

Station Hill North Site. RBC Energy Comments.

This document summaries the comments received for the 192032/HYB - Station Hill - North Site - ENERGY STRATEGY.

The comments are based on advice received from Element Energy and subsequent discussions with the Council's Sustainability Manager.

The comments received and our response are set as follows;

1. Comment Received; The applicant needs to provide further evidence why GSHP, which would normally be expected to result in better carbon reductions, has been omitted in Phase 2 (and not confirmed in Phase 3). This evidence may be in the form of, for example, detailed spatial analysis of GSHP plant and boreholes in relation to the wider Station Hill Phase 2/3 sites. This should be more detailed evidence than that which was provided in the planning application's energy statement.

HL Response:

Coordinated studies have been carried out to review the possibility of using GSHP closed loop system.

The drawing indicated below (See figure 1) highlights the extent of existing foundations and utilities such as the Thames Water sewer on site, the majority of which cannot be removed, considering that a minimum distance of 6m between each borehole is required this will limit the space where boreholes can be located. The space in green indicates the available area that could potentially be used, this works out at approximately 33No. boreholes. If the boreholes were 150m deep, it should be possible to extract 9kW per borehole, this gives approximately 300kW maximum capacity from the GSHP network. This only provides 10% of the overall required load for the building, making this option not viable for the scheme.

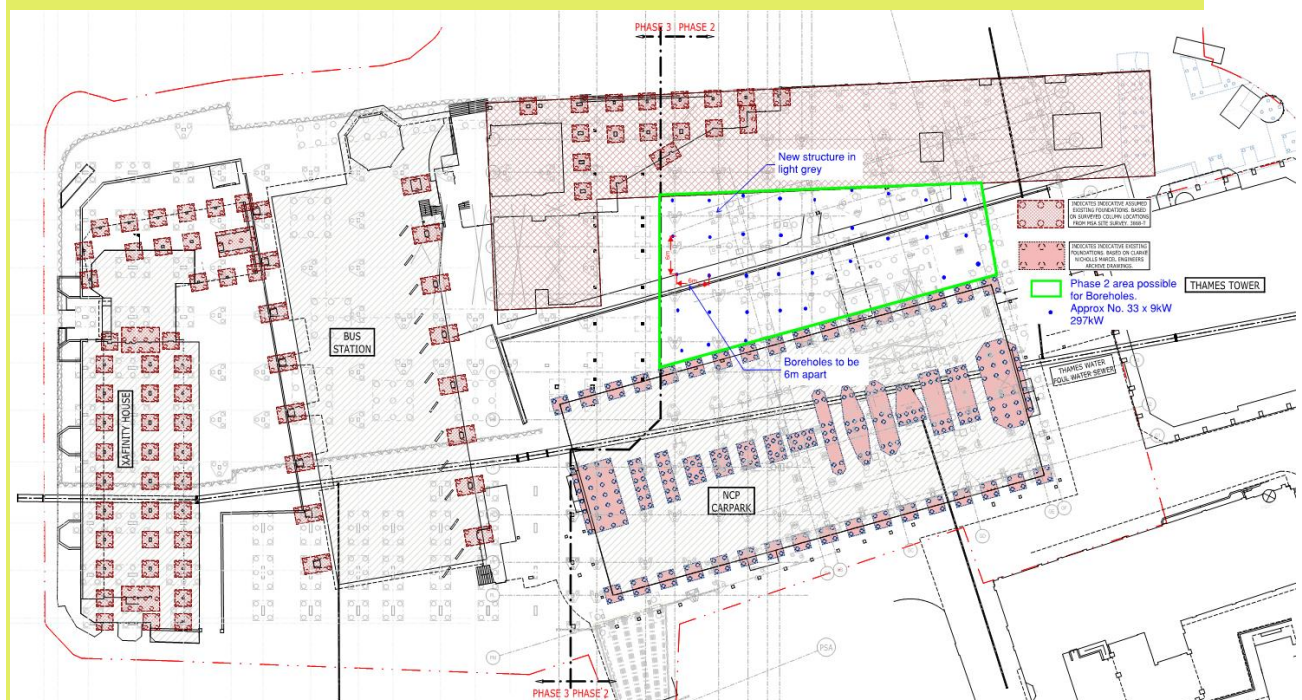


Figure 1

2. Comment Received; Open-loop GSHP is currently discounted due to an imbalance of annual heating/cooling loads, which are required for optimal open-loop GSHP operation. However, the applicant's current carbon compliance models for Phase 2 differ significantly from the expected energy consumption of the building in operation (heating-led from compliance modelling, cooling-led from Hoare Lea experience of office buildings).

The applicant should therefore demonstrate confidence in assertions that cooling will dominate the thermal energy load in operation (contrary to the current carbon compliance models), and thus why an open-loop GSHP system is not appropriate at Phase 2.

