CCUS Conference

21-24 February 2022
Virtual Events

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Society of Petroleum Engineers
Aberdeen Section

PESGB

Thursday 24th February – Choosing Storage Locations

Conference Co-Chairs

Alex Crossland

Alex graduated from the University of Nottingham in 1998 with a BEng in Environmental Engineering before then going on to complete a Masters in Petroleum Engineering at Heriot-Watt University in 2000. He then joined Reeves Wireline, a small logging company which took him to Oklahoma, Texas, Alberta and then Aberdeen in 2002. He continued to work in the North Sea and internationally before moving to Total as an offshore Well Services Supervisor, Read Well Services developing hydraulic expanded completion products and EV cameras as Region manager for Europe and West Africa. Since 2016 Alex has consulted for a variety of small technology companies focussed on well logging and intervention but is actively following the energy transition which lead to him volunteering for the recently formed SPE Aberdeen Net Zero Committee and the Geothermal and CCUS Conference Committees.

Gavin Ward

Gavin has an economic, accounting and technical skill set from over 30 years in the oil and gas industry at major international operators and independents. He has peer-reviewed and valued assets and companies in Europe, Middle East, Far East, Africa and North America. Mr. Ward is an expert on risk and volume estimation, and is able to translate technical evaluations into meaningful economic and financial assessments as a Chartered Accountant/CPA and professional geoscientist. He has used these skills previously as a sedimentologist for Corex, geophysicist for Phillips Petroleum; corporate business advisor for Noble Energy (based in Houston); Europe & Mediterranean Portfolio Manager for Noble Energy; Reserves and Economics manager for UK utility Centrica, and Regional Subsurface Manager for Centrica Energy Upstream when he also managed a team working on a CCS feasibility study for North Morecambe gas field. He currently manages the EAME regional office, based in London, for RISC Advisory, a global technical energy consultancy. Mr Ward holds a B.Sc (Hons) degree in physics and geology from Aston University in the UK, an MBA from Cranfield School of Management in the UK, Dip M. Post Graduate Diploma in marketing, MCIM Chartered Institute of Marketing, UK; and is a fellow of the Association of Chartered Certified Accountants.

Thursday 24rd February

THEME – CHOOSING STORAGE LOCATIONS

Conference Co-Chairs - A. Crossland & G. Ward /// Session Chair - R. Ellis /// Session Co-Chair - Marco Pirrone

10:00	Opening statement	A.Crossland/G.Ward
10:10	Keynote #1	Julien Perez, VP Strategy & Policy, OGCI
10:30	The OGCI CO_2 storage resource catalogue	Sylvain Thibeau, OGCI/TotalEnergies
10:50	Q&A	
11:05	Coffee Break	
11:15	Integrated subsurface - flow assurance studies for free flow CO_2 distribution in multiple storage reservoirs	Simone Nicolò, EniProgetti SpA
11:35	Integrated modelling to assess multiphase flow behaviour of CO_2 in wellbore for CCUS projects	Amin Dehghani, Computer Modelling Group Ltd
11:55	Q&A	
12:10	Lunch	
12:40	A fill-and-spill CCS mega-fairway in the Southern North Sea: a new concept to optimise CO_2 storage	Andrew Green, Talaria
13:00	Evaluating faults, fractures, migration pathways, reservoirs and seals for CCS risk assessments in San Juan Basin using rock volatiles stratigraphy of cuttings and cores from legacy oil wells and a new CCS monitoring well	Mike Smith, Advanced Hydrocarbon Stratigraphy Inc
13:20	CCS storage sites: geomechanical considerations in assuring site reliability	Phil McCurdy, AXIS
13:40	Q&A	
13:55	Coffee Break	
14:05	Containment Risk Assessment (CRA) for underground CO_2 storage using mulitple lines of evidence	Richard Metcalfe, Quintessa Ltd
14:25	Liverpool Bay CCS: A pioneering project to unlock UK's low carbon economy	B Becker, W Dickson, A Aleandri, ENI
14:45	Endurance storage site - A giant Triassic-age structure to support the decarbonisation of the UK's East Coast	Nicolas Bouffin, BP
15:05	Q&A/Panel	
15:35	Closing Statement	A.Crossland/G.Ward

Session Four - Choosing Storage Locations

Session Chair - Remke Ellis, TGT

Remke is from Aberdeen and has academic background in Geoscience and Petroleum Engineering. In 2012 he began working in oil industry with principle roles in Reservoir and Production engineering. In early 2016 he joined TGT UK as Reservoir Engineering Domain Champion. He is now based permanently in Stavanger as Domain Champion supporting all Norway operations; primarily for well integrity diagnostics and evaluation of completion and reservoir performance in facilitating flow.

