

# District Heating - Jumping a generation

Case study of a 3<sup>rd</sup> generation CHP district heating system which got updated to a 5<sup>th</sup> generation system with a shared ground source heat pump system.

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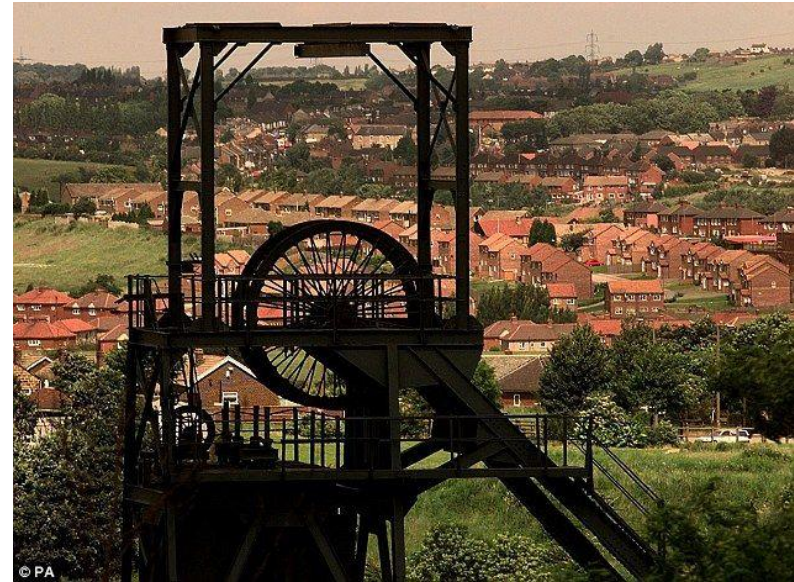


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## What was the project brief?

- Client – Local Authority
- DH scheme for Town Centre (Civic Buildings)
- Update a District Heating Study from Year 2017
- Year 2021 to 2035 – Energy centre (CHP Units).
- Year 2035 – Energy centre (Renewable sources).
- Review and Improve:-
  - Energy centre design,
  - Underground pipework specification,
  - Heat network routes,
  - DH building connections,
  - Carbon savings,
  - Paybacks,
  - Internal Rate of Return (IRR),



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# District Heating Generations terms explained

