

# NERC Innovation Scoping Workshop; Extending the Life of Mature Basins in the UKCS and West of Shetland – Dynamic Earth, Edinburgh; 13<sup>th</sup> May 2015

## SUMMARY REPORT

### **1. Rationale and Background**

Over the coming decades, society faces a significant challenge to ensure a secure, safe and affordable energy mix while continuing to tackle climate change by reducing carbon emissions.

In pursuing its remit, NERC invests in world-leading research, training and innovation across the energy spectrum to provide society with evidence and expertise to inform decision-making.

As part of its core strategy - the [Business of the Environment](#) – NERC is developing an innovation activity aligned with the oil and gas sector. NERC focus is to understand the challenges and issues facing the sector as a whole, and to explore where the opportunities exist for NERC-remit science to be translated for its maximum benefit and impact.

With this in mind, NERC, in collaboration with the NERC Centre for Doctoral Training (CDT) in Oil & Gas based at Heriot-Watt University hosted two workshops bringing together industry, academic and government representatives to scope the biggest challenges facing the oil and gas sector in the UK and the opportunities for NERC-remit science to be translated to address these and inform decision-making.

These scoping workshops were held in early 2015 on the subjects of Decommissioning and Extending the Life of Mature Basins in the UK Continental Shelf and West of Shetland.

This report, produced by NERC with administrative assistance from the CDT Secretariat at Heriot-Watt as facilitators of the workshops, summarises the output from the second of these on the subject of Extending the Life of Mature Basins in the UKCS and West of Shetland (hereafter referred to as the ‘Extending the Life of Mature Basins Workshop’).

### **2. Purpose of the Workshop**

The aim of the Extending the Life of Mature Basins Innovation Scoping Workshop, held in Edinburgh on 13<sup>th</sup> May 2015 was to bring together industry, academic and government representatives in the thematic area of extending the productive life of mature basins in the United Kingdom Continental Shelf (UKCS) to consult on and determine the topics of greatest importance in addressing the challenges facing industry as it seeks to manage the environmental impact of these activities.

Outputs from the Extending the Life of Mature Basins Workshop, as captured in this report, will be used to:

- Inform future NERC Innovation Programme funding calls for projects focused on translation of existing NERC-remit knowledge, data and expertise to provide innovative approaches, solution and tools to address real-world issues and opportunities facing UK industry; and
- Where clear gaps in research are identified, inform strategic discussions within NERC which feed into the NERC prioritisation process for new strategic research.

More broadly, outputs from the Innovation Scoping Workshops will also guide themes drawn out within NERC's planned strategic investment in a 5 year, £5m Innovation Programme in themes pertinent and relevant to the oil and gas sector (expected to be launched in 2016).

This Innovation Programme will aim to help the industry to understand and scope the scale of the environmental challenges it faces and ways to address these by:

- Providing a neutral, open interface with the vast body of UK environmental data, knowledge and expertise;
- Building effective partnerships to facilitate access to that body of knowledge; and
- Translating the knowledge and expertise generated by NERC investments into innovative, industry-relevant tools and approaches.

### **3. Format of the Workshop**

The workshop agenda covered the key challenges for the sector in terms of the environmental impacts of activities that will extend the productive life of Mature Basins in the UKCS and West of Shetland.

A copy of the day's agenda and delegate listing are attached as Appendices A and B.

Representatives from various sections of industry gave short context-setting presentations in the morning session. This included presenters from the British Geological Survey, Chevron providing the operators' perspective, Oil & Gas UK for a general overview of the challenges, the new Oil & Gas Authority to give the regulator's view and a case study from Nova Scotia which demonstrates the potential of these basins to continue to have a productive life. The purpose of this was to set the scene for afternoon break-out sessions where delegates were placed into facilitated balanced groups of 12 people covering industry, academia and government/NGO organisations to consider the following two broad areas:

- Focus on the main issues, challenges, opportunities and gaps
- Perspectives on current and future innovation themes

Two questions under each theme were posited as an aid to the group discussions. There was then a short feedback opportunity for each group to the conference after each session.