Session Co-Chair - Marco Pirrone, Eni

Marco is Production Petrophysics Team Leader at Eni HQ and he has been with the company since 2009. He specializes in dielectric dispersion log analysis, rock physics modeling, nuclear magnetic resonance in porous media, cased-hole formation evaluation, wellbore integrity, production logging and data-driven analytics for reservoir characterization. He is now a focal point for the definition of downhole monitoring activities in CCUS and UHS projects, as well as for the development of new approaches in energy transitions. Marco has authored or co-authored about 40 technical papers and joined the 2016-2017 and 2019-2020 SPWLA Distinguished Speaker programs. He holds a MSc degree in Physics and a PhD in Theoretical Physics from the University of Milano-Bicocca, Italy.

Keynote

Julien Perez, OGCI

As Strategy & Policy Vice President of OGCI, Julien is responsible for coordinating actions and commitments, developing external policy views, managing relations with institutions and external stakeholders, and providing strategic direction to drive future development of the organisation.
Previously, Julien was head of Climate & Energy Services at Ernst & Young where he assisted private and public players in setting up and implementing low-carbon strategies. Julien also worked at Total where he coordinated climate change actions and at Aecom managing environmental liabilities for various industries. Julien holds an Environmental Engineering degree from Agro ParisTech, an Energy and Climate Economics degree from Dauphine and an advanced degree in climate change management from Yale.

The OGCI CO_2 Storage Resource Catalogue

Sylvain Thibeau, OGCI CO_2 storage work group lead and TotalEnergies CO_2 Storage Expert

Carbon Capture and Storage (CCS) is one of the technologies aiming at limiting future CO_2 emissions. Global CCS deployment will require to identify and develop CO_2 storage resources at the scale of the climate change issue.

In 2019, the Oil and Gas Climate Initiative (OGCI) has deciding to establish a CO_2 Storage Resource Catalogue in order to share knowledge and promote best practices in relation to CO_2 storage resource assessments. This is a 6-year effort which first goal is to reference all published assessments of CO_2 storage resources and to categorize these assessments using the SPE Storage Resource Management System (SRMS). Using the SRMS enables to evaluate the maturity of a resource and to provide guidance how to mature it further towards a development and implementation stage.

Other objectives are to facilitate adoption of the SRMS as the international standard for CO_2 storage resource assessments; to enable uploading and sharing of future assessments into the Catalogue; and to facilitate the understanding of resource availability for policy makers or investors.

After two years of the project, it is observed that many assessments remain disconnected to any development strategy, which is a barrier to global CCS deployment.

Sylvain Thibeau is TotalEnergies expert for CO2 geological storage and OGCI Storage Work Group lead. He has been working on CCS from as early as 2000, working on Sleipner CO2 injection models and time lapse gravity interpretation. He is the author of more than 30 publications and contributed to 2 books, one on Sleipner and one on Lacs demonstration pilot. Sylvain's main topic of interest is large scale CO2 storage resource assessment.

Integrated Subsurface-Flow Assurance Studies For Free Flow CO_2 Distribution In Multiple Storage Reservoirs

Simone Nicolò & T. Mantegazza EniProgetti SpA, A. Di Lullo & G. Facchi Eni SpA

Eni's portfolio contains several late-life assets with potential suitability for CO_2 Storage and can directly contribute to achieve Energy Transition goals. It is common that such brown fields have been developed by grouping different reservoir layers with specific petrophysical properties, therefore at the end of their exploitation process they result in different residual reservoir pressures and available CO_2 storage capacities.

The potential reuse of the existing transportation facilities represents an additional challenge for CCS projects and, together with the minimization of the capital expenditure, it is the main driver to reduce the unit CO_2 storage cost.