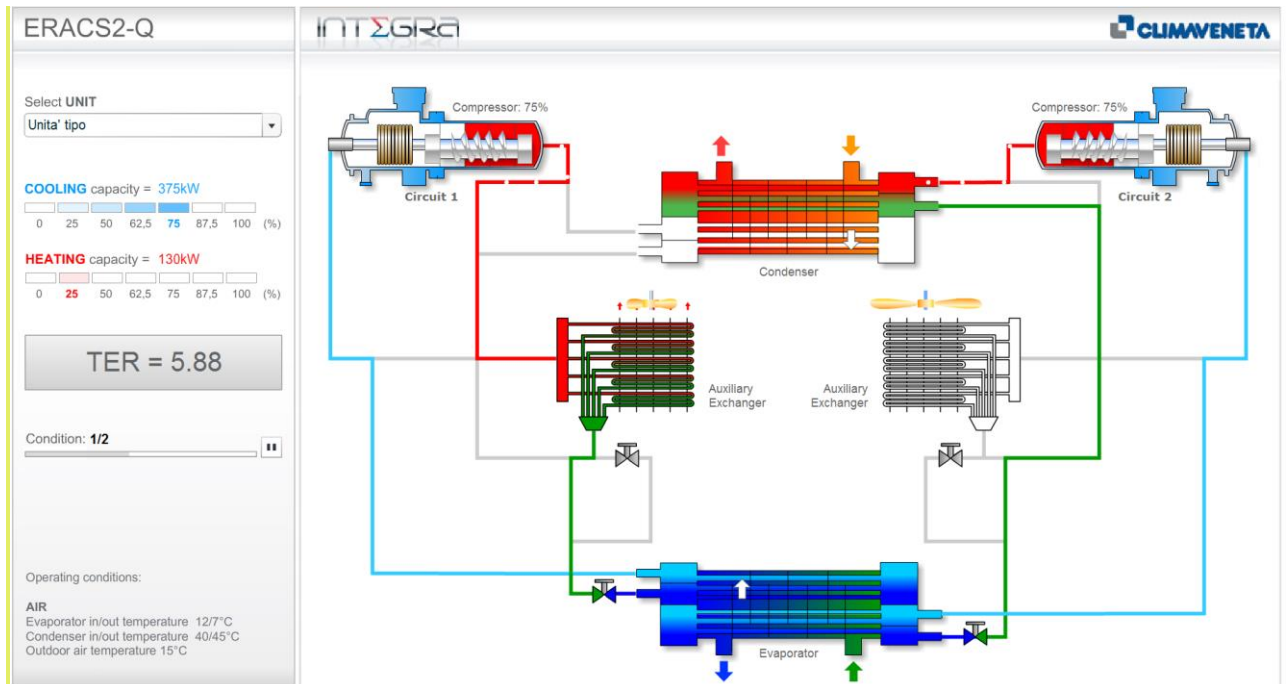
HL Response: The part L model uses a National Calculation Methodology (NCM) which is an assessment tool used to demonstrate compliance with ADL2A. However, NCM is not intended to predict energy use when the building is in operation, NCM uses templates which consist of standard operational inputs for variables such as occupancy density and hours of operation to determine energy use and excludes the energy consumption associated with small power loads, servers, external lighting etc... Thermal dynamic modelling using IES software has been undertaken for the detailed cooling and heating loads show that the cooling load is higher than the heating load, this information is comparable with other benchmark data for a new office building.

3. Comment Received; GSHP systems are generally more efficient than ASHPs. The Applicant should provide evidence to quantify the extent to which simultaneous heating/cooling demand may in fact result in similar annual efficiencies as has been suggested.