### **4. Key Themes Identified**

The output from the break-out sessions has been collated under four main themes: Geological Understanding; Data Acquisition & Sharing; Newer Technologies; and Knowledge Exchange/ Collaboration & the Regulatory Environment. A short overview has been provided for each section followed by comments taken from the break-out sessions and presented here as bullet points.

#### **4a. Geological Understanding**

The recurrent theme of the morning's scene-setting presentations was the crisis that is upon the North Sea Basin and what and innovation is needed to address it. The key areas that were identified are:

- Better-informed exploration
- More efficient sweep of the reservoirs

- Use of saline aquifers and depleted fields as storage sites – both for petroleum and safe storage of carbon dioxide (CCS)

It was recognised that all of these challenges would benefit from a better understanding and imaging of the subsurface through innovative acquisition and processing of seismic data. Subsequent discussion of the framing talks highlighted that many delegates highlighted the need for greater geological understanding of these basins in order to either extend their productive life or evaluate their suitability for alternative technologies or use.

- Source rock distribution - Seismic, West of Shetland
- Oil migration drivers
- Sub-surface knowledge is poor
- Behaviour of the overburden
- Geology of geomechanics
- Controlled-source electromagnetic surveying (CSEM)
- Stratigraphic trap detection
- Making seismic/well data more available more quickly, more regular licensing rounds, improve data interpretation/analysis, making data more available to researchers - cost?
- Interpretation studies in frontier areas, incentives for companies - NERC facilitation for data access - range of projects. e.g. interaction of salt and sedimentation in the central North Sea, group shooting, fault movements, connectivity of sand bodies, scaling, better imaging, different methods, also processing of old seismic using new methods
- Need to know more about geographical areas - Rockall trough, Malin Sea, imbalance between central North Sea and Western margin
- Production behaviour of basement (non-sedimentary rocks - crystalline rock)
- Analogues from GNU Scientific Laboratory (GSL)
- Geomechanical Modelling techniques, chalk overlay, seismic velocity e.g. volcanic and chalk.
- Imaging - handling of big datasets - link to academic fieldwork - seismic velocity
- Better methodology to calibrate yet to find.
- Gulf Stream is very mobile, western shelf sea state is dynamic and of greater magnitude than the North Sea.
- Not all basins are well understood (tectonics, petroleum system).
- Understand geology - more important than high tech methods. Information must be accessible. Cost structure of UKCS - must be addressed. Companies will migrate to wherever is most profitable for them - can this ever mean basins with good environmental management? How to remain competitive?
- Geological models from geological understanding translate to a greater chance of success.
- Ground truthing from outcrops - modelling. Better access to outcrop data - virtual fieldtrips - making outcrops accessible. Important not to lose appreciation of scale.
- Unsuccessful wells = needless environmental impact. Is there an argument for promoting exploration success as an environmental benefit? Contribution of academia to better geological understanding
- Depositional environment controls permeability. Geomechanical modelling. Shear wave technology. Reservoir characterisation, polymer injection. Good scientific principles need in field management.
- High-fidelity seismic (e.g. Broadband) is vital for good exploration and reservoir management.

- Use of reservoir analogues, ocean bottom node seismic - combination of good geology and high tech methods. Rock velocity important to know
- Making the most of small pools: Better planning to make areas more economically viable, reusable facilities, technologies to reduce capital/operating cost and footprint, reducing risk, increase well success - better understanding of subsurface geology.
- Time is not on the side of the UKCS. 4D seismic, injection (Enhanced Oil Recovery - EOR) will increase efficiency, increase recovery and decrease costs
- Real-time reservoir monitoring using 4D time-lapse is key. The question is, 'Why are more people not doing it?'
- Measurement of oil saturation in mature fields
- Seabed coring for geochemical analyses in new areas e.g. West of Hebrides

#### **4b. Data Acquisition & Sharing**

Many aspects of data collection and use were highlighted by delegates, both in terms of optimising the use of existing data as well as agreeing on standardised datasets to take forward for future planning.

