From: Martin Crane [email address redacted]
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To: EnergyEvidence Infrastructure-Commission
Subject: Value of district heat to electricity networks

My experience is in district heating so will confine my comments to this area.

The economic opportunity for DH is in area of high heat density eg city centres, where individual renewable energy solution are not practical eg limited roof space for solar and air source heat pumps. Potentially DH could also work in small rural centres. Both these applications of DH would be displacing the use electricity for heating – so the there is an immediate reduction in electrical demands and most probably peak electrical demands.

The heat sources that DH uses can have significant benefit electricity networks. Gas CHP installed with thermal storage (large hot water tanks) can respond to price signals so it generates at times of high electrical demand and is off at times of low demand. A well designed UK new build DH scheme with CHP will have sufficient thermal storage to make the time of electrical generation independent of the times of heat demands over the period of 24 hours. Typically the thermal store size will supply all the overnight (the off – peak electricity period) heat demands on the DH scheme. In Denmark the electricity price signals have led to thermal storage on gas CHP schemes being sized such that the CHP does not need to operate at the weekend (as the electricity price is lower). With the correct price signals CHPs could be sized larger and thermal stores sized bigger to allow the CHP generation to be focused into smaller higher price portion of each day. This is all tried and tested, bankable technology. Price signals should be easy to set up to incentivise optimal CHP operation. An SSE DH scheme I have helped design will when fully built out to serve 4000 new flats in London will generate 2200kW – just over 0.5 kW per flat, this generation should be operating through all the winter evenings when the grid demand peaks. The annual CHP electricity generation per connected flat is 2.6MWh per year (equivalent to the electricity demand for heating / DHW in a similarly size new build electrically heated flat, or 2 heat pump heated flats). There will across a fleet of CHPs connected to DH and Heat pumps in dwellings a high correlation between them operating – the CHP operating hour matching the heat pump operation (except where the price signals has got the heat pump operation moved to the off peak periods).

There is a clear benefit from gas CHP, and I would suggest that gas CHP is one of the most beneficial uses of gas, the electrical efficiency at 37% (gross) vs 52% (gross) for a CCGT is lower but the use of heat can lifts the overall efficiency up to 85% (gross) if supplying a well-designed (Danish standard) DH network, the current UK design practices means only 78% efficiency is achieved at best and with higher heat distribution losses. This crude efficiency analysis overlooks the fact that the extra electricity from the CCGT could be more valuable than the heat from the CHP, but to the CHP's credit is also overlooks the flexibility and potential speed of response of gas CHP with a start up time of a few minutes and that the CHP is at the demand end of the distribution network so reducing losses and reducing the need for grid reinforcement. The network loss reduction is greater than the average network losses as the CHP will tend to be operating at times of higher network loads which are times of higher losses.

Thermal storage can also help at times of surplus electricity, again look to Denmark to see that district heating operators (responding to straight forward price signals) are installing heat pumps and even direct resistance heaters to use surplus electricity – eg at times of high levels of wind generation. So the thermal store on the DH allow this electricity to be usefully consumed. At other times of low power prices the boilers would operate rather than the CHP so not adding to the generation at time of surplus / lower power prices.

Benefits of DH post natural gas, DH allows the use of the all the heat that most 'Energy' from Waste plants in the UK currently throw away – so this will reduce future electricity demands. DH networks with thermal storage can use heat pumps in place of the CHP and use the thermal stores so the heat pumps operate at the time of cheapest electricity availability, or DH could be heated from biomass or from CHP fed from AD plants or geothermal or solar thermal…. The benefits of DH is the flexibility in that one plant change can change the main heat source for a whole

town – which is somewhat easier than a number of thousand of individual changes of heating plant. DH also allows the use of heat generation solutions that are not possible on a small scale eg AD, EfW, or are less efficient at a small scale eg gas CHP. DH could take heat from large scale thermal power stations – it just at the moment no UK DH network is large enough for the economics of connecting to a large power station to be viable.

Question 1
DH with thermal storage and CHP can provide significant benefits to the electricity system. As can DH with thermal storage to usefully soak up excess electrical generation.

Question 2
Very pleased to see the question phrased as 'energy storage' not 'electricity storage'. DH and the storage of heat can offer scope for CHP to operate when network needs power and for heat pumps and direct electricity heating to operate when there are power surpluses. The scale of DH means these operations would be undertaken by a relatively small number of DH operators in the UK, potentially easier route to demand management than solutions on for example thousands of domestic properties to achieve the same demand response.

Question 4
Look at Denmark to see what district heating offers to both reduce peak electrical demands and balance electrical supply and demand.

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