbowtie/Integration workshop and first SAB meeting at Heriot-Watt University in Edinburgh • January 21-22, 2019: Planned Integration workshop in Aachen • Workshops/Industry Conferences • Marcella Dean (Shell) ACT knowledge sharing workshop (October 24th, 2017, Bucharest) • EERA-CCS Joint Program Steering Committee meeting • Andreas Busch, Stephanie Zihms (HW)poster at the EGU meeting (April 12th2018, Vienna) • Florian Doster (HW) talk at PROTECT workshop (April 2018, Geilo, Norway) • Marcella Dean (Shell) year1 poster: 1) at GHGT-14, 2) at Curtin University and CSIRO; 3) at Shell Geophysics Conference

	<ul style="list-style-type: none"> Niko Kampman and Kevin Bisdom (Shell) will present at EAGE CO2 Storage Workshop in Utrecht 21-23 November 20018
Collaboration	
Synergies	

3DCAPS

Robert de Boer (TNO, NL) presented 3D-caps which is a project on Capture technologies based on adsorption via the use of pellets. A presentation was made on how to use more expensive elements to decrease costs in capture plants. 3D-Caps aims to increase the productivity by a factor of 10 of sorbent-based capture technologies by 3D-printing, said Robert.

Applications of this technology will be included in post and pre-combustion capture in power plants (NGCC and H2).

They have set up a company 3S CAT (Startup) and also have contact with the ELGANCY project.



Key figures

- ✓ Productivity (kg CO2/m3hr) increase by factor 10 of sorbent based capture technologies

Means:

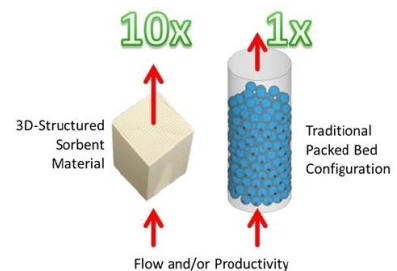
- ✓ Additive manufacturing, 3D-printing

Materials:

- ✓ Hydrotalcite
- ✓ Amine Functionalised Silica

Applications:

- ✓ Post-combustion capture NGCC power plants
- ✓ Pre-combustion capture for H2



Objectives	Results
Reach Out	Accelerating CO2 Capture technology 3D CAT: start-up company involved for business development, Discussions with CCP partners (end-users), EPC contractor.
Collaboration	Collaboration/communication F2F progress meetings 6Months Telco Progress: 3Months Frequent WP-meetings / telco Staff exchange
Synergies	Synergies with other ACT projects Elegancy (residual steel gas applications)

GASTECH

Shahriar Amini (SINTEF, Norway) presented this project and underlined that it is a project focusing on development of gas switching technologies which offers a promising alternative to chemical looping applications for highly efficient power and hydrogen production with integrated CO₂ capture.

Gastech applies to 4 different technologies; combustion, reforming, water splitting and oxygen production.

The outcome at this stage is the development and testing of oxygen carrier materials in react set up for GSWS and GSC, scale up.

WPs: Ranging from material section to business case and management in which the first 3 WP are related to the development



WP1: Oxygen carrier development for GS water splitting

WP2: Demonstration of the lab scale

WP3: Large scale High Efficiency Gas Switching Combustion and Simplified gas.

They propose to run a mini symposium workshop ideally with other ACT projects as a part of the next GHGT Conference.

Objectives	Results
Reach Out	Scientific publications in journals Popular science publications in different channels LinkedIn Twitter Plan for Youtube (plan to be made) Plan to run a mini-symposium workshop ideally with other ACT projects as a part of next GHGT conference in 2020 Creating brochures for policy makers at the end of the project
Collaboration	Monthly telecons Workshops in each consortium meeting (every 6 months) Bi lateral telecons between partners in each WP
Synergies	Plan to work with other ACT projects Open to discuss with other project (face to face or through webinars)

Closing Remarks

- ✓ Ragnhild and Heiko thanked all the participants, RWE for hosting and Vassilios Kougionas from the EC for his attendance.
- ✓ Invitation to further engage in contact between the project leaders

Twitter

During the workshop **Vegard Stokset** (Gassnova) tweeted and took pictures. Many thanks to him for these efforts.

His twitter activity at the ACT Workshop in Niederaußem, Germany 13th November generated 18 Tweets with 9000 views on the 13 November and 3400 views on the 14 November

Acknowledgements

This workshop has been organized very well by Heiko Gerhauser and has been planned and executed in cooperation with ACT's national research and innovation program owners and managers.

The ACT consortium was very pleased that Vassilios Kougionas, representing the European Commission took active part in the meeting.

So were we all pleased to have Johannes Kerner from the Ministry of Economics and Energy in Germany participating and all RWE team for hosting us in their facilities.



Agenda - The 3rd ACT Knowledge sharing workshop

Venue: RWE Kraftwerk Niederaußem

Date: 13 November 2018

10:00-10:20	Greeting, Introduction
10:20-10:50	Align (Tom Mikunda, Peter van Os)
10:50-11:20	Elegancy (Svend Munkejord)
11:20-11:50	Pre-Act (Peder Eliasson)
11:50-12:10	CCUS in the United States, Department of Energy (John Litynski)
12:10-12:30	7 th Energy Research Program, German Ministry of Economics and Energy (Johannes Kerner)
12:30-13:20	Lunch
13:20-14:50	Tour of power plant and CO ₂ capture and utilization facilities
14:50-15:10	ECO-BASE (Anders Neramoen, Roman Berenblyum)
15:10-15:30	Acorn (Hazel Robertson, Philippa Parmiter)
15:30-15:50	Detect (Marcella Dean)
15:50-16:10	3DCaps (Robert de Boer, Jaap Vente)
16:10-16:30	Gastech (Shahriar Amini)
<i>No formal dinner.</i>	

Information about RWE Kraftwerk Niederaußem can be found [here](#)

A map on how to get there is attached.

Welcome and looking forward seeing you!

Ragnhild Rønneberg
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 The Research Council of Norway
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Participant List

From the ACT Consortium

Germany	PTJ	Wolfgang Körner Heiko Gerhauser Hannes Stadler Annette Weiß
The Netherlands	RVO	Gerdi Breembroek
		Harry Scheurs
Norway	RCN	Aage Stangeland
		Ragnhild Rønneberg
	Gassnova	Hans Jørgen Vinje Vegar Stokset
Spain	AEI-FECYT	Daniel Ruiz Iruela
Turkey	TUBITAK	Ufuk Atay
United Kingdom	BEIS	Brian Allison
United States	DoE	John Litynski

From Projects Funded

Align	Tom Mikunda, Peter van Os
Elegancy	Svend Munkejord
Pre-Act	Peder Eliasson
ECO-BASE	Anders Neramoen
Acorn	Hazel Robertson, Philippa Parmiter
Detect	Marcella Dean
3DCaps	Robert de Boer, Jaap Vente
Gastech	Shahriar Amini

From the EC

European Commission	Vassilios Kougionas
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From RWE and

RWE	Peter Moser
RWE	Ferdinand Steffens

Ministry of Economics and Energy, Germany

Ministry of Economics and Energy	Johannes Kerner
Ministry of Economics and Energy	Monika Rainer

Pictures from the Tour of the RWE Plant

