Enhanced Oil Recovery
UK Policy and Regulation

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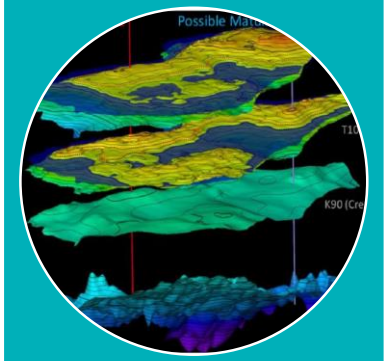
Overview

- Barriers to the Deployment of Oil Recovery
- Policy, strategy and regulatory responses:
  - Europe
  - Norway
  - Denmark
  - Netherland
  - UK
- Reflections

Barriers to the Deployment of Oil Recovery

Commercial

-High capital expenditure and long term financial return.



Physical

-Incomplete understanding of reservoir characteristics.

-Availability of injectant and supporting infrastructure.

Organisational

-Operator focus on immediate recovery and short term profit.

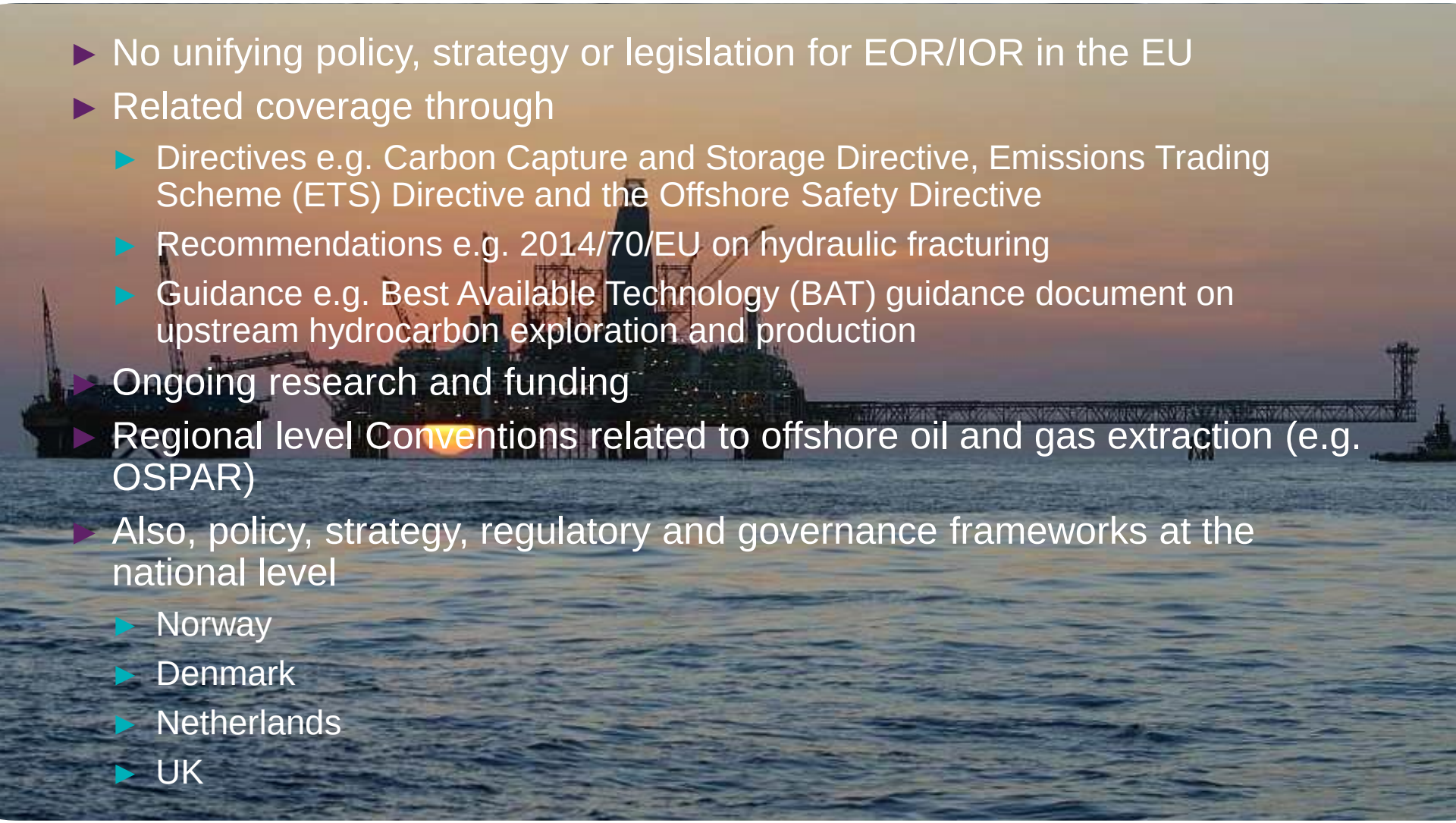
-Lack of capacity and knowledge.

