The Low Carbon Business for Operations Staff: Business, Geoscience and Engineering Fundamentals (G569)

Tutor(s)

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Overview

This course aims to provide a broad overview of notable non-technical and technical themes for those operations staff new to low-carbon business projects. The course will be divided into three principal themes: business, geoscience and engineering; and will look to combine knowledge from across the different low-carbon business streams (CCS, geothermal and hydrogen). Participants will come away with a broad knowledge of the business landscape and of the subsurface and operational engineering challenges and limitations.

Duration and Logistics

Classroom version: Three half-day sessions, totaling 1.5 days in-person classroom training.

Virtual version: Three 4-hour interactive online sessions presented over 3 days. In each case a digital manual will be provided for the participants.

Level and Audience

Fundamental. This course is aimed at production and surface engineering technical staff and managers with a background in oil and gas but limited exposure to the low-carbon business, who want an overview and appreciation of this new energy landscape, the skills required and the technical challenges.

Objectives

You will learn to:

1. Outline the current and likely future status of the European energy mix, including new energy sources and the drive towards Net Zero.
2. Understand the regulatory, policy and financial drivers for adopting these new energy sources.
3. Apply learnings from oil and gas projects to the subsurface and engineering challenges posed by these new energy systems.
4. Recall the basic principles of heat generation in the subsurface and the associated key characteristics of geothermal resources and reservoirs.
5. Appreciate the risks and uncertainties in developing geothermal resources.
6. Understand the subsurface requirements for CO2 storage and the associated leakage risk.
7. Assess the volumetrics of CO2 storage and flow away from injector wells, as controlled by reservoir properties.

8. Describe the different geological storage options for hydrogen, their capacity and storage integrity challenges.
9. Appreciate how the handling of CO2, hydrogen and heat is different from oil and gas.
10. Outline the different operational facilities requirements of new energy types, including design and lifetime.

Course Content

Course Details

The course is split into three parts: business, geoscience and engineering.

Part 1: Business for the energy transition

- Global energy demand, current and future projections by sector to 2050, with a focus on
- Europe. Demand for electricity vs primary energy
- Economic aspects of renewables (e.g. profitability, size of the application vs economics)
- Global and European energy supply – current and projected levels of primary energy supply, including hydrocarbons, nuclear and renewables (e.g. geothermal, wind, hydrogen, solar and bioenergy). European estimates of domestically produced vs imported total primary energy
- European climate policy objectives. Decarbonization targets for the EU and separately for the UK. Scale of the low-carbon energy transition that is required in Europe. Discussion of circular economy within this context

This part of the course will be anchored around case studies to illustrate opportunities, policy drivers and commercial factors:

1. CCS in the Netherlands
2. Hydrogen in the Netherlands
3. (Options) German commercial and industrial heat sector, UK offshore wind or UK rooftop solar

Each case study will discuss:

- Specific market context to outline the scale of the opportunity
- Policies, regulations and support instruments directly affecting the particular business opportunity in the case study country (for example, carbon price, contract-for difference, subsidies)
- Potential business models and commercial risks. This will include high-level descriptions of the factors determining business viability, profitability and limiting factors

Part 2: Geoscience

- Fluid properties and phase behavior of carbon dioxide, hydrogen and water, compared to hydrocarbons, at different operating pressures and temperatures. Flow assurance challenges of transporting and storing these fluids. Impact of impurities on fluid properties
- Geothermal energy and summary of associated geoscience, including subsurface heat transfer processes, use of low- and high-enthalpy resources, and underground thermal energy storage. Exploration and appraisal of geothermal resources. Geothermal project risks and uncertainty from the subsurface perspective
- Carbon geo-sequestration and the various trapping mechanisms that contain the injected CO2 underground. Subsurface storage site requirements, screening, selection, and estimation of CO2 storage capacity. Leakage risk and the design and implementation of appropriate monitoring. Lessons learnt from operational CCS projects from dedicated subsurface storage and CO2-EOR perspectives
- Hydrogen – geoscience summary of natural hydrogen occurrences. Comparison of underground storage options (salt cavern, depleted hydrocarbon reservoir, aquifer) with comparisons of capacity, injectivity and productivity, inventory monitoring, challenges and risks

Part 3: Engineering

- Geothermal – well types, completion design and operational challenges compared to hydrocarbons. Infrastructure considerations depending on end-use. Materials and engineering challenges posed by temperature, geochemical and microbial issues, and corresponding HSE aspects
- CCS – well types and different needs to those of hydrocarbon production. Required infrastructure to handle, transport and inject CO2 effectively and safely, and meet industry norms and regulations
- Hydrogen – the different ‘colors’ of hydrogen production, with respect to inputs and by-products, round-trip efficiencies, carbon footprint and HSE aspects. Requirements for wells and surface facilities to meet hydrogen duty needs and regulatory standards
- Re-purposing of existing surface and subsurface infrastructure to help accelerate delivery of and reduce capital outlay for the energy transition. Review of each element in the supply chain from pipelines to facilities, via wells to the reservoir. Interdependency between reuse and decommissioning of infrastructure

The geoscience and engineering parts of the course will feature case studies from around the world to illustrate the challenges of treatment, transportation and underground storage for the new energy systems.