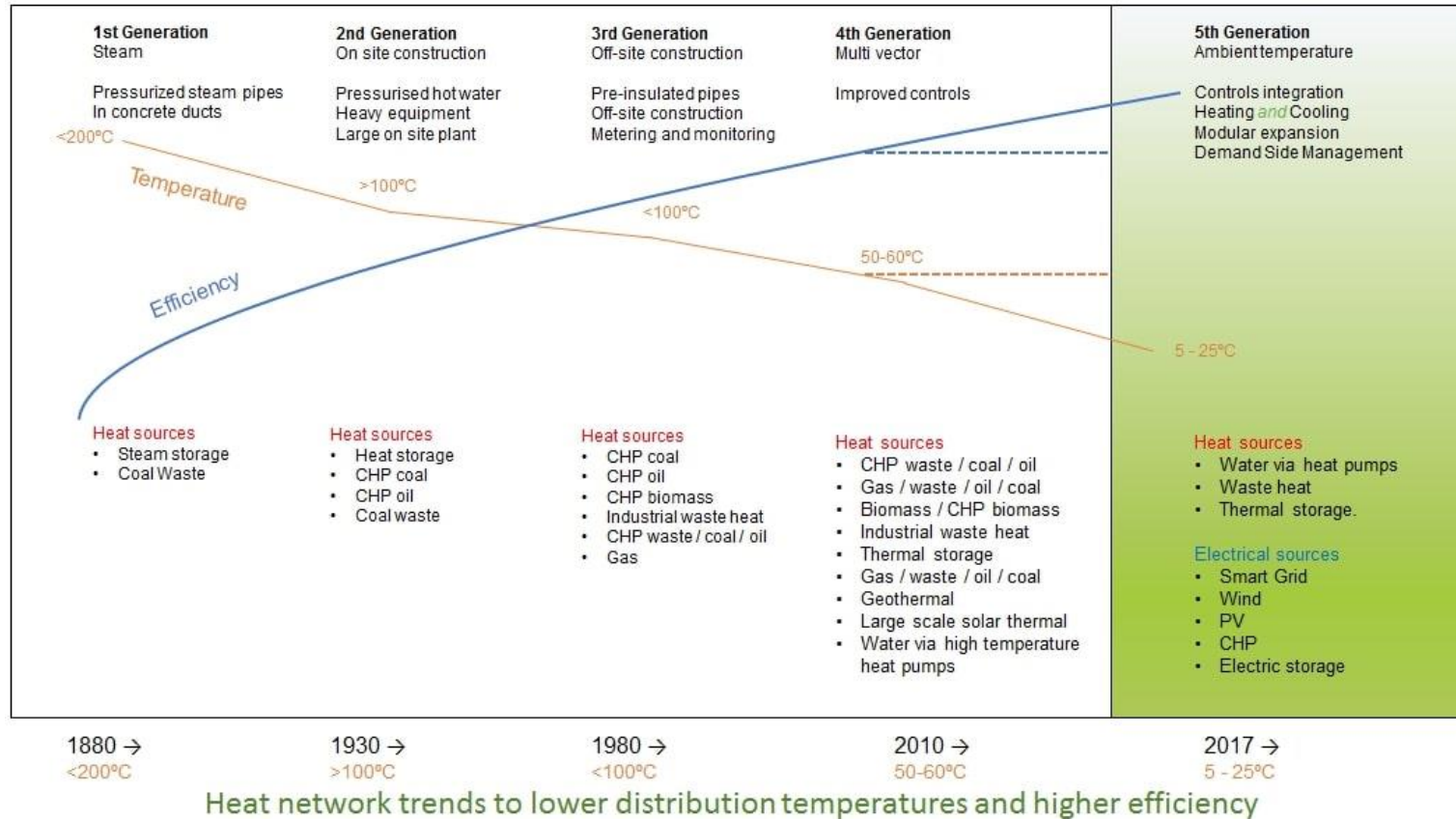


Image courtesy of [https://www.icax.co.uk/image\\_Fifth\\_Generation\\_Heat\\_Networks.html](https://www.icax.co.uk/image_Fifth_Generation_Heat_Networks.html)

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**Figure 1: Carbon intensity of different technologies**

