

HEAT FROM UNDERGROUND ENERGY LONDON

EVALUATING THE COOLING BENEFIT OF WASTE HEAT RECOVERY
FROM THE LONDON UNDERGROUND

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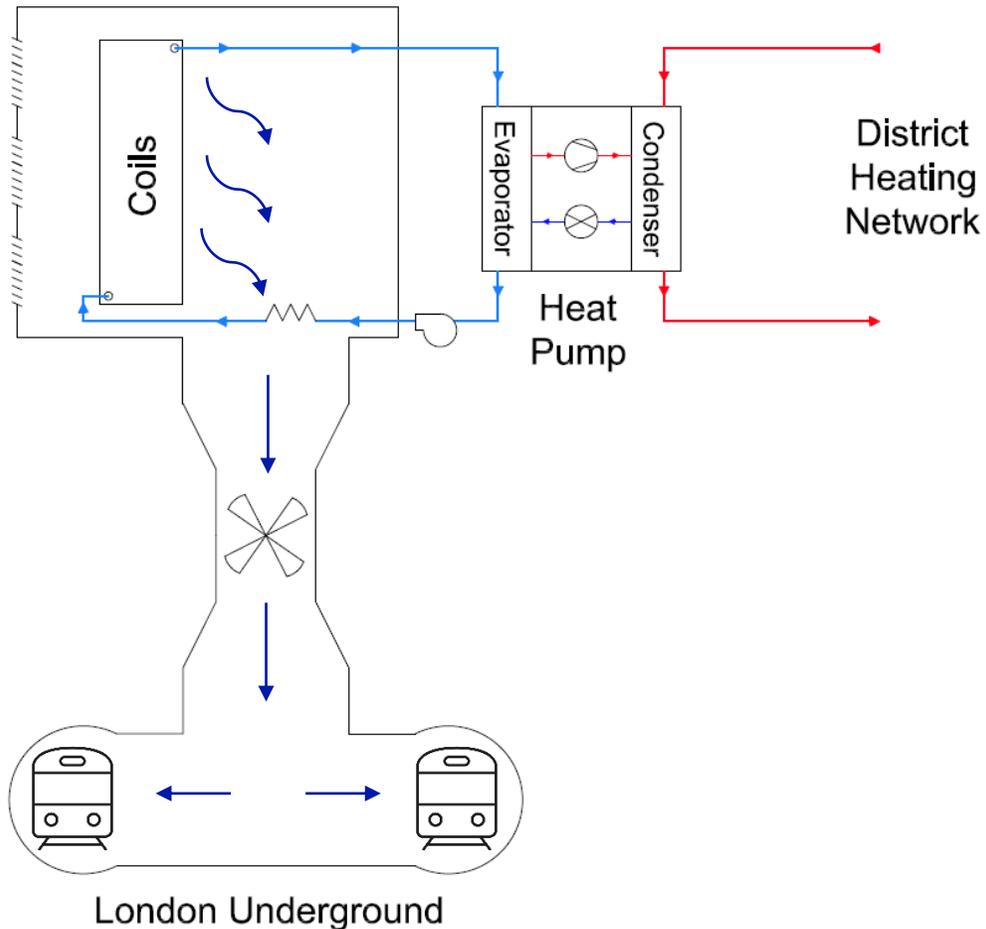
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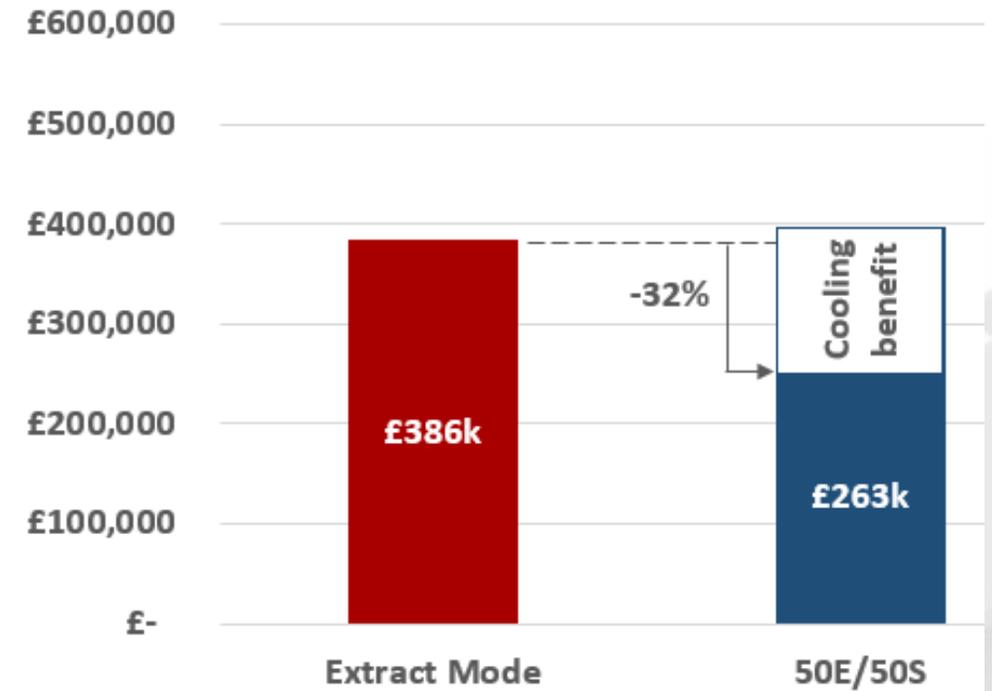
INITIAL ANALYSIS