Moreover, the typical CCS fluid compositions present impurities (e.g. H_2, N_2, light hydrocarbons) that increase the complexity of the thermodynamic modelling. The resultant fluid dynamic behaviour within the transportation systems is the key factor for a proper estimation of the actual hydraulic performances evolution during the whole injection time.

With the goals to predict and optimize the transportation and storage performances during the whole injection time (e.g. including the reservoirs pressurization), to minimize the capital expenditures and to maximize the reuse of existing facilities, a novel integrated approach has been developed with the best available simulation codes technologies.

Such approach and the details of its implementation, which includes the subsurface CO_2 storage evolution and the thermo-hydraulic phase behaviour of the surface transportation system, are described, also with the help of a case study.

Born in Rome in 1989, Simone "La Sapienza" University in Rome from 2008-2014, where he got his Master of Science in Chemical Engineering. He then joined in 2014 the Eni Spa 2nd level Master "Oil&Gas Plants Design" in University of Bologna, after which he held the position of Flow Assurance Engineer in EniProgetti Spa. With this role, he worked for different Projects worldwide, joining for two years the engineering team in EniProgetti Kazakhstan Branch. Back in Italy in 2020, he has been working on notable CCS Projects, including Ravenna CCS (Italy) and Liverpool Bay HyNet Project (UK).

Integrated Modelling To Assess Multiphase Flow Behaviour Of CO2 In Wellbore For CCUS Projects

Amin Dehghani, Computer Modelling Group Ltd

As various CCUS injection projects are coming up worldwide, it has become evident that a successful design of dynamic CO2 injection needs a proper understanding of multiphase flow behavior of CO2 This work presents an integrated solution whereby a transient thermal reservoir simulator was coupled to a steady-state well and network model, with CO2 properties being defined by an Equation of State model. The coupled model predicts the pressure and temperature changes along the wellbore to capture the challenges related to CO2 phase transition, which can affect well performance and operations. This could manifest as a low bottom-hole injection pressure or an unrealistic pressure gap at surface. A sensitivity analysis was also conducted to evaluate the impact of various operational and design factors on the injected CO2 flow behavior.
Since bottomhole pressure and temperature for CO2 injection projects was predicted based on accurate modelling of CO2 phase behavior in the wellbore, this results in more accurate modelling of well injectivity and CO2 flow through the reservoir. This work can also act as a guide for operators to predict CO2 injection capacity.

Amin Dehghani is a petroleum engineer with over nine years of production and reservoir engineering experience in the middle East and North America. He has conducted various well-intervention operations in the Middle East, and is experienced in the wellbore and network modeling. At CMG, he has been providing wellbore analysis and integrated production system modeling (IPSM) to CMG customers. He holds a BSc and MSc in reservoir engineering from Petroleum University of Technology, Iran.

A Fill-and-spill CCS Mega-fairway In The Southern North Sea: A New Concept To Optimise CO_2 Storage

Stefano Patruno[1], Andrew Green[2], Davide Caldarella[3], Vittorio Scisciani[3], Joel Corcoran[4], Marianne Nuzzo[2], Marcin Przywara[5] and Graham Gillott[6]

[1] Department of Engineering, University of Nicosia, [2] IGI, [3]University of Chieti-Pescara,[4] Goel EP Ltd, [5] ul. Żułowska Kraków, [6] Talaria Technology Ltd.

A potential carbon capture and storage (CCS) fill-and-spill mega-fairway is here identified in UKCS Quadrants 43-44, by combining regional wellbore data with 3D seismic interpretation and migration modelling.

In the study area, the Triassic Bunter Sandstone reservoir shows consistent thicknesses (90-216 m) and prospective core-based porosities and permeabilities (11-28%, 9-669 mD). A connected reservoir is suggested regionally from consistent, near-hydrostatic aquifer pressure gradients (~0.51 psi/ft) and leakage is mitigated through a thick, laterally-effective top seal. Structural closures in the area are generally less than the CO_2 column heights necessary to breach the seal. At least eleven mapped closures are shown to link together into the proposed regional fill-and-spill "Silverpit CCS Fairway". If filled to spill, these traps could cumulatively host up to 7.9 Gt of CO_2, three times that of the proposed Endurance CCS Field.

