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Mining for Heat

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Durham University
The Coal Authority
Lanchester Wines

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- The Role of Geoscience in Decarbonising heat
  - When coal was king
  - UK energy mix
  - Decarbonising heat
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Source: www.readly.com

When Coal was King

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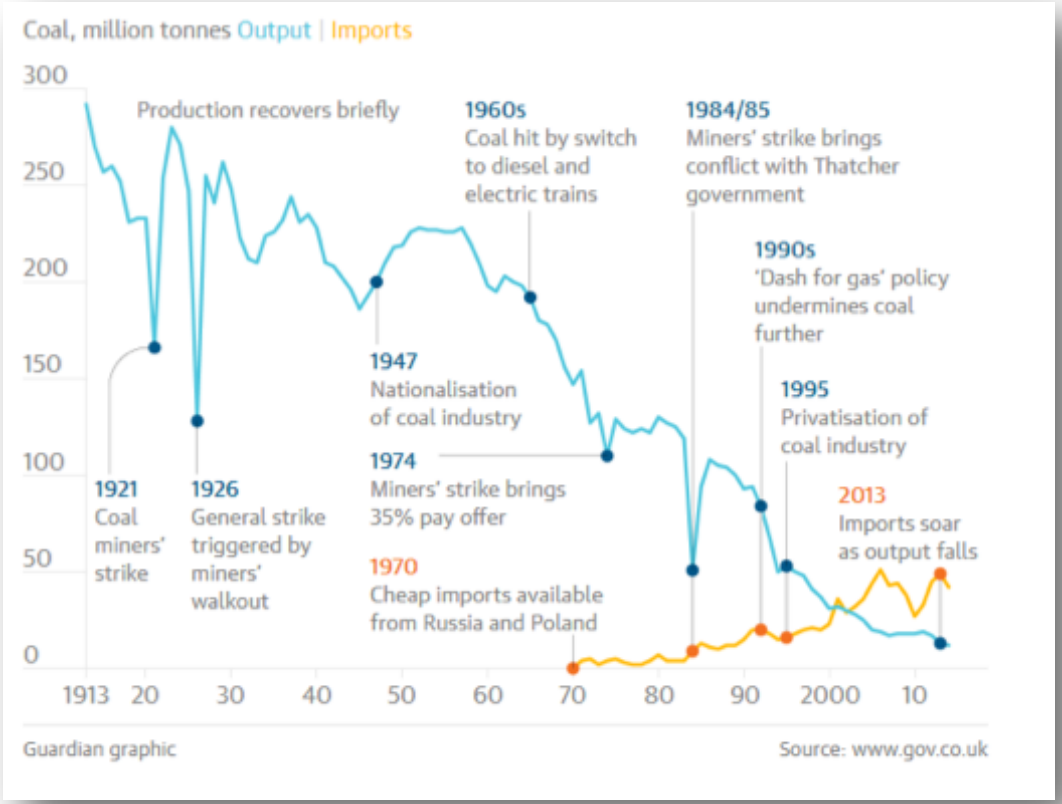

- 15bn tonnes coal mined
- 2bn m^3 water
- 2.2MGwh of heat in place
- 12-20^oC – heat pumps
- Heating/cooling/ storage
- 80MW currently pumped

Great Britain's Energy Mix

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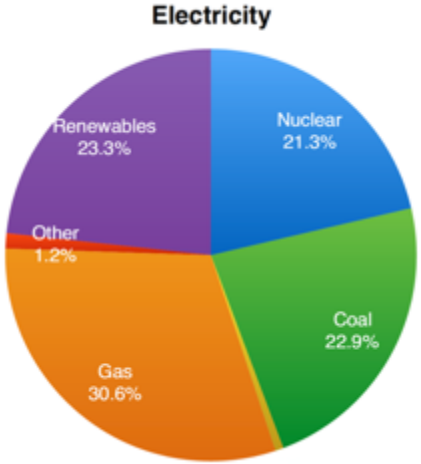