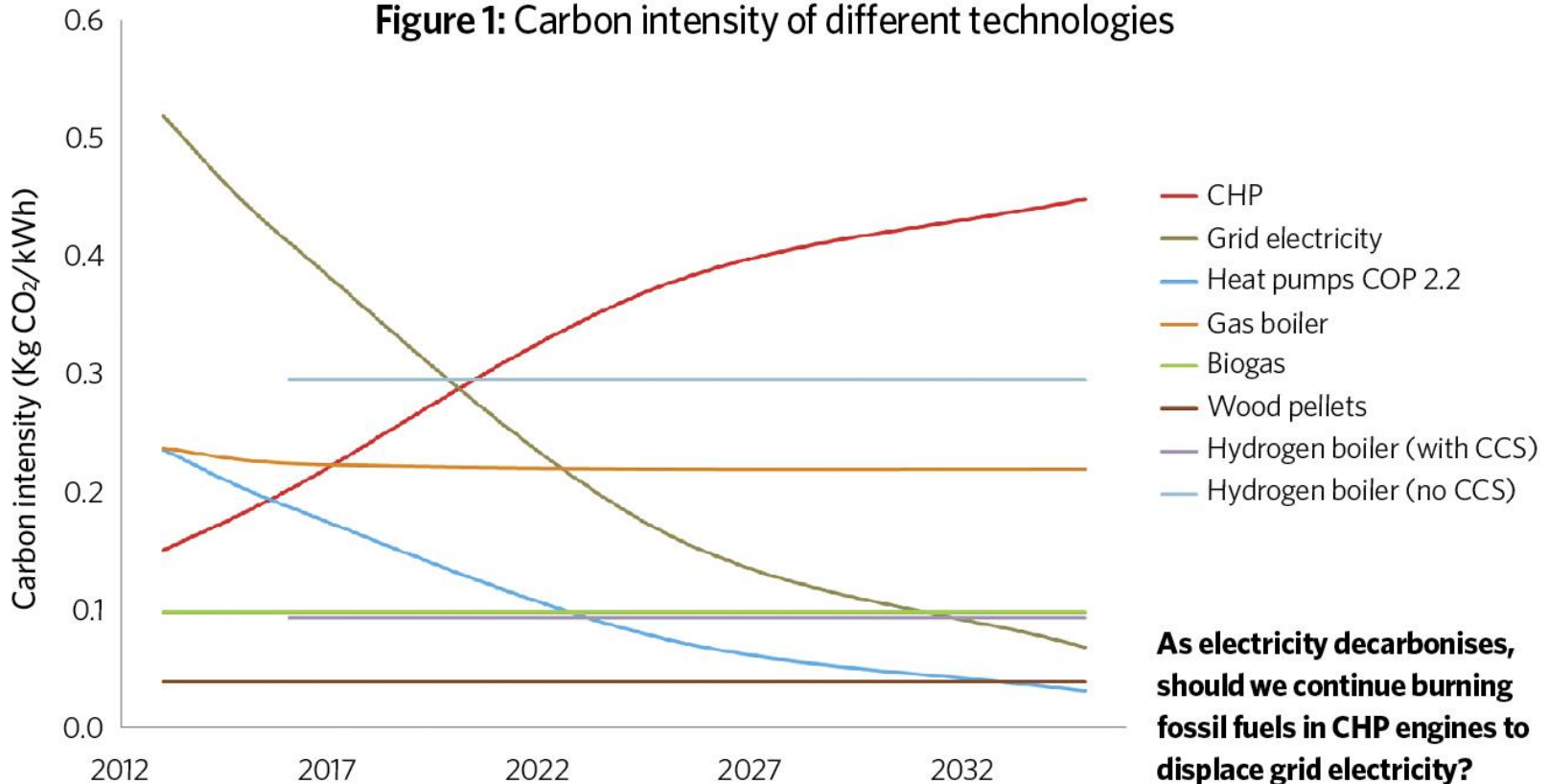


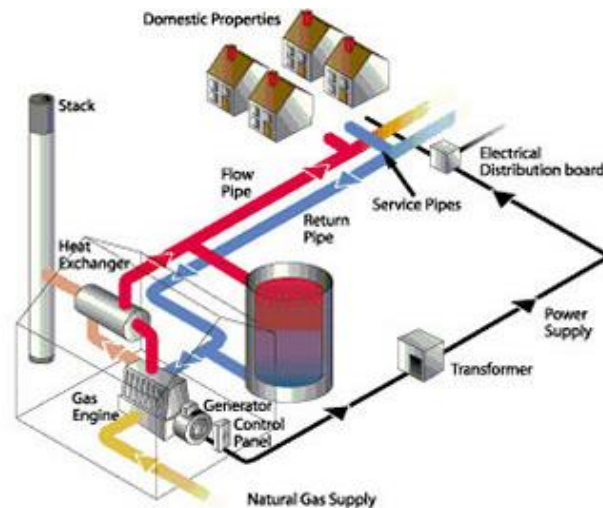
Image courtesy of <https://www.cibsejournal.com/general/power-of-good-future-of-uk-heat/>

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## 3<sup>rd</sup> Generation System

- Air emissions.
- Noise.
- Planning permission.
- Less car parking spaces.
- Fossil fuel for 15 years.



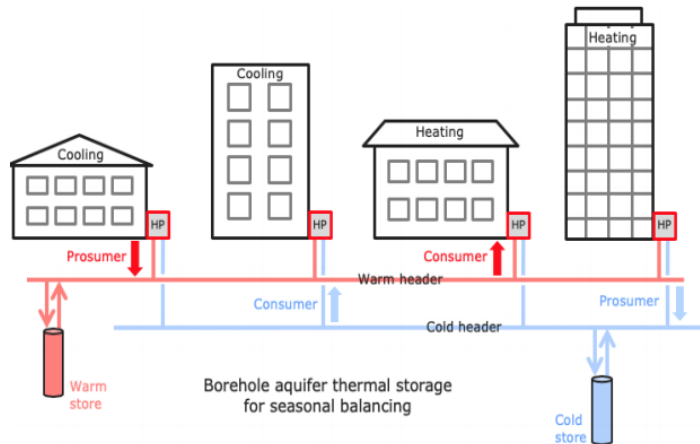
Energy Centre Car Park Location  
One (1) x CHP engine rated 770kWe,  
One (1) x CHP engine rated at 520kWe  
Two (2) x thermal store capacity each rated 120m<sup>3</sup>  
Four (4) x gas boilers each rated 1500kW

One (1) off Heat Water Source Heat Pump rated at 1500kW  
Replaced CHP engine in 2035

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## 5<sup>th</sup> Generation System

- Net zero carbon 1<sup>st</sup> day of install.
- Repurpose Plant rooms.
- No air or noise emissions issues.
- Additional cooling connections.