Through management of the injection and fill-spill strategy, this fairway could be future-proofed in relation to CO_2 spill hazards, whilst possibly requiring less 'injector hubs' to fill the traps. Migration spill-point modelling along the fairway may also inform the placement of permanent, cost-effective multi-physics seabed system for leakage and migration monitoring.

Exploiting fill-and-spill fairways for CCS is a new concept with vast potential applicability globally.

Andrew is a Senior Geochemist and Basin Modeller at IGI Ltd., an independent sub-surface fluid consultancy and geochemical software company based in the UK. With 15yrs industry experience, focused primarily on exploration petroleum geology and geochemistry, Andrew fully appreciates the benefit of sound integration between analytical data and regional, basin-scale geology and processes when it comes to de-risking sub-surface systems. Alongside delivering software training and user support, Andrew is currently developing knowledge related to reservoir & production geochemistry, analytical methods linked to environmental geochemistry and CO2 storage.

As part of a collaborative team involving academia and industry, Andrew will present a novel CO2 storage solution in the UK, Southern North Sea.

Evaluating Faults, Fractures, Migration Pathways, Reservoirs And Seals For CCS Risk Assessments In San Juan Basin Using Rock Volatiles Stratigraphy Of Cuttings And Cores From Legacy Oil Wells And A New CCS Monitoring Well.

Michael P. Smith[1], William Ampomah[2], Luke Martin[2], Timothy Smith[1], Patrick Gordan[1], & Christopher Smith[1]. [1]Advanced Hydrocarbon Stratigraphy, [2]New Mexico Institute of Mining and Technology

Cuttings' volatiles are analyzed from the CCS target Jurassic section from the 1961 Kirtland #1 well in the San Juan Basin (SJB) and the 1982 Stephenson #1 well on the Hogback Monocline using AHS's unique cryo-trap mass spectrometry system. The wells are near each other but on opposites sides of the multiple 1000's of feet displacement Hogback Fault. Core and cuttings volatiles from the soon to drill nearby SJB CarbonSAFE#1 well are also presented.

Kirtland cuttings' CO_2 increases below 7200', suggesting a pressure seal within the Morrison Formation's Saltwash Member, indicating reduced vertical CO_2 loss risk.

There is no Jurassic oil or gas production in the NW of the petroliferous SJB, but oil occurs in cuttings throughout the Jurassic in Kirtland #1 as a series of oil spikes. Previous work by AHS on samples from different basins shows oil spikes in our data indicate oil filled fractures.

A likely vertical oil migration conduit is the Hogback fault. Fault associated oil filled fractures could increase CO_2 loss risk by facilitating CO_2 migration to the Hogback fault.

This work together with other analysis conducted as part of the SJB CarbonSAFE and the SJB fault characterization projects will assist in siting future CO2 injection wells within the Basin.

This material is based upon work conducted as part of the San Juan Basin Fault Characterization project, supported by the Department of Energy under Award Number DE-F0032064. Additional support was received from the San Juan Basin CarbonSAFE Phase III project, supported by the Department of Energy under Award Number DE-FE0031890.

Mike Smith earned a BA in Geology from Rutgers College in 1977, and PhD in Geology and Geophysics from U Hawaii in 1981. At U Tulsa (1981-1984) Mike developed the first Mass Spectrometer system to analyze Individual Fluid Inclusion Volatiles with Colin Barker. At Amoco's Tulsa Research Center (1984-1994) Mike invented Fluid Inclusion Stratigraphy (FIS), now owned and marketed by Schlumberger. Mike resigned Amoco in 1994 to start Advanced Hydrocarbon Stratigraphy (AHS) inventing Fluid Inclusion Volatiles (FIV). Mike sold FIV to ExxonMobil Upstream Research in 1999 and consulted with ExxonMobil until 2009. In 2010 Mike restarted AHS developing new patented technology to gently analyze present-day oil, gas, inorganic gases (such as CO_2), organic acids, reservoir properties, and formation water in old and new drill cuttings and core. AHS markets this technology worldwide as Rock Volatiles Stratigraphy (RVStrat). RVStrat also evaluates CCS reservoir viability, as well as CO_2 phobicity. And, RVStrat aids Helium and Geothermal exploration. Mike has been awarded more than 40 patents worldwide.