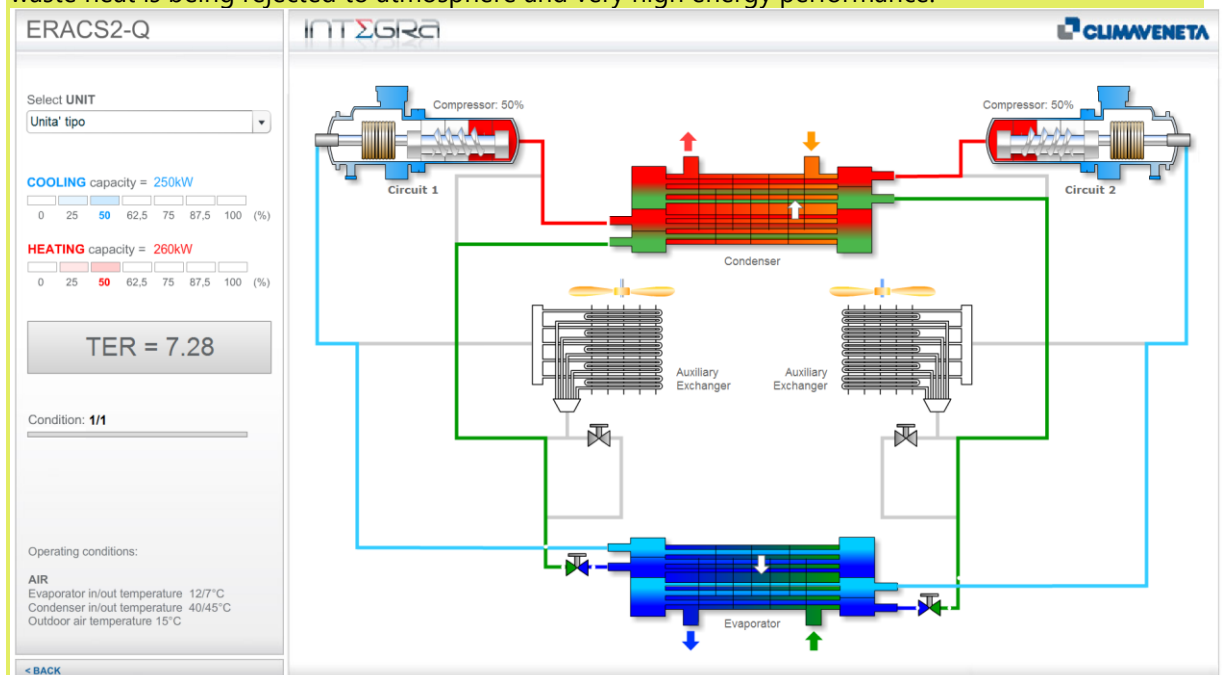
HL Response: We have looked at the energy comparison between GSHP systems compared to ASHPs. In general, a low temperature heating only GSHP would typically achieve a COP of 5, for a system that is providing both heating and cooling this would typically achieve a COP of 4. The ASHP that will be used for station hill phase 2 recovers waste heat when there is a simultaneous heating and cooling demand, therefore the Seasonal Energy Efficiency Ratio (SEER) for the proposed ASHP is 4.24. The ASHP proposed are more energy efficient when used to produce chilled water and LTHW at the same time, as the waste heat can be used to help provide heating and/or cooling.

When there is a requirement for heating and cooling at the same time, then instead of rejecting waste heat/coolth to atmosphere it can be used as shown in images below.

The first image is of the building with a cooling demand 75% and heating demand 25%. The image shows some waste heat is still rejected to atmosphere.



The second image shows the cooling demand 50% and heating demand 50%. The image shows no waste heat is being rejected to atmosphere and very high energy performance.



In reviewing the energy usage for the year, we have considered the Total Energy Ratio (TER) when the unit is in cooling/heating mode versus different external temperatures and this is shown in the table below. We have highlighted in green the TER we are expecting to achieve for the office building based on external temperatures and internal gains. This shows that the minimum TER is likely to be 2.35-2.55 with maximum likely to be 7.38. However, given the average weather temperatures for Reading the ASHP TER will be in region of 3.66 to 7.38. This demonstrates that the ASHP will achieve a similar annual efficiency to GSHP system.

ASHP Ambient Condition TER Data											
Heating Load	100	90	80	70	60	50	40	30	20	10	0
Cooling Load	0	10	20	30	40	50	60	70	80	90	100
Ambient Air Temp											
-6	2.04	2.67	4.02	6.55	7.21	7.25	7.15	6.77	6.38	5.98	5.42
-3	2.35	3.2	4.57	6.93	7.66	7.42	7.11	6.71	6.31	5.93	5.38
0	2.55	3.42	4.76	6.98	7.6	7.36	7.05	6.65	6.25	5.88	5.34
3	2.83	3.72	5.01	7.05	7.55	7.3	6.97	6.59	6.2	5.83	5.3
6	3.3	4.2	5.44	7.17	7.5	7.25	6.92	6.53	6.14	5.79	5.26
9	3.66	4.58	5.75	7.22	7.43	7.17	6.85	6.47	6.1	5.74	5.23
12	4	4.94	5.96	7.22	7.38	7.13	6.8	6.42	6.05	5.7	5.19
15	4.44	5.25	6.17	7.23	7.31	7.06	6.72	6.36	6	5.65	5.15
18	4.82	5.58	6.4	7.29	7.23	6.89	6.51	6.06	5.64	5.21	5.15
21	5.08	5.9	6.83	7.89	7.62	6.97	6.39	5.81	5.32	4.78	4.28
25	5.08	5.91	6.88	7.99	7.57	6.74	6.02	5.37	4.85	4.22	3.74
28	5.08	5.92	6.92	8.1	7.51	6.56	5.72	5.03	4.43	3.81	3.36
31	5.08	5.92	6.97	8.1	7.48	6.42	5.37	4.82	4.25	3.72	3.17

- The applicant should demonstrate the difference in total thermal energy supply system efficiency when employing ASHP versus open-loop GSHP.