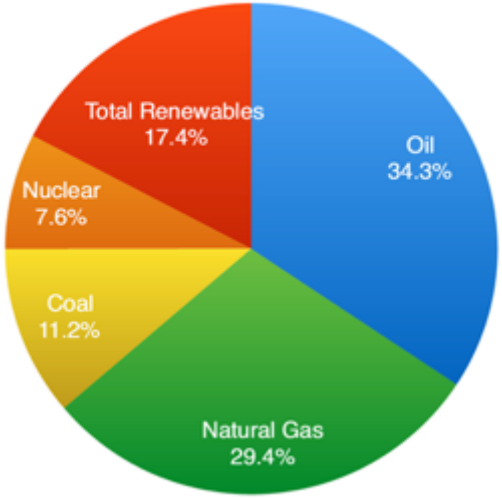

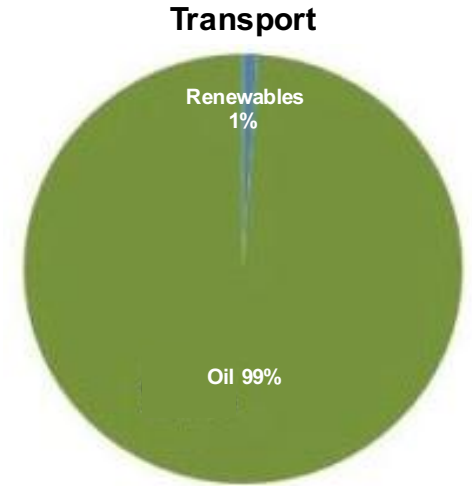

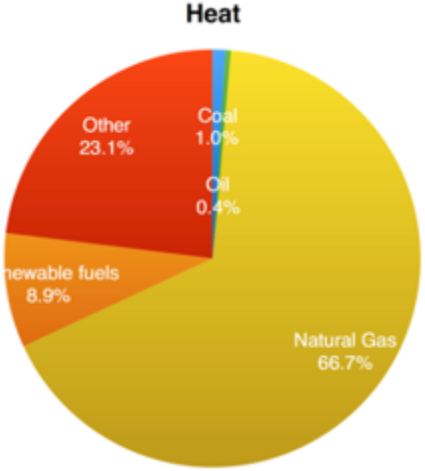

Great Britain's Energy Vectors GWh per day

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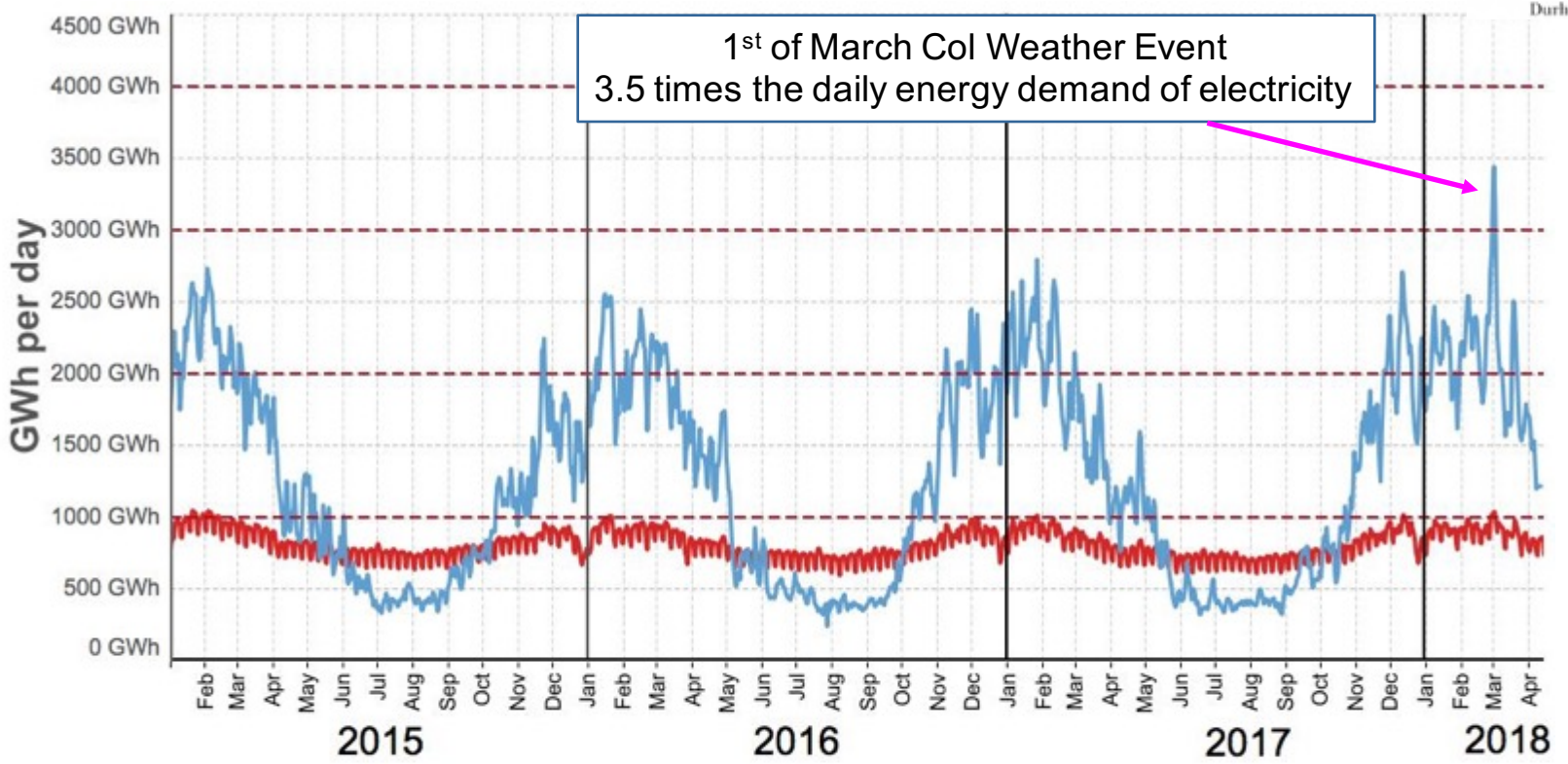

Charts can be downloaded from http://bit.ly/energycharts

by Dr Grant Wilson grant.wilson@sheffield.ac.uk

Celebrating the end of coal?