CCS Storage Sites: Geomechanical Considerations In Assuring Site Reliability

Phil McCurdy, AXIS

The world needs to find a realistic and practical way to transition from a hydrocarbon powered economy to one more dominated by renewable energy sources. CCS can play a key role to reach the net zero target by 2050.

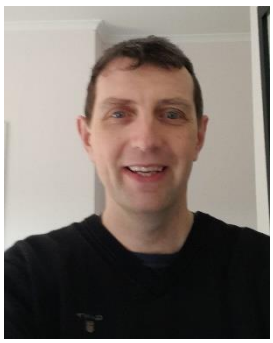
This talk summarises a large site selection project that was undertaken on potential storage sites covering the UK sector of the North Sea. 579 initial sites were filtered down to 20 of the more promising candidates.

The key candidates were checked Vs the site location relative to CO2 sources, geology , storage capacity and risk factors . Geomechanical considerations were fundamental to assessing site suitability , considering

- The optimum strategy for well construction.
- Potential impact of reservoir compaction on abandoned wells.
- Sanding risk posed over CO2 injection life.
- CO2 injection and induced hydraulic fracturing / fault instability.

A more recent case study from a recent project in a depleted gas field in the SNS will be also shown, highlighting the geoemchanics risks reviewed.

The talk will highlight some of the key conclusions reported from the site reviews. It will detail noted key differences in possible storage site (aquifer Vs depleted field).



Phil is a Geomechanics Engineer with 25 years of industry experience with a broad range of technical skills. Experience includes Geomechanics projects for fields in the North Sea, West Africa, and Asia. Phil currently works as geomechanics team leader in Axis. Specialist technical skills include assessment of Co2 storage sites, wellbore stability, sand failure prediction, sand control and management, compaction and fault risk assessment. Also involved in reviewing Geomechanical aspects of abandonment plans for North Sea fields and CO2 storage reviews. Philip has nine published Society of Petroleum Engineers (SPE) papers in the field of Geomechanics and received an SPE award for services to industry in 2010.

Containment Risk Assessment (CRA) For Underground CO_2 Storage Using Multiple Lines Of Evidence

Richard Metcalfe [1], Renato Zagorščak [1*], Steven Benbow [1], Paul Suckling [1], Emma Cairns [2], Kate Thatcher [2], George Towler [2], Alex Bond [2]. [1] Quintessa Ltd, Oxfordshire UK; [2] Quintessa Ltd, Warrington, UK

Carbon, capture and storage (CCS) will be necessary to expedite a cost-effective transition to a net zero-carbon-emitting economy. CCS requires effectively permanent underground CO_2 storage, risks to which are the subject of a containment risk assessment (CRA) which is required for any proposed CO_2 storage site. Such an assessment involves making judgments about risks based on multiple lines of evidence, and presentation of the outcomes to stakeholders, including regulators. Here we present a structured approach to doing this, based on a combination of scenarios, decision trees, bowties and risk matrices. Using real-world examples, we illustrate the approach by showing how it has been used to assess the risk of CO_2 leakage from wells, including those that are part of a CCS project (newly drilled ones, or re-purposed existing ones), or legacy wells unrelated to the project. It is necessary to ensure that wells perform as required during any operations and, in the long term, do not leak CO_2 or provide pathways for movement of natural formation fluids. Uncertainties and future needs are considered in the context of the energy transition, highlighting other applications that could benefit from the assessment approaches developed for CCS.

Richard has been working on risk assessments connected with underground activities such as radioactive waste disposal, hazardous waste disposal, natural gas storage and CO_2 storage for more than 30 years. He spent 9 years at the British Geological Survey where he first worked on CO_2 storage in the mid-1990s'. He then moved to Japan where he was an International Fellow at the Japan Nuclear Cycle Development Institute. He joined Quintessa Japan in Yokohama in 2002 but relocated to Quintessa in Henley-on-Thames in the UK in 2006. While working at Quintessa he has been involved in many CO_2 storage related projects, including the CEC-supported CO2ReMoVe and RISCS projects, the White Rose Project and several projects in Japan. He has a degree in geology from the University of Durham and a PhD in low-temperature water / rock reactions from the University of Bristol.

