Mining for Heat


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Source: www.readly.com
When Coal was King

- 15bn tonnes coal mined
- 2bn m$^3$ water
- 2.2MGwh of heat in place
- 12-20ºC – heat pumps
- Heating/cooling/storage
- 80MW currently pumped
Great Britain’s Energy Mix

- **Electricity**
  - Renewables: 23.3%
  - Nuclear: 21.3%
  - Coal: 22.9%
  - Gas: 30.6%
  - Other: 1.2%

- **Heat**
  - Natural Gas: 66.7%
  - Renewable fuels: 8.9%
  - Coal: 1.0%
  - Oil: 0.4%
  - Other: 23.1%

- **Transport**
  - Renewables: 1%
  - Oil: 99%
Great Britain’s Energy Vectors GWh per day

1st of March Col Weather Event
3.5 times the daily energy demand of electricity
Celebrating the end of coal?

How secure are our future supplies?

Source: British Gas
Developing a Legacy

Former coal mining areas
Source: The Coal Authority

England and Wales heat demand
http://csembaa1.miniserver.com/index.html
County Durham

- Coal Output 2.5bn t
- Approx 10,000m$^3$/day are pumped
- 0.4bn m$^3$ of water in flooded workings
- Reserve in place heat for over 100,000 homes
- Extractable heat 25,000 homes or 12% of homes in the County

Source: Durham Mining Museum
Heat Network Compatibility

- DHN decarbonisation for urban areas
- UK -14-43% building heat by DHN by 2050
- Current build rates = 27-83 years
- In Denmark over 61% DHN
- UK 2% of heat demand
- Depends upon design temp

Source: www.decentralized-energy.com
Mine Energy for Heat Networks

Pros
• Low carbon
• Heating and cooling
• Offsets gas consumption
• Accessible to many regions
• No fuel transport required
• Continuous
• Energy storage
• Economic improvement

Cons
• Upfront cost
• Perceived risks
• Low grade heat
• Social acceptability
• Retrofit complex

Source: www.thomasons.co.uk
A New Approach

- Rethink heat
- Higher T = more gas and more CO$_2$
- Higher T = more losses
- Changes to policy and planning
- Consumer demand
- Design temps
Assessing the Resource

Source: The Coal Authority
Approach

• Develop a model of the subsurface
• Calculate heat in place
• Consider flow through system
• Calculate extractable heat

Source: The Coal Authority
Spennymoor Case Study

- Volume of Top Busty Seam approx. $50,000m^3$
- A flow rate of 65l/s could supply 200 homes if $3^\circ$C is removed
- Spennymoor has both good resources and planned new build
- Consultation with Coal Authority, Local Government and developers

Source: Daniel Mallin-Martin MSc Thesis, University of Strathclyde 2017
How this works?

Source: https://inhabitat.com/heerlen-minewater-project/
Heerlen the Netherlands

• Five wells were drilled into old workings of the Oranje Nassau Mine
• Water up to 28°C is extracted from 700m
• Supplies to homes and commercial buildings
• New and retrofit
• 7km heat distribution network comprising of 3 pipes (for the hot, cool and mixed water respectively) serves the connected buildings
• Supplies heating for around 200,000m² of floor area
• Smart grid – between buildings
• Keeps money spent on energy in the region

Images: http://www.mijnwater.com
Lanchester Wines

- Combined 4MW open loop water source heat pumps in Felling, Gateshead
- 2x Lanchester Wines warehouses
  - 2.4MW at Abbotsford Road (220,000ft²)
  - 1.2MW at Nest Road (140,000ft²)
- Utilising water from flooded coal mines – a vast network going back to Victorian times
- £3.5million investment by Lanchester Wines – project started 2016, ongoing (learning curve)
- Boreholes 80m – 120m deep
Summary

• Heat is as important as electricity
• A vast infrastructure exists for heat supply and storage
• Mine energy provides indigenous and low carbon energy supply compatible with heat networks
• Mine energy could provide a low carbon source of heat in future
Making this happen

Main science questions
• How is mine energy best integrated into energy networks
• Explore the vast opportunity for energy storage
• Longevity and connectivity of systems if uptake increases

Main barriers to development
• Upfront capital cost
• Risk averse attitudes
• Perceptions of heat

Implications for policy or regulation
• Planning policy should consider mine energy potential in coalfield areas
• Building control – include low temperature systems

Source: www.geograph.org.uk
Thank you for Listening
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