

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

# LOCAL



## ALKANE Energy

ALKANE Energy is the UK's leading producer of green energy using methane from abandoned coal mines. The Alkane team is led by Keith Parker MBE, Projects Director. Keith formerly set up and led the UK's world leading minewater treatment program for the Coal Authority, constructing over 60 treatment systems and managing pumping operations at numerous sites across the coalfield areas of the UK. Keith was awarded an MBE for services to the coal industry and environmental protection in 2002. Alkane has a number of sites in its portfolio which can be used to gather scientific data and carry out tests to further the knowledge base for this proposal.



**Alkane**  
HARNESSING RENEWABLE ENERGY

### ALKANE ENERGY

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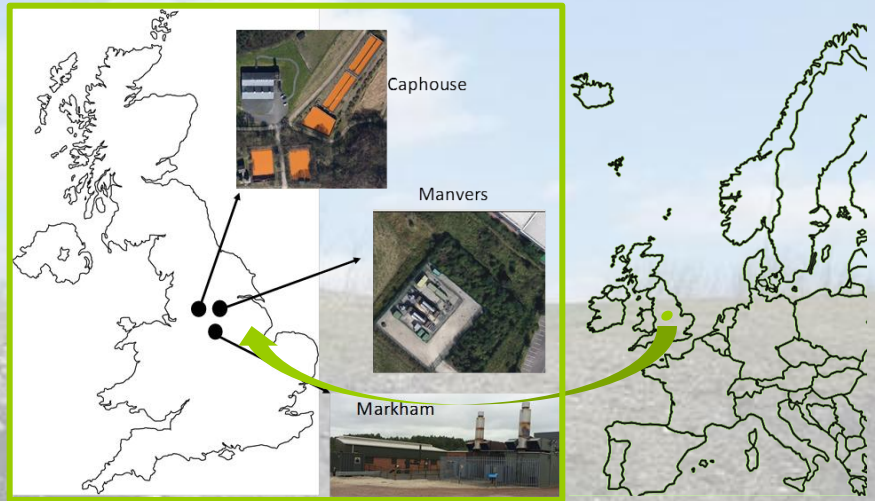
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## Pilot action in UK



Alkane Energy has built two GSHP pilot plants at Alkane Energy, Markham and at Caphouse colliery, Wakefield to demonstrate the concept of using the mine water for space heating applications. At Markham the mine water is pumped from an abandoned mine shaft and after recovering the heat, the mine water is discharged back into the same shaft. At Caphouse colliery, the mine water is pumped out and treated before discharging into a stream. A small amount of this raw mine water is used to recover the heat and heat the Inman shaft building

## Markham



Alkane Energy used to extract methane from the abandoned Markham Colliery through a shaft until the gas was cut off by raising water levels. A pilot GSHP plant has been installed at Markham to test the feasibility of using the energy from the mine water to heat the office buildings of Alkane at Markham

This project is implemented through Research Fund for Coal and Steel (RFCS).