Access to newer datasets with full (broad) bandwidth was recognised as being vital. Such datasets exist but are not currently shared despite a legal obligation on the acquisition companies to do so. The obstacles to data sharing were highlighted and calls made to NERC, other Research Councils, industry and academic bodies to consider opening access to their datasets, particularly those acquired through public money<sup>1</sup>.

It was recognised that there is clearly a role for the new regulatory Oil & Gas Authority (OGA) in tightening up on procedures to ensure full public disclosure of data and access thereto.

It was acknowledged that some efforts are being made to regenerate the North Sea mature basin already through new (OGA-led) studies such as the BGS Palaeozoic report and seismic data acquisition as in the ongoing tender for the Rockall and Mid North sea surveys. However, it was also recognised that the BGS Palaeozoic study is suffering from a lack of sharing, poor communication and a focus on sponsors to date rather than providing greater collaboration and openness as the Wood Review demanded.

The new seismic tender process was welcomed and the OGA encouraged to extend the scheme to other areas of the mature basin to ignite renewed interest. Other specific issues identified by the delegates and the groups were:

- Baseline studies and filling in the gaps between fields, noise, cetaceans, simple models, ocean modelling / hydrographic data, new chemicals (risk assessment and understanding), robotics / AUVs - link to baseline studies, stigma of working with industry - KE and facilitation, ongoing monitoring, sensors on platforms
- Data archiving and management to make the most of it - keeps data active, added value
- KE Fellows to improve industry data gathering.
- Collaborative areas of research - facilitation & exchange

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<sup>1</sup>Note that NERC data policy aim is that all NERC-funded data are managed and made available for the long-term for anybody to use without any restrictions – see <http://www.nerc.ac.uk/research/sites/data/policy/>

- Meteorological and oceanic data is needed
- Data sets, better basin modelling, dataset integration, play fairway mapping
- Focus upon collaboration - someone like NERC to initiate a coordinated approach to promoting inter-company collaboration
- There is no willingness to collaborate, which stops innovative solutions being developed. The risks of collaboration are obvious, but the rewards are less tangible. Collaboration would allow for less duplication of work, i.e. more efficiency, but companies do not want to risk losing their competitive edge
- There exists an issue with data sharing. Collaboration seen as being a buzzword - joint ventures have existed for years - a more specific definition is needed of what collaboration actually would need to bring about tangible change
- Very specific definitions of what collaboration means in individual projects - pressure to be applied to motivate working efficiently.
- Current collaboration is often between 2-3 companies max, scale of collaboration needs to change
- There is no (easy) access to really useful data - why? 1) No-one will risk giving it out 2) No-one has the time to deal with the requests for data 3) Cost - where is the incentive to share something you have paid for? 4.) Why say yes?
- How can NERC provide access to commercially sensitive data?
- USE: publicly funded research = public access - why does that not happen here? NERC have research cores but how do you go about accessing them?<sup>2</sup>
- Opportunity: NERC could set up a proper, usable data library (define 'data') - become environmental data google.
- The process of how to access data and samples is currently not at all clear
- Companies may advertise what they have, but not how to access it e.g. Southampton core materials - no instructions on how to gain access. NERC to lead by example (subcontract to the BGS).
- Is there information on West of Scotland from National Oceanography Centre (NOC)? MAREMAP, EMODNET.
- Is there unused legacy data out there that would have a present use? Yes!
- Need to overcome individual companies' natural fear of data sharing by showing that it makes money.
- Access to NERC physical data sets e.g. cores at NOC in same way as BGS core store.
- 'The bigger brain' leveraging academic and industry knowledge to support the BGS basin evaluation.
- Digital database - MAKE DATA ACCESSIBLE e.g. core photos online.
- Crowd-sourcing phenomena = greater efficiency, access to expertise and greater scope for innovation e.g. Tomnod.
- OGA role for exploration data sharing/release.
- Encourage data/knowledge 'searchability'.
- Crowd sourcing interpretation (Co-ordinating different assessments).
- Encourage secondments between industry and academia.