Environmental

-Potential environmental impacts of EOR and associated permitting risk.

Interconnected

Europe



- No unifying policy, strategy or legislation for EOR/IOR in the EU
- Related coverage through
  - Directives e.g. Carbon Capture and Storage Directive, Emissions Trading Scheme (ETS) Directive and the Offshore Safety Directive
  - Recommendations e.g. 2014/70/EU on hydraulic fracturing
  - Guidance e.g. Best Available Technology (BAT) guidance document on upstream hydrocarbon exploration and production
- Ongoing research and funding
- Regional level Conventions related to offshore oil and gas extraction (e.g. OSPAR)
- Also, policy, strategy, regulatory and governance frameworks at the national level
  - Norway
  - Denmark
  - Netherlands
  - UK

Norway

- Norwegian Continental Shelf (NCS) producing since 1966
- NCS discovered and undiscovered resources c 89 billion boe. c50 billion boe yet to be recovered
- Average recovery rate of **46%**, but as high as **66%**
- More than 70 companies involved in exploration, production and infrastructure
- Close cooperation between Government, industry and academia to improve oil recovery. Facilitated through the Norwegian Petroleum Directorate (NPD)
  - **Guidelines** produced for a plan for development and operation of a petroleum deposit (PDO) including methods for improving recovery
  - **Joint Chalk Research** established in 1980 to share information and promote research co-operation in Norway and Denmark. Current IOR research project (JCR-7) looking at formations of tight chalk
  - Recent studies carried out to examine potential for CO2 EOR. Findings indicate potential for an **increase in recovery factor of between 5-12%**
  - **Annual IOR prize** for innovation
  - **Established an IOR Centre** at Stavanger University and Forum for Reservoir Characterisation, Reservoir Engineering and Exploration Technology Cooperation (FORCE)

NORWEGIAN PETROLEUM DIRECTORATE

OG21 – Norway's Technology Strategy for the Petroleum Sector

- Purpose is "*to contribute to efficient and environmentally friendly value creation from the Norwegian oil and gas resources through a coordinated engagement of the Norwegian petroleum cluster within education, research, development, demonstration and commercialization*"
- EOR identified as one of ten priority areas for technological development
- **Potential prize identified of 8% increase in recovery rate**
- Strategy recommendations focus on three areas
  1. Technology development to address prioritized technology needs
  2. Stimulation of technology application
  3. Competence to develop, adopt and apply new technologies

Denmark and the Netherlands

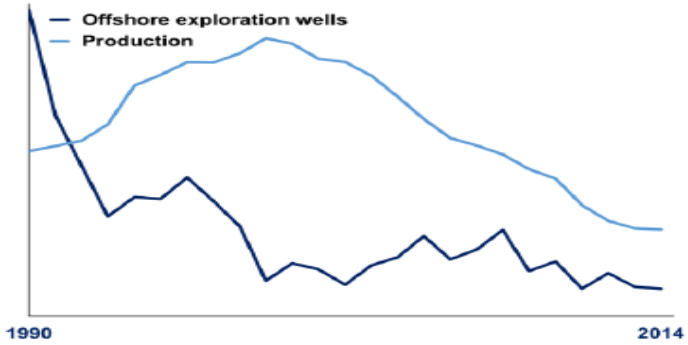
- Both countries also have a long history of offshore oil and gas production

- **In the Netherlands**, existing legislation has been adapted to incorporate the requirements of the EU Directive on the geological storage of carbon dioxide

- **In Demark**, there is a long standing history of funding and arranging cooperation on IOR research in Denmark
  - Joint Chalk Research (with Norway)
  - Danish Hydrocarbon Research and Technology Centre - opened in 2014 to develop new knowledge, ideas and methods for increasing the extraction of oil and gas in the North Sea
  - The Danish Technology Institute (DTI) - a non-profit organisation that is conducting research into the applications of EOR in Danish fields

UKCS - the challenge

- **Oil and gas exploration and production on the UKCS was (and still is) facing a range of issues**, including (but not limited to):
  - Mix of plays
  - Mix of operators
  - Declining investment
  - Declining exploration activity
  - Declining efficiency



- Combination of these factors led to a **fall in production of 38%** between 2010 and 2013

The Response
The Wood Review

amec foster wheeler

Key recommendations

- Urgent need for **enhanced stewardship**
- New **Maximising Economic Recovery** strategy
- Commitment from **industry to collaborate**
- **Stronger tripartite relationship** between industry, government and regulator
- New independent regulator with **additional powers and resources**

Sector strategies

Prize of additional 3-4 billion barrels **375,000 industry jobs to protect**

Wood Review – the prize

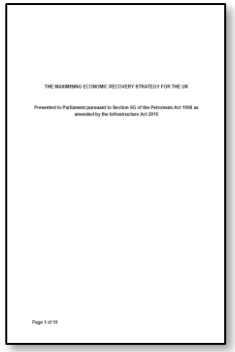
“There could be a further 12 to 24 billion boe that could be produced, with ultimate recovery in a large part dependent on how well the UK manages the overall development of the remaining resources…

…Full and rapid implementation of the recommendations could deliver 3-4 billion barrels of oil equivalent more than would otherwise be recovered over the next 20 years, worth over £200bn.”

