Project acronym and title:
SECURe – Subsurface Evaluation of Carbon capture and storage and Unconventional risks

Online e-resources for online training and school children in STEM, on environmental monitoring for shale gas

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Public introduction

Subsurface Evaluation of CCS and Unconventional Risks (SECURe) is gathering unbiased, impartial scientific evidence for risk mitigation and monitoring for environmental protection to underpin subsurface geoenergy development. The main outputs of SECURe comprise recommendations for best practice for unconventional hydrocarbon production and geological CO2 storage. The project is funded from June 2018–May 2021.

The project is developing monitoring and mitigation strategies for the full geoenergy project lifecycle; by assessing plausible hazards and monitoring associated environmental risks. This is achieved through a program of experimental research and advanced technology development that includes demonstration at commercial and research facilities to formulate best practice. We will meet stakeholder needs; from the design of monitoring and mitigation strategies relevant to operators and regulators, to developing communication strategies to provide a greater level of understanding of the potential impacts.

The SECURe partnership comprises major research and commercial organisations from countries that host shale gas and CCS industries at different stages of operation (from permitted to closed). We are forming a durable international partnership with non-European groups; providing international access to study sites, creating links between projects and increasing our collective capability through exchange of scientific staff.

Executive report summary

Dissemination of research to a wider audience than academics and organisation of training activities represents nowadays an important part of the scientific research. Together with the usual means of dissemination (workshops) newer technologies and media can be used.

In particular, video-lectures tuned for different audiences (experts, scientific journalists, school pupils) are becoming extremely popular for this task. In addition to this, freely accessible web resources greatly increase the scope of the presentation of argument of the project

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1 Background

Interaction with the media is critical for the correct dissemination to a wide audience of the research. Direct exchange with media professionals and press releases are not always the most effective method for dissemination of complex scientific knowledge, such as the multidisciplinary research areas like CCS and shale gas.

Science, Technology, Engineering and Mathematics (STEM) are subjects that the EU has identified as being absolutely critical to its future prosperity and global competitiveness. Whilst STEM subjects are studied at school, many pupils have misconceptions regarding engineering that can extend to complex topics in which engineers play a key role, e.g. CCS and shale gas. SECURe will develop a range of new outreach events designed to inspire school children (aged 11-17) to consider studying engineering at University.

2 Developed resources

2.1 OUTREACH

In January 2020, the University of Nottingham (UNOTT) developed training resources and an outreach session where year 10 students (aged 14-15) were given the understanding about the importance of carbon capture and storage as means to mitigate climate change. Pupils were given an illustration on how mathematics and engineering can help quantifying the risk of a Carbon Capture and Storage project. UNOTT developed training resources dedicated for school children to calculate leakage times of a conceptual storage site. 30 students were involved in the delivery as part of the “year 10 Ambition Nottingham: taster session”. The event was organised by UNOTT’s Widening Participation and Outreach team [10]

Figure 1: Year 10 pupils attending the outreach session, Nottingham January 2020

During the event, the importance of STEM subjects was emphasized, and students were encouraged to study engineering at university. The topics of CCS and shale gas were used as focussed examples, giving pupils practical activities that will help to educate and inspire them towards undertaking a future career in these areas. Future plans for communicating CCS/Shale gas science to UK key stage 4 students include conducting more