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<sup>2</sup> Note details of British Geological Survey materials collections and access to them can be found at: <http://www.bgs.ac.uk/collections/home.html>

- NERC knowledge brokerage. NERC could collaborate e.g. bringing in environmental assessment information and metocean data. Existing data e.g. seafloor/habitat mapping that could help with development of baselines. Don't have basin-wide data.
- It was recognised that Environmental Impact Assessments (EIAs) create a lot of primary scientific data which rarely sees the light of day. Much potential in basic science, ecology, biology, ecosystems...
- EIAs for vast area of West of Shetland.
- Improved/Enhanced Oil Recovery (IOR/EOR) data sharing

#### 4c. Newer Technologies

There was some debate on the amount of 'Yet to Find' oil and how that figure is derived. Discussion focussed on the prolonging of the productive life of mature fields through techniques such as Improved/Enhanced Oil Recovery, and on the re-use of these basins through Carbon Capture & Storage.

The use of broadband seismic acquisition techniques was recognised as being an innovative step change in improving (uplifting) subsurface resolution and as such, a fundamental new tool to extend the life of a mature basin.

- 24 billion yet to find - derived from flawed logic and excessive risk/poor quality information.
- CF - methodology of extending recent exploration performance. Better methodology to calibrate yet to find.
- Subsurface CCS - does it work? Lower cost carbon capture?
- Footprint reducing technologies - reducing emissions etc., potential price increases? Novel capabilities to reduce cost and improve sustainability and environmental responsibility
- Research into CCS, but need the pilot information
- Small scale project pumping CO<sub>2</sub> into Scottish loch doesn't scale up to support industrial CCS venture
- CCS inshore - no 'fit for purpose' infrastructure
- Geothermal use of hot fluids generated in offshore-operations
- Re-use of existing infrastructure? Modelling requires.
- Shallow gas resources to prolong platform life.
- Industry typically follows on fast from discoveries, but not Lower Carboniferous and Cygnus (SNS)
- Use of autonomous underwater technology to do wide area monitoring and sampling
- Automation! Automation coming from research has potential to change process and guidance. Remove human error?
- Role of regulator in encouraging FPSO (Floating Production Storage and Offloading vessels) use. 'National' FPSO company/strategy/funding – OGA/NERC to look at this? What is NERC's role in whole life-cycle analysis of infrastructure?
- Need to know Yet To Find (YTF) volumes, the age/working life of current infrastructure, possible new basins and the potential of EOR/IOR
- Low salinity water injection – who would trial it? Can pilots be upscaled to industrial/commercial viability?
- Enhanced Oil Recovery (EOR) – With £20m you can drill a good many wells with a higher degree of certainty than you would achieve by investing £30m in EOR. There's a

significant up-front capital expenditure with EOR so companies would pay a higher tax per EOR barrel in return for help with EOR start-up.

- Research into how to unlock heavy oils
- Thermal recovery - variable environmental impacts observed so far so more research required in this field
- Smart wells, ICD/AICD valves
- Improved Oil Recovery (IOR) techniques used in Norway not used in UKCS – possibly under-utilised

#### **4d. Knowledge Exchange/Collaboration and the Regulatory Environment**

Delegates recognised that there are many players involved in this field, even as funders of activity, but that the area would benefit from a larger critical mass of funding. The money available to each funding organisation is generally too small to do anything more than tackle a small part of what are much bigger challenges and the pooling of resources is to be encouraged to facilitate larger research partnerships.

- Computational facility for complex modelling
- EPSRC & NERC collaborative call e.g. fluid flow
- Knowledge-sharing force as in Norway. Speed-dating model
- Research Councils work together
- Support collaborative approach to problem-solving but the funding calls are always competitive so Research Councils UK (RCUK) need to reward collaboration
- Issue with panel make-up and influence on what is funded
- Palaeozoic project as an exemplar of NERC/industry collaboration -> expand this to other basins.
- International reach. Collaboration/learning from other countries. Research into technologies that are currently applied on-shore to test their applicability to the off-shore environment
- Is there no applicability to this sector of polar research that NERC has been involved with for a great many years?
- Research that turns into technology. Funding for exploratory research, not testing a hypothesis. This requires a culture change. NERC could learn from JIP model, and bolt-on their funding to JIPs
- Environmental regulation is too complex, need for process clarity leading to standardisation – there's no need for so much complexity
- Subsidy of new processes and products e.g. 1970's USA government promotion of coal bed methane
- Role of regulator in encouraging FPSO (Floating Production Storage and Offloading vessels) use. 'National' FPSO company/strategy/funding – OGA/NERC to look at this? What is NERC's role in whole life-cycle analysis of infrastructure?