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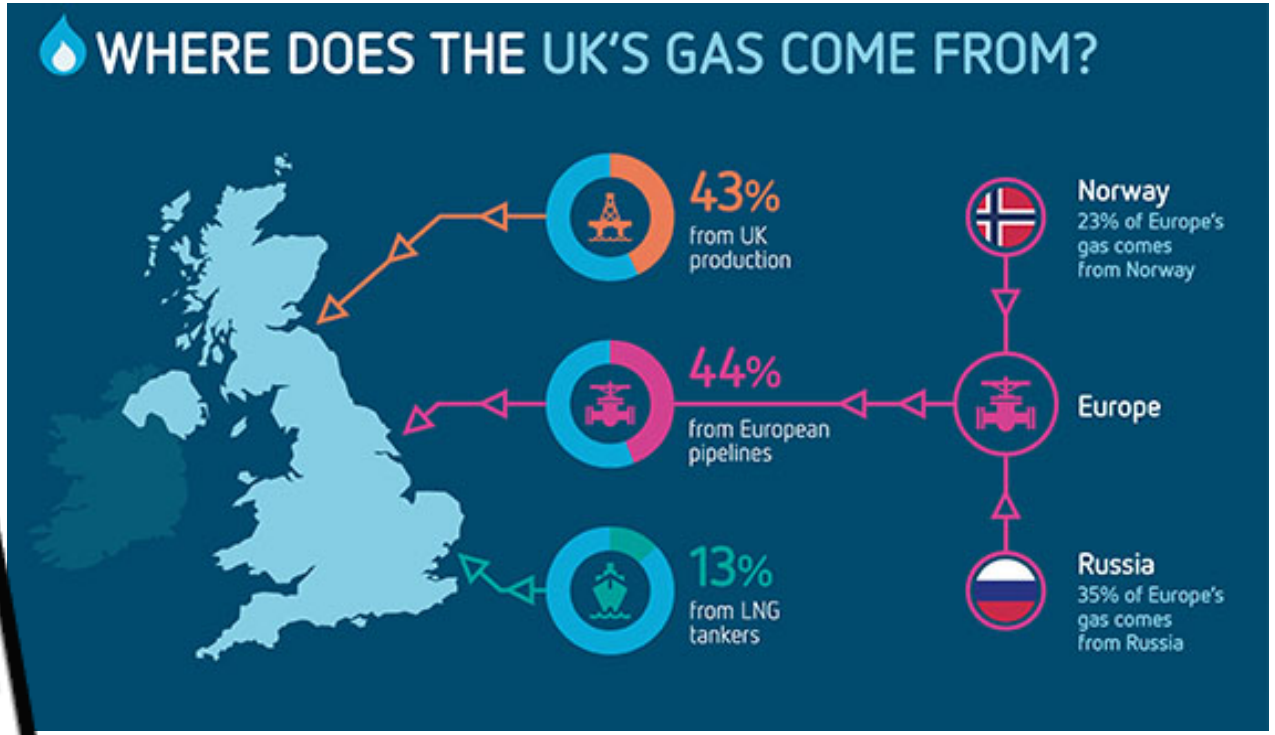

Source: British Gas

How secure are our future supplies?