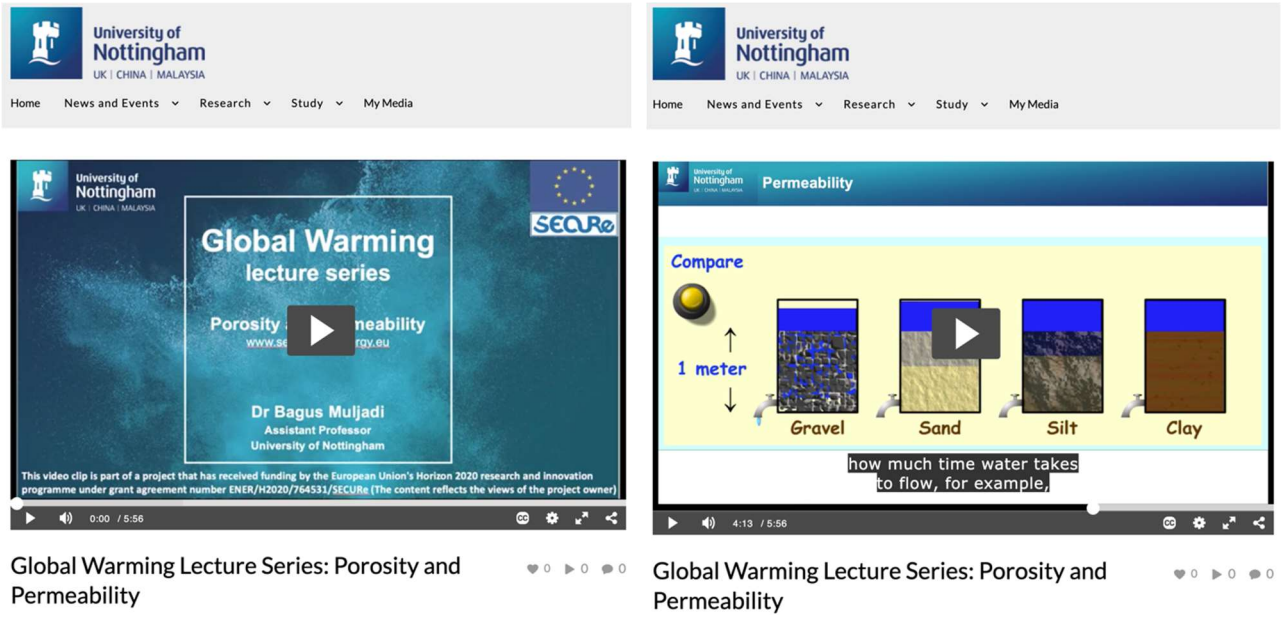
outreach sessions and gradually add, and therefore enrich the national curriculum with more resources relevant to CCS/Shale gas science.

2.2 ONLINE RESOURCES

UNOTT lead the development of new teaching e-resources for Schools to download and underpin national curriculum. Resources are developed and shared using UNOTT's MediaSpace service (mediaspace.nottingham.ac.uk) which allows academics to upload and share media files. The following resources were developed to help introduce the concepts of porosity and permeability; and estimation of leakage times – which are crucial for determining the risk associated to a potential storage site.

2.2.1 Understanding Porosity and Permeability

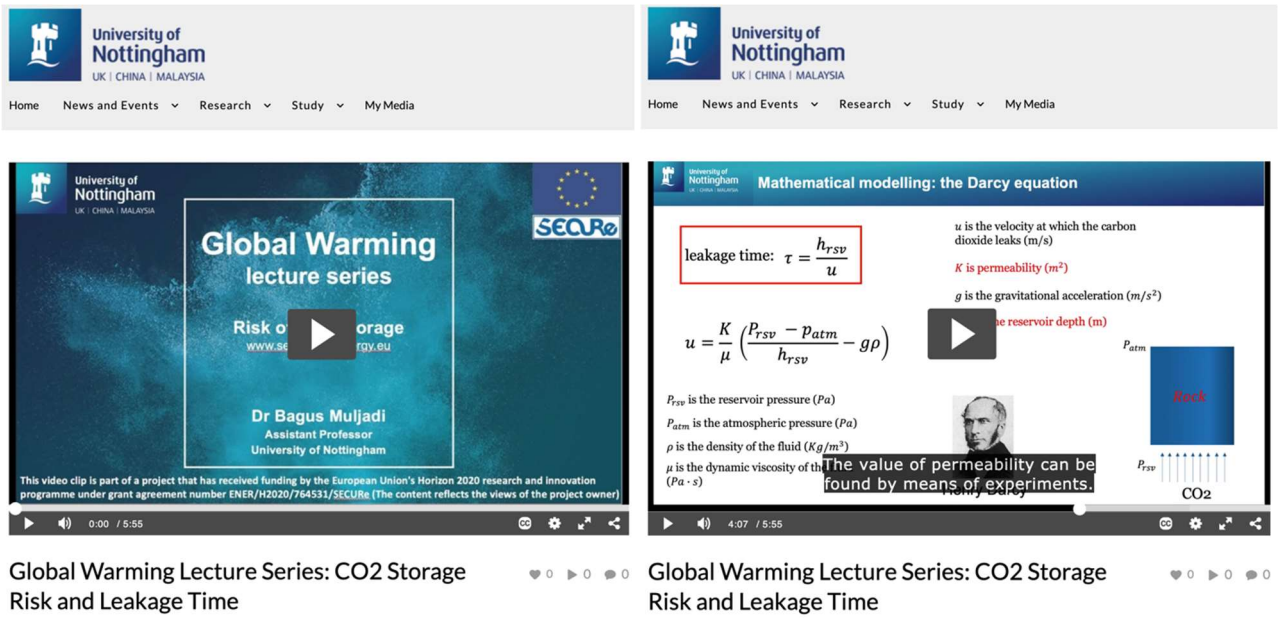
In this lecture, students are first introduced to concepts of global warming, and greenhouse effect. Then, the concept of carbon capture and storage as means to mitigate global warming is introduced. The focus of the lecture is to introduce the technical concepts of porosity and permeability which students normally are not accustomed to since these are not yet a part of national curriculum. The link to the lecture is https://mediaspace.nottingham.ac.uk/id/1_481yrm7c?width=400&height=285&playerId=13724441. Subtitles are provided to improve accessibility.