Potential cooling benefit can have a significant impact

Extract and Supply Modes

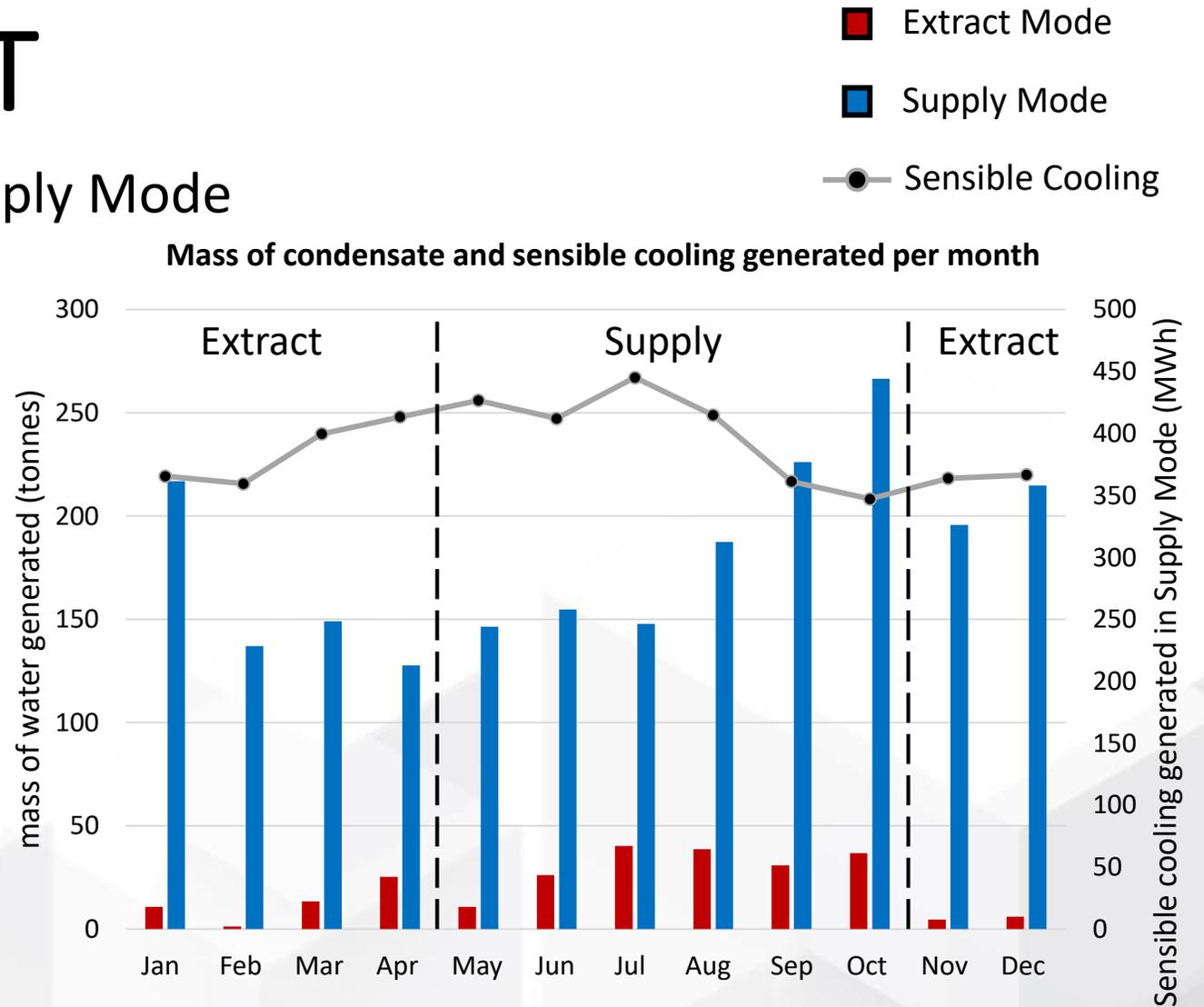
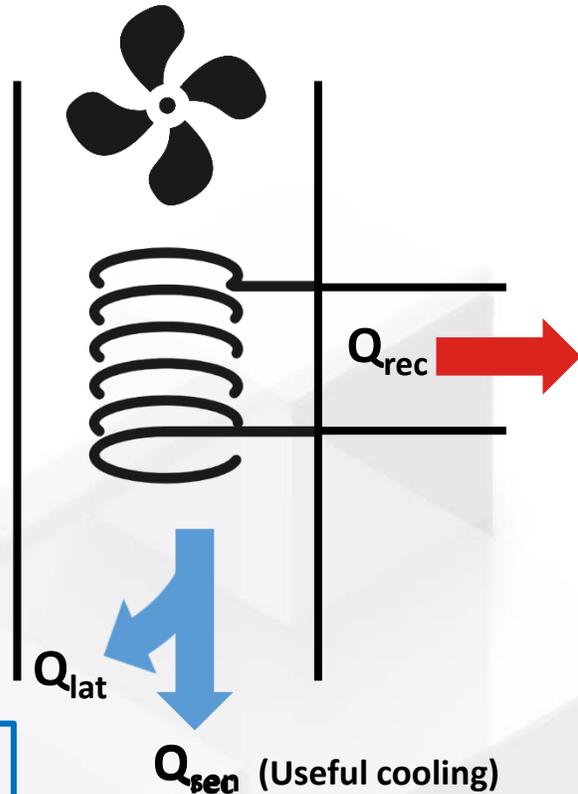


Annual energy costs to meet a heat demand of 7,884 MWh



COOLING BENEFIT

The impact of condensation in Supply Mode



Average: **530 kW** of sensible cooling for **710 kW** of heat recovered in Supply

