LOw Carbon After Life: sustainable use of flooded coal mine voids as a thermal energy source - a baseline activity for minimising post-closure enviromental risks

LOCAL

Research Fund for Coal & Steel

In short

We welcome you to the second newsletter of the **LoCAL Project**: Low-Carbon After-Life: sustainable use of flooded coal mine voids as a thermal energy source - a baseline activity for minimizing post-closure environmental risks.

Six partners from three countries developed the project to harness energy from the mine water as a heat source and succesfully applied to the Research Fund for Coal and Steel (RFCS).

This newsletter will inform you why and how the harnessing thermal energy from mine waters is so important, as well as the LoCAL Project idea and will give you an impression of the goals each partner will pursue.

For further information, please also visit the project at: www.local.gg.eu

LoCAL project brief information

n the LoCAL project we aim to bring together the state-of-the-art in modelling and management of abandoned coal mine workings to use the mine water as a heat source.

Our approach provides an active, low-carbon after-life for old mine voids after closure, and also delivers ongoing monitoring of water levels and quality, which in turn will increase the understanding of the systems, thus making it easier to manage all other environmental issues that might arise (e.g. outflow of polluted water, gas emissions, subsidence etc).

Use of mine water as an energy source can also help subsidise the cost of other environmental monitoring. Planned active pilot projects on mine water as a heat source are themselves aimed at obtaining a low-carbon energy source from the remains of the high-carbon past, but also in terms of the CO_2 capture agenda they will also yield information on hydraulic behaviour of very deep mine voids which in places are deep enough (> 750m) to be considered potential CO_2 storage zones in their own right. .

Main tasks

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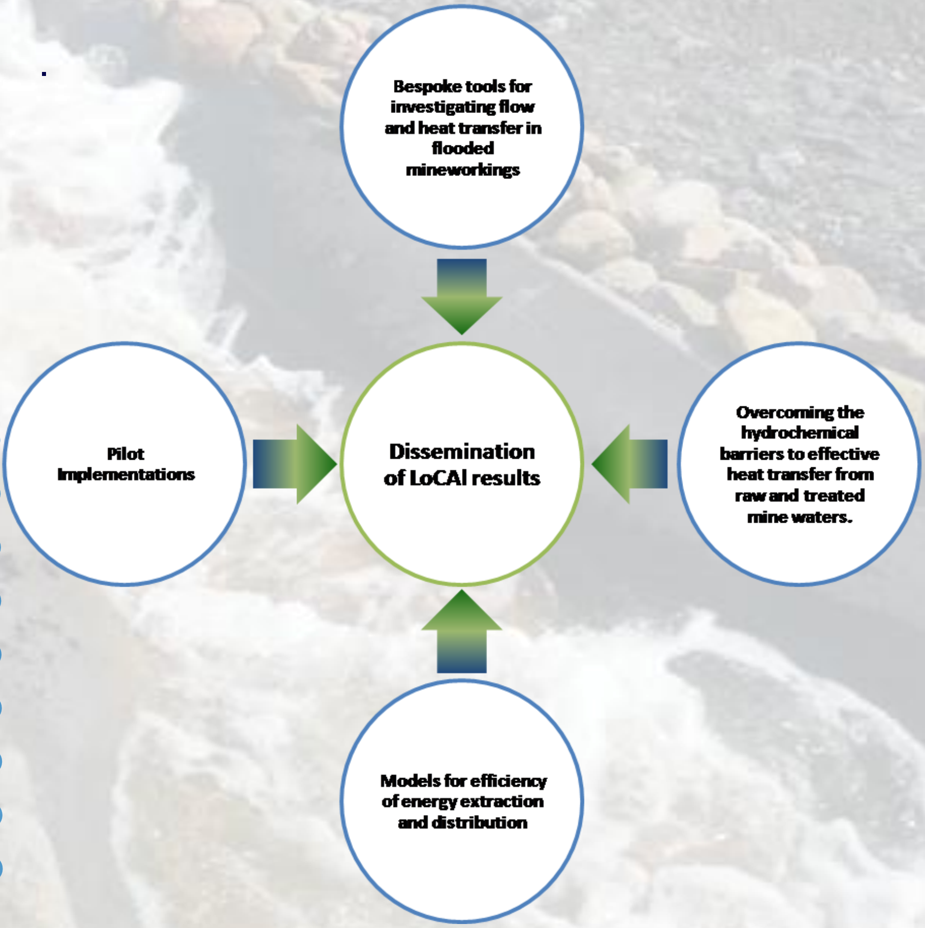