HL Response: we have consulted with ground source heat pump and energy specialists ESB Energy who have obtained data on the existing ground conditions and suitability for an open loop system, this has identified that there are a number of very old wells in the area installed within the chalk, and this would provide an average yield of around 4.0l/s, this would equate to 300kW of heating which represents approximately 10% of the load and therefore would be insufficient.

Considering there will be an imbalance in cooling and heating loads during the year, and in the summer the cooling demand will be more than the heating demand, the excess heat will need to be "dumped" this heat dump is not allowed to be returned to the underground water source therefore this would need to be either sold off locally to a property with a very high hot water load, or air cooled chillers would be required to meet the cooling load.

- If confidence in the thermal loads and the comparative efficiencies of ASHP versus open-loop GSHP cannot be demonstrated, (and it is expected that in most cases it cannot), then the following should be undertaken in respect of open-loop GSHP:

- Demonstrate whether open-loop GSHP is technically feasible considering available aquifer water within the vicinity of the Station Hill North development. A hydrological/geological study is required but to save some time/effort, the Council understands there to be plenty of water in the aquifer.
- Demonstrate whether open-loop GSHP is technically feasible with regard to utility clashes in the surrounding area. This should be a detailed assessment and not a general overview.

If the proposed ASHP system energy supply strategy can be shown to perform similarly to an open-loop GSHP thermally, or that GSHP is technically unfeasible, only then will it be accepted that the proposed energy strategy is acceptable as the best solution for Station Hill North Phase 2.

HL Response: As mentioned above an open loop system will not be feasible due to the limitation of the flow available and the imbalance of loads. However, the energy efficiencies shown in table above shows that we can achieve high COPs throughout the year and at many times greater efficiencies using the proposed ASHP.

6. Potential disadvantages of ASHP on this scale, noise levels, high electrical load at peak times (exacerbating peak demand on the local electricity network) and localised cooling effects in cold weather should be addressed and balanced against claimed benefits.

HL Response: The noise from the ASHP has considered and coordinated with architect and acoustic consultant, to meet the acoustic criteria, this includes mitigation measures such as screening at roof level. If an open loop GSHP solution were to be adopted then it would need to be provided with a backup heating and cooling system to provide resilience and top up the cooling/heating capacities at peak times. This will add additional plant and pumping with the backup ASHP/chillers at roof level and GSHP within the basement.

To minimise the peak demand, we have included thermal storage to help meet with the peak load. The benefit of using the ASHP with simultaneous heating and cooling outputs does help improve the efficiency of the ASHP.

7. Regardless of the technology adopted the SPD is clear in seeking a heat network at Station Hill, beyond the current site boundary: "Station Hill and around – centred on seven plots of the large Station Hill redevelopment site and includes three other planned redevelopments at Sainsbury's, Garrard House and Weldale Street."

The applicant should engage further with the Council and Element Energy to ensure that adequate provisions are put in place to facilitate future connection of the Station Hill development to a wider area DH scheme. For example, this might include agreeing a position for connecting pipework to be laid to and capped off, ready for later connection. This should address the neighbouring sites referred to in the SPD.

HL Response: The proposed energy strategy for the North Site is future proofed enabling a connection to a wider heat network, when one materialises (this could be phase 3 or any other future network). It is proposed that the ASHP provided for the Office building will connect into the Phase 3 energy network. The details for this network will be developed when more is known about the usages for Phase 3.

The thermal model results for phase 2 show there is a higher cooling load than heating load, which means there is an opportunity to recover the waste heat when producing the chilled water for the cooling.

When there is a demand for cooling in the office development, the ASHP will produce the required chilled water and the waste heat from this process will be captured. The captured waste heat is then used to charge the buffer vessels with low temperature hot water. This low temperature hot water will be stored in highly insulated buffer vessels and it can be used for hot water requirements in phase 3.

When there is a demand for hot water in phase 3 and the heating buffer vessels have available hot water, it can be pumped to phase 3 to help meet the heating demand requirements.

There shall be a plate heat exchanger to provide a physical separation between the office building (phase 2) and the phase 3 network. The buffer vessels shall be installed in phase 2 with connections in the tank for the phase 3 connections.

The pipework shall be extended from the buffer vessel in phase 3 with pumps and plate heat exchanger also being installed in phase 3. The below shows the concept schematic of the system showing how the heat can be used by Phase 3