Figures 2. Lecture on the concepts of porosity and permeability that underpin a quantitative risk assessment of potential CO2 storage site [1]

2.2.2 Estimating leakage time

In this lecture, students are first introduced to concepts of risk and the importance of quantifying risk in the context of assessing the feasibility of potential storage sites. Then, the concept of CO2 trapping and leakage are given. The focus of the lecture is to introduce the Darcy's law of hydraulics — which again, students normally are not accustomed to since these are not yet a part of national curriculum. Further, students are given the example of how to calculate leakage time of a migrating CO2 within natural porous media, in this case a caprock of a given depth. Finally, students are taught to assess risk by calculating leakage times for a range of scenarios. Subtitles are provided to improve accessibility. The following is the link to the video: https://mediaspace.nottingham.ac.uk/id/1_k3zcpoew?width=400&height=285&playerId=13724441



Figures 3. Lecture on how to estimate CO2 leakage times that underpins a quantitative risk assessment of potential CO2 storage site [2].

To boost impact, these videos will be shared by UNOTT's social media outlets e.g facebook, youtube, and twitter.

2.2.3 Additional resources

The presence of online material related to the argument of the project can represented valuable resources to integrate the material presented here, especially on side-topics to help in spreading the message. The preferred media to discuss these arguments is represented by video lectures and streaming that are preferably uploaded on the video streaming web site "Youtube". By looking at the already available materials produced by colleagues at UNOTT, we compiled a list of possible resources which could integrate the narration presented in our produced materials.

We can divide the resources available in two main groups: i) popular science / research dissemination videos; and ii) lecture videos. Please note, these resources were funded outside of the SECURe consortium of work.

2.2.3.1 POPULAR SCIENCE / RESEARCH DISSEMINATION VIDEOS

In this video [3], colleagues at UNOTT including Professor Sir Martyn Poliakoff talked about the challenges of storing CO2 at a supercritical state. The terminologies which are otherwise complex were explained using everyday language.

In this video [4] colleagues at UNOTT explained that fossil fuel power stations and other industrial sources account for more than 65% of global CO2 emissions

We also include the following videos [5-8] as example of the possible approach to the topic. They are short videos (5-7 minutes long) explaining the very basics of the CCS for a non-specialistic audience. Their format makes them very useful when the audience is represented by school pupils.

2.2.3.2 VIDEO LECTURES:

In the series of lectures [9] Professor Philip Ringrose, NTNU Norway, gives an overview of CCS technologies and models. The main difference with respect other similar video-lectures is that they are recorded live. In this case YouTube allows the people to interact directly with the people involved through a chat. This gives an immediate feedback regarding the discussion

3 Remarks

Science, Technology, Engineering and Mathematics (STEM) are subjects that the EU has identified as being absolutely critical to its future prosperity and global competitiveness. Whilst STEM subjects are studied at school, many pupils have misconceptions regarding engineering that can extend to complex topics in which engineers play a key role, e.g. CCS and shale gas. We have developed outreach events and online e-resources for online training and school children in STEM focused on educating school children about the concepts of porosity, permeability, Darcy's equation and other concepts that are crucial for understanding CCS and shale gas production and delivery.

4 References

[1] https://mediaspace.nottingham.ac.uk/id/1_481yrm7c?width=400&height=285&playerId=13724441

[2] https://mediaspace.nottingham.ac.uk/id/1_k3zcpoew?width=400&height=285&playerId=13724441

[3] https://www.youtube.com/watch?v=2hjvNwDmO3g&t=2s

[4] https://www.youtube.com/watch?v=K9MBK2qJxcU&t=1s)

[5] https://www.youtube.com/watch?v=R0i6dhEPSwU

[6] https://www.youtube.com/watch?v=ROEFaHKVmSs

[7] https://www.youtube.com/watch?v=0d7FObM4N7o

[8] https://www.youtube.com/watch?v=R0i6dhEPSwU

[9] https://www.youtube.com/watch?v=ETALqgtagaE

[10] https://www.nottingham.ac.uk/externalrelations/student-recruitment/widening-participation-and-outreach.aspx

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