Heat From Underground Energy London

Henrique R.P. Lagoeiro | 7 May 2019
7th DHC+ Student Awards
Agenda

- Highlighting the relevance of low carbon heating
- Introducing the opportunity
- Showing the key components of the system
- Analysing its potential benefits
The Future of London

Carbon Emissions (2015)

Energy Consumption (2015)

- 90% of heating sources are gas-fired boilers
- CHP will no longer be low carbon

London to become a zero carbon city by 2050

Wide deployment of low carbon heating systems

District energy only meets 6% of energy demand
The Opportunity

The Underground generates significant amounts of heat

500 GWh of heat per year is generated, which would be enough to heat nearly 42,000 homes in London.

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The Bunhill Waste Heat Recovery System

- The Underground as a heat source
- Extension of an existing heat network
  Bunhill 1 + Bunhill 2
- Expand affordable and low carbon heat
- Move away from fossil fuel heating
- To become operational in June 2019
The Energy Centre

An overview of the system

- 780 kW
- 1 MW COP = 3.76
- 75 m³
- 17 to 25°C
- 372 kW_th
- 237 kW_e
- Thermal Store
- Dry Air Coolers
- Vent Shaft
- CHP units
- Heat Pump

Demand: 6 Buildings - 11,358 MWh/year
Waste Heat Recovery

**Extract Mode**
- 9 to 16°C
- 11 to 18°C
- 6 to 13°C
- 18 to 25°C

**Supply Mode**
- 17 to 25°C
- 6 to 13°C
- 11 to 18°C
- 8 to 16°C

**Extract Mode:**
Colder months

**Supply Mode:**
Warmer months

780 kW
Copper finned copper tubes
Benefit Analysis

Comparison: 1 MW$_{th}$ CHP and Heat Pump meeting a demand of 5000 MWh/year

Reference case: Communal gas boilers and vapour compression refrigeration

Analysis: Different CHP to Heat Pump deployment ratios gradually varying from 1:0 to 0:1

Benefits: the analysis considered expected energy, carbon and cost savings
Energy and Carbon Savings
Energy and Carbon Savings

Gas, Electricity and Carbon Savings for Different CHP/Heat Pump Deployment Ratios

- Gas
- Electricity

CHP/Heat Pump Ratio

0% 100/0 90/10 80/20 70/30 60/40 50/50 40/60 30/70 20/80 10/90 0/100

-40% -20% 0% 20% 40% 60% 80%
Energy and Carbon Savings

Gas, Electricity and Carbon Savings for Different CHP/Heat Pump Deployment Ratios

- Gas
- Electricity
- Total Energy

CHP/Heat Pump Ratio

100/0  90/10  80/20  70/30  60/40  50/50  40/60  30/70  20/80  10/90  0/100
Energy and Carbon Savings

Gas, Electricity and Carbon Savings for Different CHP/Heat Pump Deployment Ratios

- Gas
- Electricity
- Carbon
- Total Energy

CHP/Heat Pump Ratio

39th Euroheat & Power Congress   |   (6) 7-8 May 2019   |   Nantes, France   -   www.ehpcongress.org
Energy Cost Savings

Energy Cost Savings for Different CHP/Heat Pump Deployment Ratios

CHP/Heat Pump Ratio

-50% -40% -30% -20% -10% 0% 10% 20% 30% 40% 50%

Heating

100/0 90/10 80/20 70/30 60/40 50/50 40/60 30/70 20/80 10/90 0/100
Energy Cost Savings

Energy Cost Savings for Different CHP/Heat Pump Deployment Ratios

- **Heating**
- **Electricity**
- **Total**

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<th>CHP/Heat Pump Ratio</th>
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Energy Cost Savings

Energy Cost Savings for Different CHP/Heat Pump Deployment Ratios

- Heating
- Cooling
- Electricity
- Total

CHP/Heat Pump Ratio

Energy Cost Savings Chart
Summary

- Heat pumps can reach significant carbon savings (up to ~60%)

- The cost savings can be even greater if cooling is considered (up to ~40%)

- CHP can be cost-effective depending on electricity prices

- A flexible system can explore the benefits of both technologies
Conclusion

Heat pumps can be a key technology towards low carbon heating

**Residents**
- Energy security
- Better air quality
- Lower heating bills
- Addressing fuel poverty

**The Underground**
- Cooling benefit
- Potential revenue

**Government**
- Emission targets
- Energy savings
- Energy security

**Community**
- Lower emissions
- Better air quality
THANK YOU!

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