Pump run within council offices.  
Twelve (12) x boreholes  
Secondary side water source heat pump

Image courtesy of [https://smartenergysystems.eu/wp-content/uploads/2019/09/17-3\\_PhilJonesSESAAU2019.pdf](https://smartenergysystems.eu/wp-content/uploads/2019/09/17-3_PhilJonesSESAAU2019.pdf)

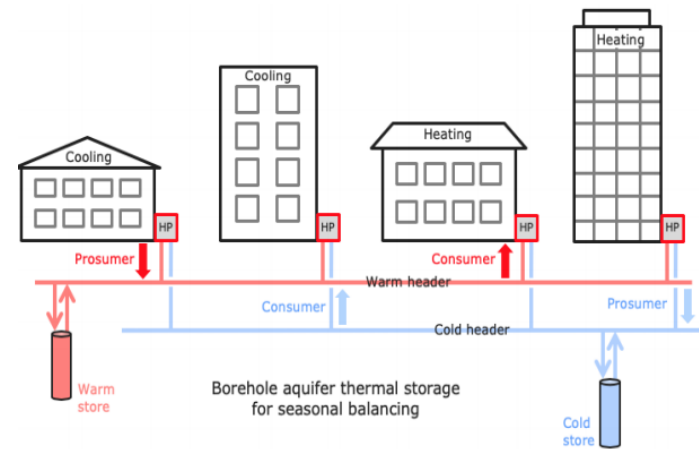
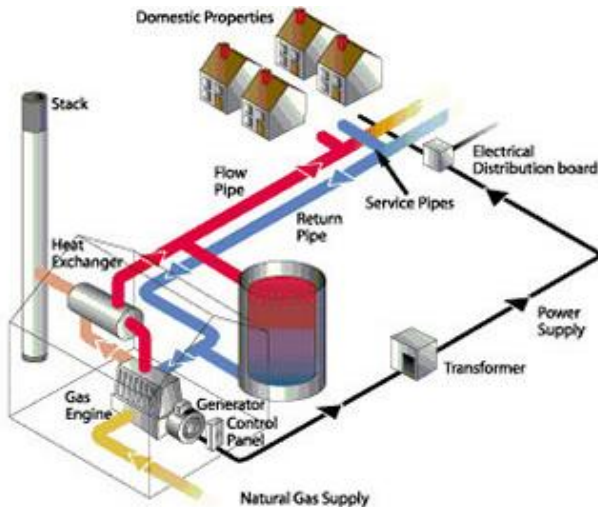
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### Revised Civic quarter District Heating Network

CAPEX = £7,810,455 (€8,541,033)  
 Total CO<sub>2</sub> Savings = 44,087 tonnes  
 DH unit price = 8p (15c)/kWh  
 Internal rate of return = 4.1%  
 Net Present Value = £244,031 (€266,857)  
 Project Lifetime = 40 years

### Revised Ambient Loop Option

CAPEX = £9,909,012 (€10,835,886)  
 Total CO<sub>2</sub> Savings = 63,141 tonnes  
 DH unit price = 11p (12c)/kWh  
 Internal rate of return = 4.3%  
 Net Present Value = £675,938 (€739,164)  
 Project Lifetime = 40 years



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# Comments from grant funder?

Grant Funder – Uncertain domestic heat pumps can deliver flow temperatures at 80°C?

Sweco – **Manufacturers available in the marketplace.**

Future - **Included data sheets and case studies on future reports.**

Grant Funder – Concerns over adjustments of building's heating systems (e.g. changing radiators to underfloor heating systems).

Sweco – **All buildings need to be adjusted for DH adaption.**

Future – **Provide detail of typical secondary side system adjustments needed and its importance if not applied correctly.**

Grant Funder – Considered COP = 2.5 too low, why not just fit, air source heat pumps (ASHP)?

SWECO – **On ASHP's COP values will reduce below 2.5 during peak winter time when it -5°C ambient.**

Future - **Show comparison between air source and ground source during -5°C ambient air.**

Grant Funder - Uncertainty of back up heating supply.

SWECO – **Back up unnecessary, main point of failure would be electrical blackout at connecting building.**

Future - **Report to include available fail safes (e.g. batteries, standby generators, PCM thermal storage).**

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# Help from Industry?

*Please send us :-*

- Data sheets and brochures of water source heat pumps with output of 80°C
- Turnkey contractors with ambient loop experience
- Case studies of 5<sup>th</sup> generation ambient loop success stories
- Case studies of high thermal losses for badly installed 3<sup>rd</sup> generation systems
- Data sheets and brochures of industrial batteries and electrical storage
- Data sheets and brochures of PCM thermal storage

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