## **5. Conclusion and Key Research Themes Identified**

A number of recurrent themes and questions were identified throughout the course of the workshop that could be used to inform the Innovation Programme or future research. These include:

- Use of innovation e.g. broadband and time-lapse seismic to improve subsurface imaging of aquifers and reservoirs, be they petroleum repositories or for potential use as carbon storage sites
- Better informed use of innovative and quantified field studies as analogues for reservoirs housing oil and gas or for use as carbon storage sites e.g. through LIDAR and ROV drones
- Reducing uncertainty in the integrity of potential carbon capture and storage sites
- Improved data management and synthesis thereof ('big data')
- Opportunities for automation e.g. through the use of Autonomous Underwater Vehicles (AUVs) and Marine Autonomous Robotic Systems (MARS)
- The need for collaboration between funders of research and innovation, and between industry organisations.





**NERC INNOVATION WORKSHOP – EXTENDING THE LIFE OF MATURE BASINS,  
NORTH SEA & WEST OF SHETLAND**

**13<sup>th</sup> May 2015, Our Dynamic Earth, Edinburgh**

- 9:00 a.m.      *Registration (tea/coffee available)*
- 9:20 a.m.      Welcome, HSE and Introductions - Prof. John Underhill, Shell Chair of Exploration Geoscience, Heriot-Watt University
- 9.35 a.m.      Welcome - Prof. Iain Gillespie, Director of Science & Innovation, NERC
- 9:40 a.m.      Welcome and background to the workshop – Robyn Thomas, Senior Innovation Manager, Natural Environment Research Council
- 9:50 a.m.      Overview of the challenges facing the sector – Andy Leonard, Oil & Gas UK
- 10:10 a.m.      Getting back to basics to innovate - with the 21C Exploration Roadmap as an example – Dr. Phil Richards, BGS
- 10:30 a.m.      Case History: Nova Scotia and the rejuvenation of exploration - Hamish Wilson, PESGB President
- 10:50 a.m.      Scottish Government perspective – Fergus Ewing MSP, Minister for Business, Energy and Tourism
- 11:00 a.m.      *Coffee/Tea break*
- 11:30 a.m.      An Operator Perspective: Field Examples, Innovation Partners and R&D Opportunities – Dr. Steve Garrett, Chevron
- 11.55 a.m.      The future of the UKCS and the role of the OGA regulator - Glen Cayley, Oil & Gas Authority
- 12:20 p.m.      Outline of afternoon break-out sessions – Prof. John Underhill
- 12:30 p.m.      *Lunch*
- 13:30 p.m.      Break-out Session 1    Focus on challenges, opportunities and gaps
- What knowledge gaps need to be addressed to extend the life of the UKCS responsibly?

- What are the key industry and scientific challenges in this area with respect to environmental impact?

14:20 p.m. Break-out feedback to workshop

14:50 p.m. *Coffee/Tea break*

15:10 p.m. Break-out Session 2 Perspectives on current and future innovation themes

- What opportunities are there for existing research outputs to inform regulatory guidance and policy formulation?
- What existing research, technologies and assessment methods could be applied or developed to extend the life of the UKCS in a responsible way?