Developing a Legacy

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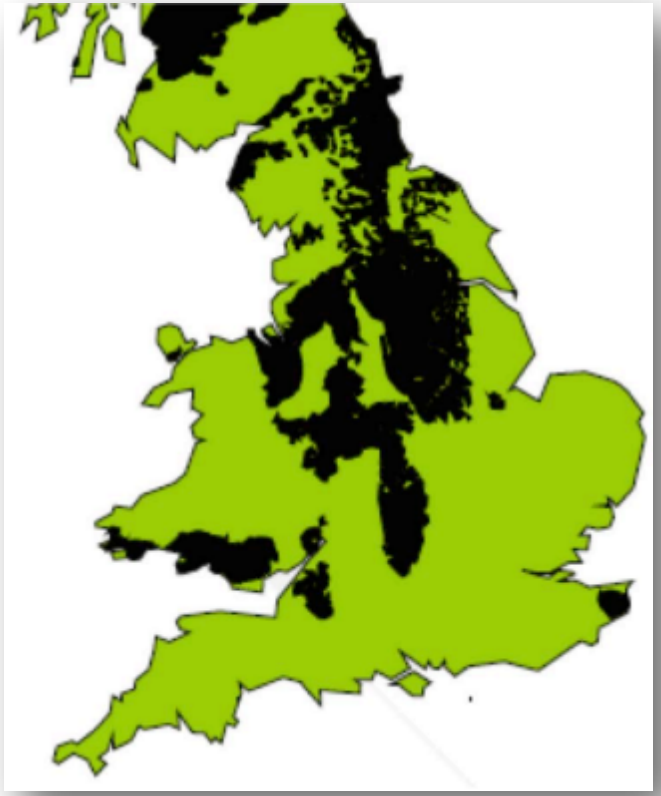
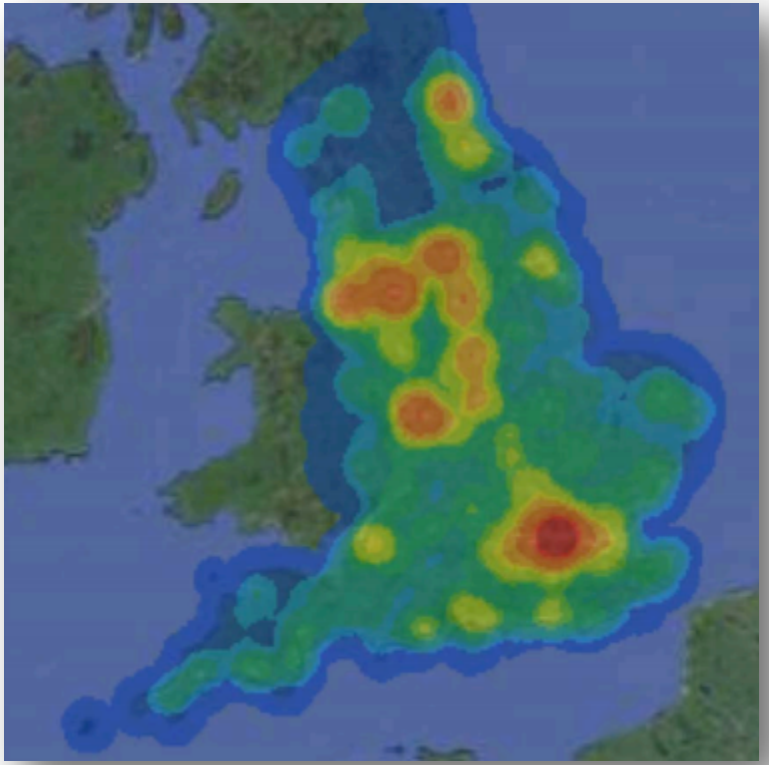