Liverpool Bay CCS: A Pioneering Project To Unlock UK's Low Carbon Economy

B. Becker, W. Dickson, A. Aleandri

Abstract Eni's portfolio in the UK includes several late life assets with the potential for re-purposing for Carbon Capture and Storage (CCS) initiatives, which can assist in achieving a low carbon economy and contribute to meeting the target milestones defined by the UK Government's drive to net zero. The Liverpool Bay CCS project is being developed in parallel with and as a key part of the HyNet NW integrated project, which is aimed at decarbonising the important industrial district of North West England and North Wales. Eni has been awarded a Carbon Dioxide Appraisal and Storage License by the UK Oil & Gas Authority for CO2 sequestration in the depleted Liverpool Bay fields and the Liverpool Bay CCS project has recently been selected on Track 1 under the BEIS Cluster Sequencing Process. This paper aims to summarise Eni's recent multidisciplinary work, from subsurface, flow assurance, engineering and project management, and describes the integrated, full chain studies that led to the selected development case. This strategic case study demonstrates the development of a practical and low-cost solution to decarbonise an industrial district by exploiting synergies with existing O&G assets that have reached the end of their production life.

Alessandro has over 10 years of professional experience in the O&G industry working with an Italian oil company, Eni S.p.A. He has a significant background in reservoir and petroleum engineering working both in Milan Headquarters and in various Eni's affiliates (Italy, Iraq, United Arabian Emirates and United Kingdom). He is currently acting as CCUS Subsurface Manager for Eni UK Limited; he oversees and manages subsurface and MMV related workflows associated with the Liverpool Bay CCS project.

William Dickson is a member of Eni UK's Decommissioning & Renewables team, and is a member of the Liverpool Bay CCS Project Management team. After a degree in Mechanical Engineering and initial roles in the mining and utility industries, William progressed through engineering management and project management positions in the oil and gas sector. A later MBA enabled him to take a broader view of project development. William has a range of project experience from feasibility studies to FEED, execution and construction and has worked in a number of roles in the oil and gas sector with both main contractors and operating companies. Prior to his current role, he managed early development of Eni's LNG initiatives, and before joining Eni he worked on a major LNG liquefaction project in Australia.

Endurance Storage Site: A Giant Triassic-age Structure To Support The Decarbonization Of The UK's East Coast

Nicolas Bouffin**,** bp

The Northern Endurance Partnership project intends to deliver an innovative First-of-a-Kind (FOAK) offshore low-carbon CCUS infrastructure in the UK, connecting the Humber and Teesside Industrial Clusters to the Endurance CO2 Store in the Southern North Sea (SNS). This includes CO2 pipelines connecting from Humber and Teesside compression/pumping systems to a common subsea manifold and well injection site at Endurance, allowing initially an average of 4 Mega Tons of CO2 emissions per annum (MTPA) from both clusters to be transported and stored by 2026 (circa 100 MT to be stored from power and industrial sources).

The project initially evaluated two offshore CO2 stores in the SNS: 'Endurance', a saline aquifer formation structural trap, and 'Hewett', a depleted gas field. The result of this assessment after maturation of both options, led to Endurance being selected as the primary store for the project in 2020.

The presentation will look at some of the key aspects of the Endurance storage site (capacity, injectivity, and containment) evaluated by the project subsurface and wells team as well as its potential for expansion beyond Phase 1.

Nicolas is a senior reservoir engineer with bp based in London, where he is working on the bp-operated Net Zero Teesside/Northern Endurance Partnership Carbon Capture and Sequestration project. Nicolas has over 14 years of international reservoir and petroleum engineering experience having worked for bp on a large variety of oil and gas fields throughout the life cycle (North Sea, North America Rockies, GoM Deepwater, Caspian, Iraq). His career interests include reservoir management, reservoir modelling and simulation, resources estimation, subsurface risk management, and carbon capture & storage. He holds B.Sc. and M.Sc. degrees in geological engineering from INPL-ENSG in France. He also holds a M.Sc. degree in petroleum engineering from Texas A&M University (College Station).

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