Wood Review
The UK Government's response

- **Legislation** to enshrine objective of maximising the economic recovery of UK petroleum in February 2015
- Established the **Oil and Gas Authority** in April 2015
- A **new strategy** for Maximising Economic Recovery from the UKCS (MER UK) adopted in January 2016
- A new **EOR Strategy** adopted in July 2016
- A **EOR Delivery Plan** adopted in December in 2016

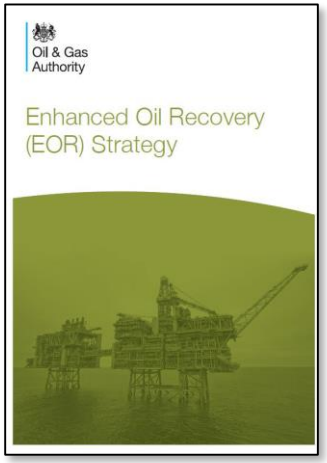
UK Maximising Economic Recovery (MER) Strategy



- The first UK MER Strategy was published in January 2016 by the Department of Energy and Climate Change (DECC) and the Oil and Gas Authority (OGA)
- '**Central Obligation**' reflecting the legislation to ensure that:
  - 'Relevant persons must, in the exercise of their relevant functions, take the steps necessary to secure that the maximum value of economically recoverable petroleum is recovered from the strata beneath relevant UK waters'
- **Supporting Obligations** and **Required Actions** and **Behaviours** including
  - Asset stewardship
  - Technology
- Legal and financial **safeguards**

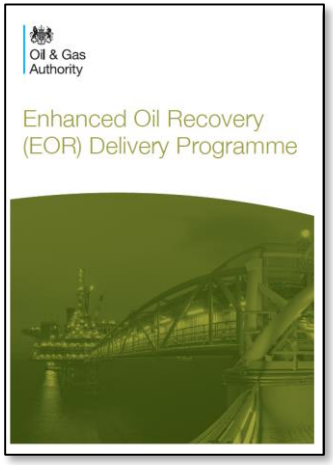
UK EOR Strategy

- OGA published the UK EOR Strategy in July 2016
- Identified the **principal barriers** to implementing EOR projects in UKCS
- Established the following **priorities**:
  - Driving economic development of 250 mmboe incremental reserves primarily through polymer EOR over the next decade
  - Supporting existing EOR projects to ensure readiness for future projects
  - Demonstrating a proven offshore operation of low salinity EOR and progressing further opportunities by encouraging evaluations for all new projects
- Focuses on **three EOR technologies**:
  - Chemical EOR (polymer and surfactant)
  - Low salinity water flooding
  - Miscible gas injection (either hydrocarbon or CO2)



UK EOR Delivery Programme

- OGA published the UK Delivery Programme in December 2016
- Identified **eight delivery areas**
  - Existing EOR Projects
  - MER for future EOR projects
  - Workgroups and industry partnerships
  - Technology development and deployment
  - Creating value
  - Advance next EOR and support CO2 storage
  - Knowledge management
  - Communication and stakeholder plans
- Activities will be **monitored by a joint industry/OGA task group**



Field Development Plans (FDPs)

- **Guidance** issued for FDP that emphasises EOR

  '*to ensure that, at the planning stage, the Licensees have examined those options which are most likely to secure the full recovery of the economic reserves of the area*'

- As part of the development and evaluation of the FDP, the OGA requires
  - a full appreciation of the commercial factors and constraints involved
  - an understanding of the factors as to why full MER is not being achieved
  - that the approach agreed does not lead to the permanent loss of reserves which could otherwise be recovered economically
  - the appropriate level of EOR modelling and screening has been completed
  - future EOR forecasts (production/capital expenditure/operating expenditure) are presented

Reflections

- Importance of
  - Recognising and analysing the change in economic and operating environment
  - Legislation to maximise economic recovery
  - Incentives to promote EOR and IOR
  - Revised guidance on Field Development Plans to increase EOR
  - Field information to inform screening
  - Collaboration e.g UK PILOT, agreement of EOR targets, Norwegian national petroleum technology strategy (OG21) and the Danish-Norwegian Joint Chalk Research (JCR)
  - Pragmatism

Thank you

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