15:50 p.m. Break-out feedback to workshop

16:20 p.m. Next steps – Sarah Keynes, Knowledge & Innovation Manager: Natural Resources, Natural Environment Research Council

16:30 p.m. Conclusion – Prof. J. Underhill, Shell Chair of Exploration Geoscience, Heriot-Watt University

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**APPENDIX B MATURE BASINS WORKSHOP, 13<sup>th</sup> May 2015 – DELEGATE LISTING**

<b>Organisation</b>	<b>Forename</b>	<b>Surname</b>
Addax Petroleum	Guillaume	Ageneau
Babcock International Group	Michael	Pettigrew
BG Group	Beverley	Smith
BG Group	Gordon	Veitch
Bibby Offshore	David	Sinclair
BIS	Jeff	Asser
BMT Cordah	Joe	Ferris
BP	Ronnie	Parr
British Geological Survey	Philip	Richards
CEFAS	Mark	Kirby
CGG	Adrian	Cookney
Chevron Energy Technology Company	Steve	Garrett
DECC	Saravan	Marappan
DECC	Derek	Saward
ffa Geosciences	Gaynor	Paton
Gardline Environmental Ltd	Farah	Chaudry
Gardline Geosciences Ltd.	John	Morse
Geological Survey of Northern Ireland	Derek	Reay
Heriot Watt University	Bruce	Blanche
Heriot Watt University	Anna	Clark
Heriot Watt University	Patrick	Corbett
Heriot Watt University	Liz	Fellman
Heriot Watt University	Kate	Gormley
Heriot Watt University	Jingsheng	Ma
Heriot Watt University	Eric	Mackay Maroto-
Heriot Watt University	Mercedes	Valer
Heriot Watt University	Lorna	Morrow
Heriot Watt University	Mehran	Sohrabi

<b>Organisation</b>	<b>Forename</b>	<b>Surname</b>
Heriot Watt University	John	Underhill
Heriot Watt University	Gordon	Winton
Imperial College	Chris	Jackson
Industry Technology Facilitator	Giuseppe	Astarita
Industry Technology Facilitator	Keith	Mackie
Industry Technology Facilitator	David	Riddell
Maersk Oil North Sea UK Limited	(Ali) Shahbaz	Sikander
Marathon Oil	Callum	Falconer
National Oceanography Centre	Frank	Peel
NERC	Iain	Gillespie
NERC	Sarah	Keynes
NERC	Sophie	Laurie
NERC	Robyn	Thomas
Oil & Gas Authority	Sylvia	Buchan
Oil & Gas Authority	Bill	Cattanach
Oil & Gas Authority	Glen	Cayley
Oil & Gas Innovation Centre	Ernie	Lamza
Oil & Gas UK	Andy	Leonard
OMV	Raheleh	Ehrlich
OMV	Peter	Soroka
OMV	Lucy	Springall
PESGB President	Hamish	Wilson
Richmond Energy Partners	Keith	Myers
Scottish Government	Simon	Coote
Scottish Government	Malcolm	Ricketts
Scottish Oil Club	Paul	Binns
Scottish Oil Club	Rob	Schneider
Shell UK	Andy	Bell

<b>Organisation</b>	<b>Forename</b>	<b>Surname</b>
Shell UK	Martin	Grecula
Shell UK	Ann	Montgomery
SLR Consulting Ltd.	Andrew	Bannister
Spectrum Geoscience Ltd	Paolo	Esestime
Statoil	Catherine	Allsop
University of Aberdeen	Stephen	Bowden
University of Aberdeen	Rob	Butler
University of Aberdeen	Jefferson	Gomes
University of Aberdeen	Adrian	Hartley
University of Aberdeen	Alex	Kemp
University of Aberdeen	Benjamin	Kneller
University of Aberdeen	Matteo	Spagnolo
University of Aberdeen	Amer	Syed
University of Aberdeen	Yukie	Tanino
University of Birmingham	Ian	Boomer
University of Birmingham	Tom	Jones
University of Durham	Jon	Gluyas
University of Durham	Bob	Holdsworth
University of Edinburgh	Andrew	Curtis
University of Edinburgh	Enzo	Mangano
University of Leeds	Quentin	Fisher
University of Leeds	Bill	McCaffrey
University of Leicester	Sally	Morgan
University of Liverpool	Richard	Worden
University of Manchester	Masoud	Babaei
University of Manchester	Mike	Bowman
University of Nottingham	Sean	Rigby
University of Strathclyde	Simon	Puttock
Xodus Group	Rebecca	Hewlett