Former coal mining areas
Source: The Coal Authority



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

County Durham

Source: Durham Mining Museum

- 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

Heat Network Compatibility

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- 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

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Pros

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

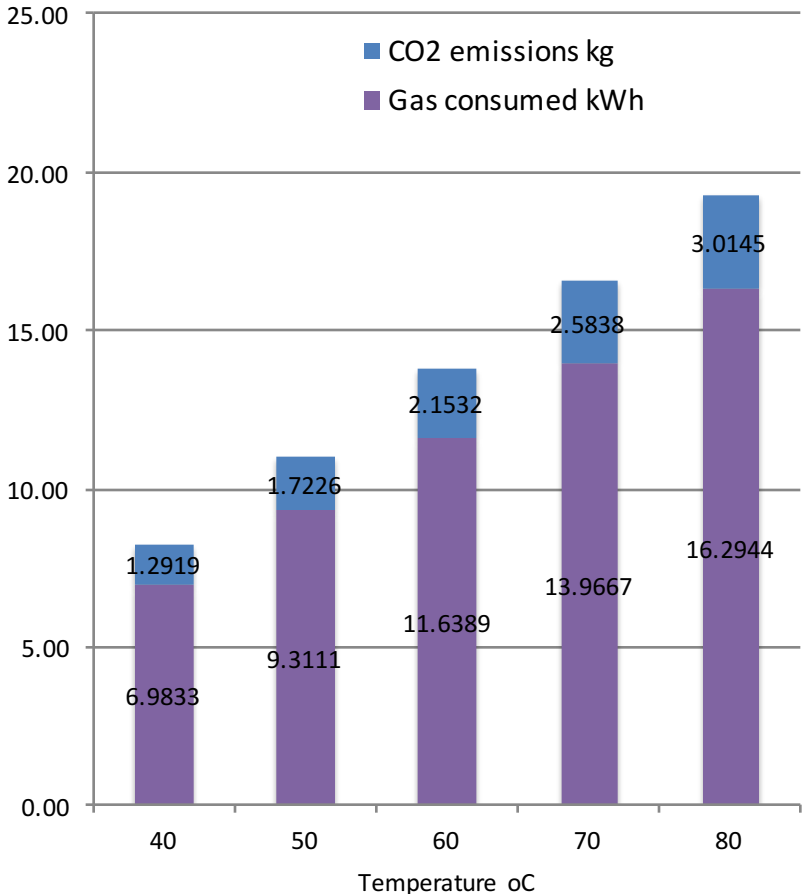
Cons

- 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



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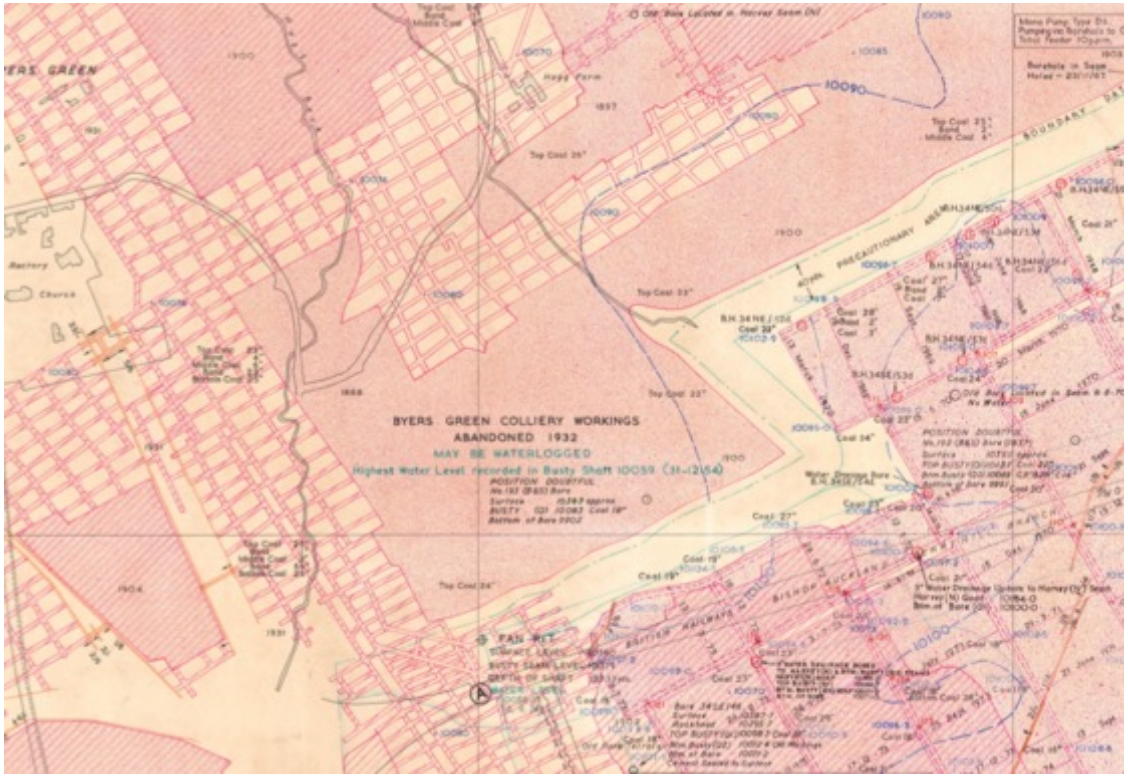
Assessing the Resource



Source: The Coal Authority

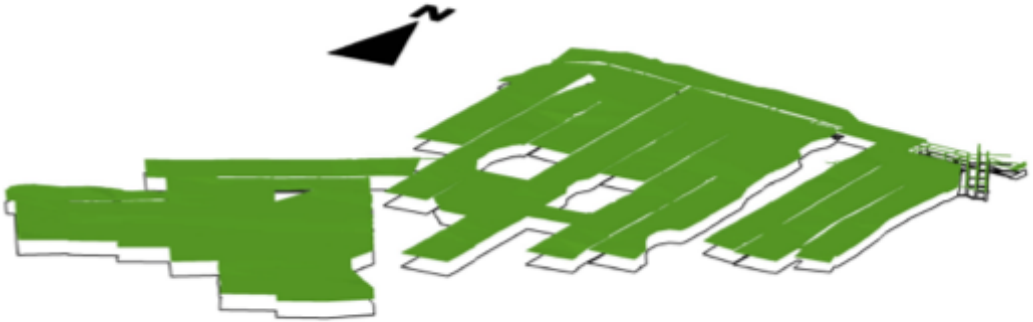
Approach

- 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°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

