

elementenergy

***Vastern Road
Development
Energy Strategy
Review Update***

Final report

for

**Reading Borough
Council**

19/03/2021

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Executive Summary

Reading Borough Council (RBC) commissioned Element Energy to provide a critical review of Hodkinson’s proposed energy strategy for the Vastern Road redevelopment by Berkeley Homes (the Applicant). This review was completed in June 2020, finding that the proposed energy strategy was not compliant with RBC energy and carbon policy, as well as not meeting wider council aspirations, for the following reasons:

- The thermal energy systems were not decentralised and did not use ground source heat pump (GSHP) or air source heat pump (ASHP) as a primary heating source;
- There was no decentralised hydraulic heating system proposed, therefore the development was not “connection-ready” for any future DH networks that may be deployed in the area around the development.

A revised energy strategy was completed by Hodkinson in December 2020, which employed a hydraulic heating system and heat pumps as the primary low-carbon heat source and natural gas boilers for top-up heat. It has been found however that the development remains non-compliant with RBC energy and carbon policy guidance, as well as not being future-proofed for incoming national policy, for the following reasons:

- Insufficient evidence to discount open-loop GSHP, which is identified in the RBC Sustainable Design & Construction Supplementary Planning Document (SPD) as the preferred heat pump technology over ASHP;
- Reliance on natural gas boilers for heat top-up in winter periods is not future-proofed for the expected national Future Buildings Standard policy, which are currently at the consultation stage.

The energy strategy does comply with Local Plan energy and carbon policies.

It is recommended that the Applicant complete the following to address the concerns regarding non-compliance with policy guidance and future-proofing of the energy strategy:

- Provide evidence on open-loop GSHP to confirm justifications for discounting the technology are valid:
 - A site investigation to confirm the ground is contaminated to the extent that boreholes cannot be safely installed;
 - A desktop survey by a hydrogeological expert to demonstrate the lack of sufficient aquifer groundwater to satisfy the heat demands of the development;
- Should this evidence show that open-loop GSHP is technically viable for the development, this should replace the ASHP + gas boiler approach currently employed within the energy strategy;
- Should this evidence show that open-loop GSHP is not technically viable for the development, a fully ASHP-supplied heating system should replace the ASHP + gas boiler approach from the current strategy.

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Acronyms

ASHP Air source heat pump

DH District heating

GSHP Ground source heat pump

MEV Mechanical extract ventilation

MVHR Mechanical ventilation and heat recovery

RBC Reading Borough Council

SPD Supplementary Planning Document

WSHP Water source heat pump

1 Introduction

Reading Borough Council (RBC) has commissioned Element Energy to provide critical review of Hodkinson’s proposed energy strategy (December 2020) for the Vastern Road redevelopment. The intention of the review is to ensure the energy strategy meets council energy and carbon policy. This report has been written in response to Hodkinson’s document “Vastern Road - Energy Statement - HC Final v3 - 10.12.2020”. This is an updated document following Element Energy’s review of the previous strategy (June 2020).

1.1 Vastern Road development

The Vastern Road development is located in the centre of Reading on the site of an old power station, north of the rail station and just south of the River Thames. The proposed development proposal comprises 208no. residential dwellings.

A heat mapping and energy masterplanning study was undertaken by Element Energy in 2017 for RBC. This study demonstrated potential for a number of district heating (DH) networks in Reading town centre (Figure 1).

It was demonstrated in this study that there was commercial potential for a public sector led water source heat pump (WSHP) based heat network serving the Vastern Road residential development.