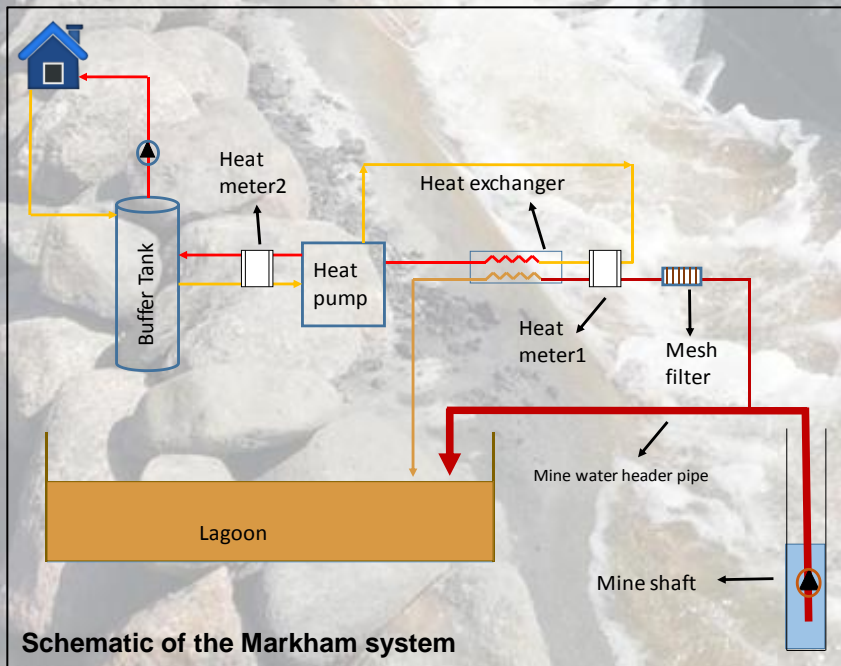
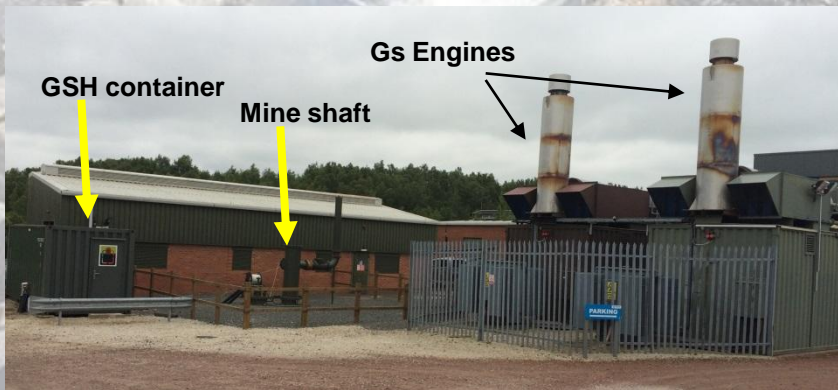


PILOT ACTION IN UK

Progress so far:

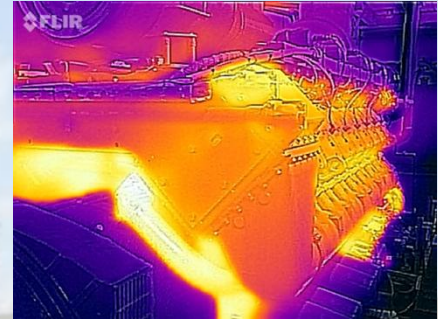
Markham

- The pilot GSHP system kept the Markham offices warm throughout the winters of 2014-16
- No ochre problems were experienced, the heat exchangers and the filters were taken out and inspected.
- A new energy meter to measure the power consumption of the heat pump
- Water samples were taken to check the water quality.
- Water level rise in the shaft was monitored.
- The temperature of the mine water was constantly measured.
- The existing heating system was extended to additionally heat the generator engine.



Schematic of the Markham system

Engines in operation



Publications

Published

*The design and evaluation of an open loop ground source heat pump operating in an ochre-rich coal mine water environment.* International Journal of Coal Geology (2016). ATHRESH, A.P., AL-HABAIBEH, A. and PARKER, K.,

Accepted

*An innovative and integrated approach for using energy from the flooded coal mines for pre-warming of a gas engine in standby mode using GSHP.* Energy Procedia. ATHRESH, A.P., AL-HABAIBEH, A. and PARKER, K.,

Ready to be sent

*Performance and analysis of using mine water from an abandoned coal mine to heat the buildings using an open loop based single shaft GSHP system.* Applied Energy. ATHRESH, A.P., AL-HABAIBEH, A. and PARKER, K.,

Research Fund for Coal & Steel





PILOT ACTION IN UK

Caphouse



Caphouse colliery has been converted into a mining museum and water is pumped out daily to prevent the rise the in mine water levels and flooding of the underground galleries. The water is treated before discharging into a nearby stream. The mine water known for its high ochre levels. Alkane Energy have built a GSHP plant to use a part of the raw mine water and use its energy to heat the nearby Inman shaft building. The system has been uniquely designed to overcome any maintenance issues due to the ochre.