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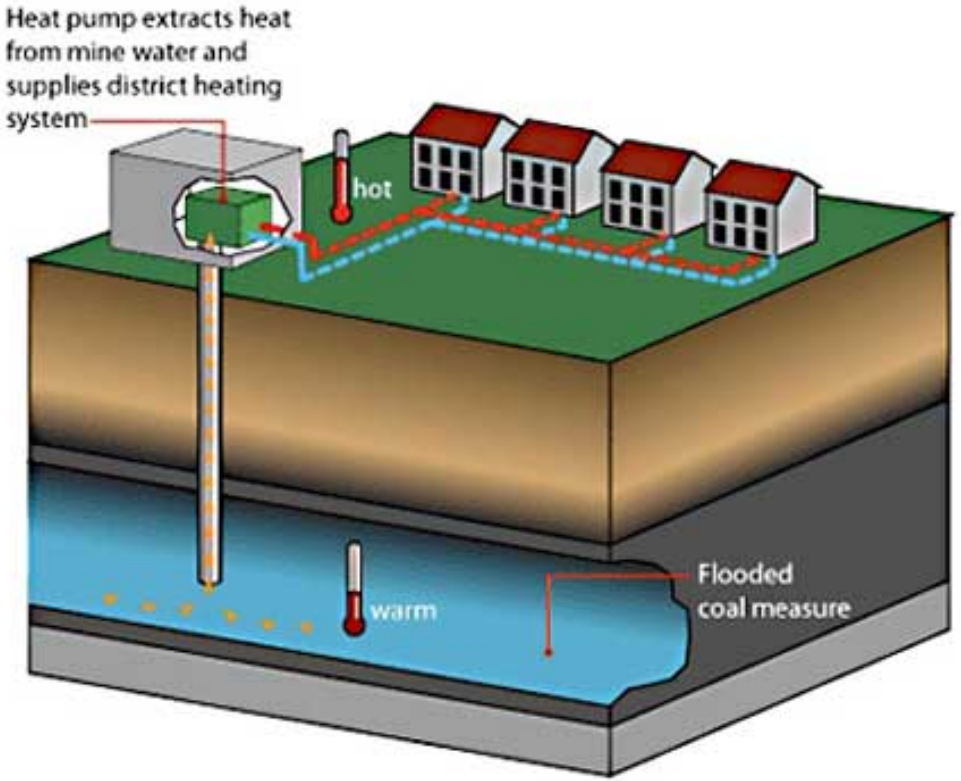
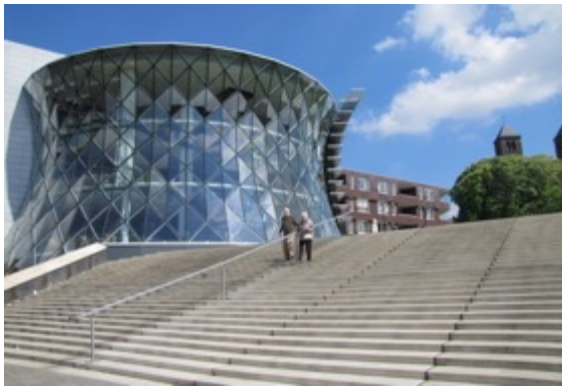
How this works?



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 200,000m^2 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 (220,000ft^2)
  - 1.2MW at Nest Road (140,000ft^2)
- 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

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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

Source: www.geograph.org.uk

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

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Thank you for Listening

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