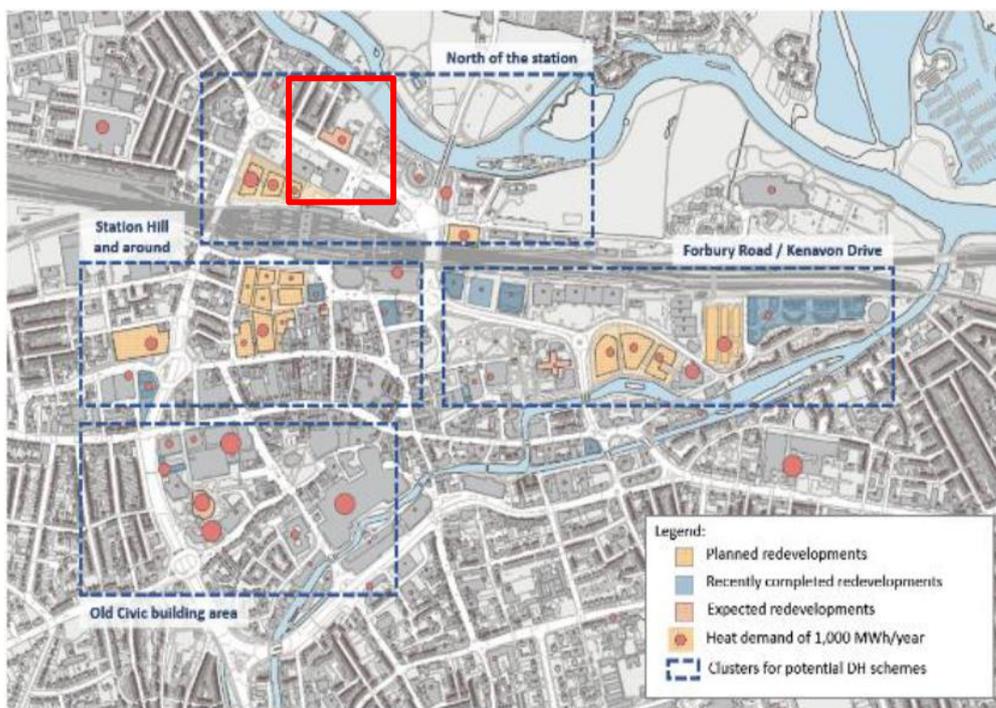


Figure 1 Vastern Road development area (highlighted red) in relation to wider Reading town centre development areas

2 Revised energy strategy

2.1 Overview

Hodkinson’s revised energy strategy can be summarised as follows:

- An ASHP-led thermal heating supply system, supplemented with natural gas boilers (heat pumps serving two-thirds of the development’s annual heat consumption with the boilers serving one-third);
- Building fabric and services that exceed Part L minimum requirements to reduce space heating consumption within dwellings, including mechanical ventilation and heat recovery (MVHR) to improve efficiency further (except in Block A, which has centralised mechanical extract ventilation, cMEV);
- Solar PV arrays installed on rooftops for renewable power supply (~60kWp).

2.2 Adherence to energy and carbon policy

Considering Local Plan policy CC4, the proposed energy strategy can be considered as compliant. However, there are a number of improvements that could be made to the strategy considering policy guidance within the Sustainable Design & Construction Supplementary Planning Document (SPD) and incoming national policy. These elements are outlined in the following subsections for consideration by RBC.

2.2.1 Heat pump technology

ASHP has been selected by Hodkinson as the primary low-carbon heat supply technology. The RBC Sustainable Design & Construction SPD, which supplements the Local Plan, states the following regarding heat pump technology selection:¹

Paragraph 8.5 (pp. 29):

“The preference for air-source and ground-source heat pumps over CHP is set out in the Local Plan, but in general GSHPs should be investigated as a priority over ASHPs. This is because they enable greater seasonal efficiencies.”

Paragraph 8.6 (pp. 29):

“Evidence should be provided at the detailed planning application stage where GSHP systems are discounted, and ASHP systems selected, with the following technical analyses:

- Calculated system seasonal efficiency comparison;
- Evidence of any constraints on boreholes related to existing utilities or other sub-surface infrastructure;
- Borehole spatial constraints; and
- Any other technical reasons why GSHP cannot be progressed and ASHP must be taken forward as the primary heat technology.”

¹ <https://www.reading.gov.uk/planning/planning-policy/>

Supporting evidence provided by Hodkinson, and whether this complies with the policy set out in the SPD excerpts above, is given in Table 1, with further details provided below the table.

Table 1 Evidence provided by Hodkinson for discounting GSHP

Sustainable Design & Construction SPD evidence	Evidence provided by Hodkinson	Policy pass (✓) / fail (✗)
Calculated system seasonal efficiency comparison	None.	✗
Evidence of any constraints on boreholes related to existing utilities or other sub-surface infrastructure	“Possible” contamination of ground due to brownfield site. No evidence provided to support this assertion.	✗
Borehole spatial constraints	Insufficient space on-site for closed-loop borehole GSHP system.	✓
Any other technical reasons why GSHP cannot be progressed and ASHP must be taken forward as the primary heat technology	Basic review of freely available British Geological Survey data that shows relatively shallow boreholes (30m or less) within the vicinity of the development.	✗

Calculated system seasonal efficiency comparison

The purpose of this policy requirement in the SPD is to ensure the difference in efficiencies between ASHP and GSHP systems is well understood by all parties, and that performances of proposed ASHP units are well-evidenced and optimised. This is due to the known inefficiencies associated with ASHPs in the heating season, which typically require supplementation by use of less efficient or higher-carbon systems (e.g. direct electric heating) in peak winter periods, as output temperatures from the heat pumps cannot always meet requirements in below-freezing conditions. This comparison has not been provided by Hodkinson. More on heat supplementation and top-up within the energy strategy is provided in section 2.2.2.