CONDENSATION

Next steps in the analysis – psychrometric chart

■ $T = 20^\circ\text{C} / \text{RH} = 95\%$

▲ $T = 18^\circ\text{C} / \text{RH} = 50\%$

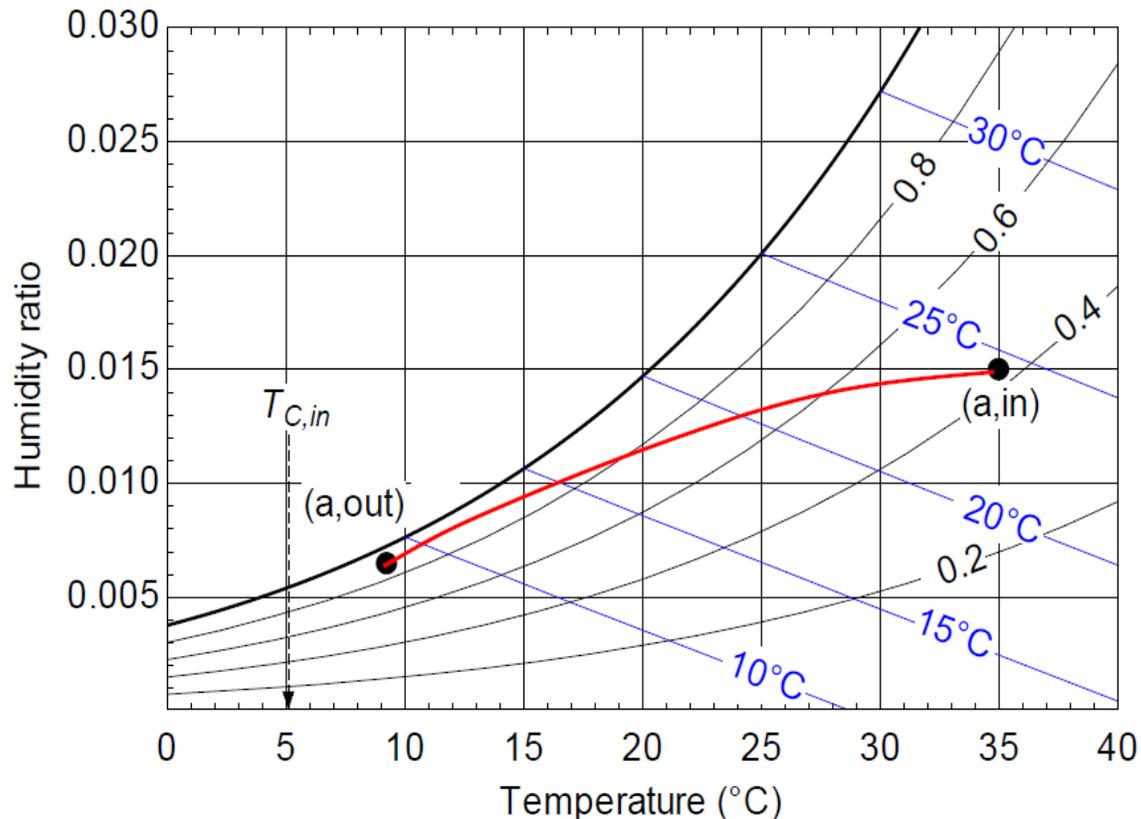


Figure 9-12: Actual process followed by the air passing through a cooling coil.

(Nellis & Klein, 2008)

Energy balance

$$Q = \dot{m}\Delta h_a = \dot{m}(h_{a,in} - h_{a,out}) \rightarrow h_{a,out}$$

$$Q = UA * LMTD \rightarrow T_{a,out}$$

$$h_{a,out} = f(T_{a,out}, \omega_{a,out}) \rightarrow \omega_{a,out}$$

Mass of condensate

$$\text{If } T_{a,out} > T_{dp,in} \rightarrow \omega_{a,out} = \omega_{a,in}$$

$$\text{If } T_{a,out} < T_{dp,in} \rightarrow \omega_{a,out} = \omega_{sat}|_{T=T_{a,out}}$$

- Whole mass of air at same condition
- Dry surface heat transfer equations

THANK YOU!



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