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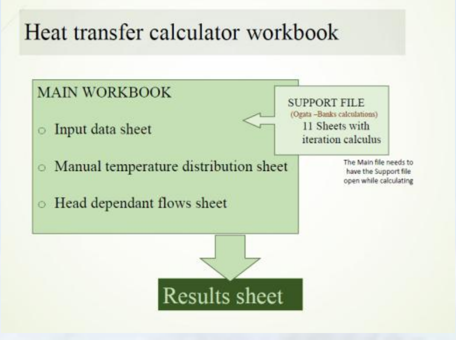
LoCAL: Basic information about the project

Tasks description

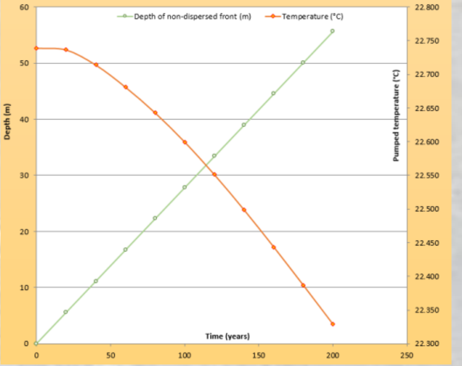
Work-package (WP) 1: Bespoke tools for investigating flow and heat transfer in flooded mineworkings.

Objectives :

- **to develop a modelling tool for advective heat transfer in flooded coal mine workings, building on existing coal mine pond flow algorithms, to enable realistic evaluation of heat and mass transfer during ground-source heat exploitation of coal mine workings.**
- **to extend existing natural tracer testing approaches (already applied for pollutant migration in flooded coal mines) for the profiling of thermal mixing dynamics in static and pumped flooded coal workings.**
- **to test the combination of these two tools to a proposed new coal mine water source heat-pump system.**



Picture 1.1: Draft of model elaborated in WP1



Picture 1.2: First results of model works

WP 2. Overcoming the hydrochemical barriers to effective heat transfer from raw and treated mine waters.

Objectives :

- **to investigate those hydrochemical changes affecting mine waters (especially ochre clogging) that are potentially inimical to the use of these waters in effective thermal exchange processes.**

Picture 2.1: Google map image of the ochre treatment pond at Caphouse
Source: Alkane

Alkane

Picture 2.2. Ground source heat pump (GSHP) open loop system. Source: Alkane

- **to develop strategies for minimisation of deleterious effects of these hydrochemical barriers to heat transfer for the two cases of:**
  - **raw mine water that has not yet been oxidised.**
  - **partly or fully oxidised mine waters, both in underground infrastructure (shafts, pumps, rising mains) and in oxidation and settlement ponds at surface.**

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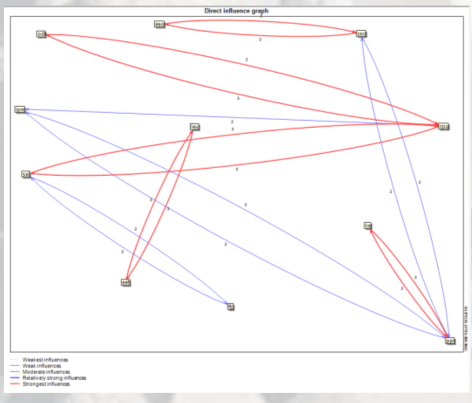
All tasks designed within WP 3 are logically connected and coherently oriented on the line from informing, helping to understand, parametrising and supporting with certain tools to make improvement in aspects of potential investments during mine closures period.
One of first steps is STEEP analysis.