Inman shaft building



Treatment Lagoon



Container housing GSHP plant

Pipes carrying the mine water for treatment



Vaillant GSHP unit.



GSHP display screen.



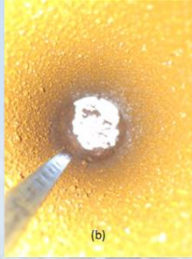
Buffer Tank.



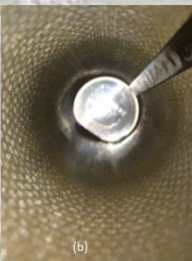


PILOT ACTION IN UK

Ochre clogging at Caphouse



Ochre accumulation in the filter



Clean filter

The mine water at Caphouse has an iron content of circa 30 mg/l and is oxidised in the pumping shaft and hence the ochre precipitation is noticed. The ochre accumulates and clogs the duplex filter basket. Environmentally benign sodium hydrosulfite was used in suppressing the ochre formation. Thanks to that, light difference in ochre clogging is being seen .

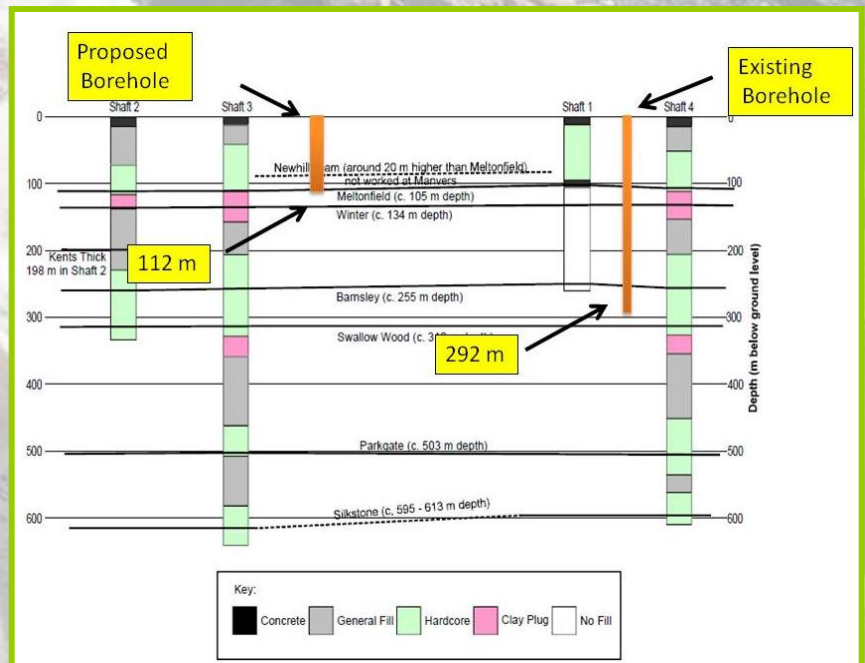


Alkane Energy site at Manvers

Manvers

Manvers Colliery was one of the largest colliery complexes in South Yorkshire, it closed in the early 1990's after nearly 100 years of production. Manvers is linked underground to several other collieries including Wath Main, Kilnhurst and Barnburgh. Several seams were worked, the principal ones being the Newhill and Meltonfield which are relatively shallow, and the deeper Barnsley and Swallow Wood seams. The Barnsley Seam is the principal worked seam throughout the Yorkshire coalfield with interconnecting workings spanning many hundreds of square kilometres.

There are 4 shafts on the Manvers Colliery and all of them have been filled and capped. The shafts are known to include engineered concrete plugs to hydrological separate the deeper workings from the shallower workings. This was done in early 1990 to prevent water from flowing to the deep interconnected collieries to the east. A borehole was drilled by Alkane Energy to a depth of 282m below ground level to Barnsley seam to extract methane from the mine. Workings in the Newhill and Meltonfield exists at depths of around 90m and 120m respectively.



Manvers colliery complex