Picture 3.1. Logic scheme for STEEP analysis



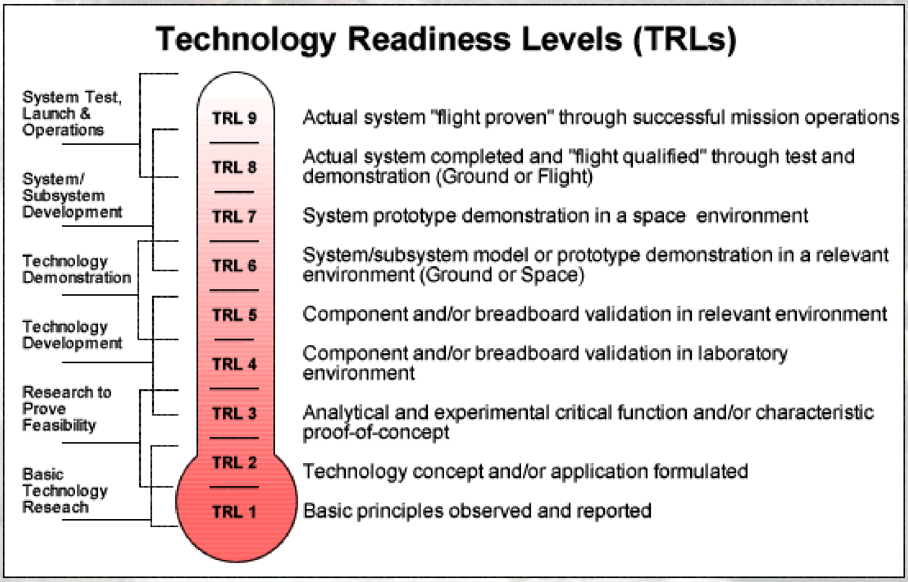
Picture 3.2. Examples of STEEP results

Tasks description

WP 3. Models for efficiency of energy extraction and distribution.

Objectives:

- **using recent commercial performance data from large-scale groundwater cooling systems in the UK as a platform for developing a mine-water specific protocol and costings model for direct and indirect use of abandoned coal mine waters for space cooling.**
- **using established Technology Readiness Level (TRL) appraisal tools widely used in the EU to evaluate all the technical results arising from the other work packages, to establish how far up the TRL scale they have reached during the life of LoCAL.**
- **selection of the optimal solution as regards centralized and decentralized system of heat transfer the comparative analysis.**
- **identification of the optimum solution from the point of view of all the relevant criteria and factors affecting the viability and profitability of the pilot.**



Source: http://www.mindef.gov.sg

The TRL is a scheme to assess the maturity of technologies. The corresponding TRL scale provides a measure of technology maturity with a view towards operational use of the technology concerned in a system context. It also serves as a scale to compare maturity levels across technologies.

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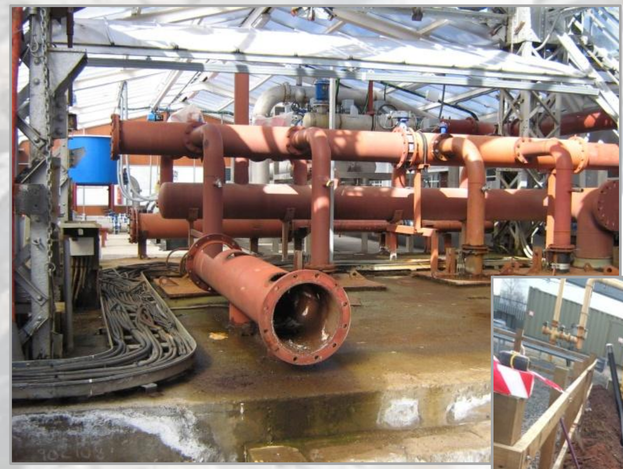
Tasks description

4. Pilot Implementations.

Objectives:

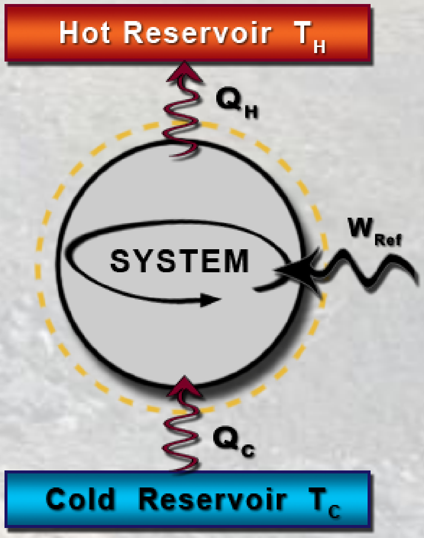
- to find out how the COP of a large-scale system differs with a water level at different heights below the ground surface attending to a flooding process.
- to quantify the mixing process and the affection to the efficiency (COP) in a large-scale system the reinjection of used mine water.
- to find out how the COP of large-scale system differs by the use of different heat exchanger and the economic impact of the WP2, advanced methods for preventing corrosion and incrustation affecting heat transfer.
- to support with real data models for efficiency of energy extraction and distribution analyzed on WP3.



The coefficient of performance (COP or sometimes CP) of a heat pump is a ratio of heating or cooling provided to electrical energy consumed.

$$COP_R = \frac{\text{Desired Output}}{\text{Required Input}}$$

Higher COPs equate to lower operating costs.



Source: www.learnthermo.com

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