Evidence of any constraints on boreholes related to existing utilities or other sub-surface infrastructure

Hodkinson state that the development’s land could “potentially” be contaminated as it is a brownfield site, which would preclude boreholes being deployed here, however no formal evidence is provided. On submission of a query to the Applicant on this point by Element Energy (email correspondence, 24/02/2021), which included a request for details of the site ground investigations (that would have been submitted with the original planning application), the following response was received:

“The submitted ground investigation reports set out the constraints of the site and the remediation strategy which will need to be followed; our predominant concern [relating to the deployment boreholes] lies with the pathway between the source and the receptor.”

Whilst it is not clear what this response is referring to in relation to the ground investigations, this does not constitute sufficient evidence of site contamination, and further investigation is required to discount open-loop GSHP on this basis.

Borehole spatial constraints

Considering the peak heat demands of the Vastern Road site, it is acknowledged that insufficient space is available for the requisite number of boreholes needed for a closed-loop GSHP system to be deployed. It is therefore acceptable to discount closed-loop GSHP for the development.

Any other technical reasons why GSHP cannot be progressed and ASHP must be taken forward as the primary heat technology

It is highlighted by Hodkinson that there are no boreholes deeper than 30m in the immediate vicinity of the Vastern Road site, suggesting that this indicates there are no aquifers available for groundwater abstraction and reinjection for an open-loop GSHP system. The British Geological Survey (BGS) is cited as the key piece of evidence to support this.

Through Element Energy experience it should be noted that this open-source BGS data on boreholes is incomplete. The same BGS source does show deeper boreholes around Reading (up to 100m), however it is unclear from the information available what types of boreholes these are. Additionally, the lack of existing boreholes deeper than 30m does not discount the existence of aquifers beneath the Vastern Road site.

For Hodkinson and the Applicant to confirm the assertion that the BGS data suggests there are no available aquifers for groundwater abstraction, a non-intrusive desktop hydrogeological survey should be commissioned. These are typically quick and inexpensive analyses, and so should not impact budgets or programmes in a significant way. Should this demonstrate that no adequate aquifers are expected beneath the development, then open-loop GSHP can be discounted as a heat supply option and an ASHP approach can be selected. The evidence provided to date by Hodkinson regarding aquifers is not sufficient to discount open-loop GSHP.

The Applicant also state in a response to queries submitted by Element Energy (email correspondence, 24/02/2021), in relation to investigating further the potential for open-loop boreholes:

“The investigations being requested are a significant undertaking which may put the programme we are currently working to at risk and are considered inappropriate for a site of this size, especially when a policy compliant energy strategy with ASHPs has already been proposed, ensuring a deliverable strategy on site.”

Element Energy do not agree that an open-loop GSHP system for this scale of development is inappropriate (a 200+ residential unit development is an ideal context). Additionally, the equipment used for drilling of boreholes could be coupled with other works that are to be conducted on the site during construction, reducing programme risks as well as costs for borehole drilling. Planning officers at RBC must decide whether the risk of affecting the construction programme for Vastern Road is acceptable to the council’s aspirations for new developments reaching completion. It is incumbent on the Applicant to identify the potential construction programme risk impacts of open-loop GSHP.

Further considerations around open-loop GSHP

Further to email correspondence with the Applicant, the following were suggested as justifications for discounting open-loop GSHP:

“In addition, the GSHP option relies on an abstraction licence from the EA which is out of the control of Berkeley and could potentially leave residents exposed should the licence be revoked. Coupled with licensing, there is also the ongoing monitoring and reporting which would be required as part of this process and would be an incredibly onerous commitment for the residents of this site moving forwards given its relatively small size.”

Abstraction licences can be obtained at relatively low-cost from the Environment Agency (EA).² It is unclear from the Applicant’s response what the reasons for licence revocation entails, however it would be expected that these risks would be taken into consideration during system design, in liaison with the EA. It is incumbent on the Applicant to demonstrate what the “incredibly onerous commitment for the residents” would be for monitoring and reporting of compliance with the EA’s requirements on groundwater abstraction for open-loop GSHP purposes.

The reasons given above by the Applicant for discounting open-loop GSHP cannot be considered justified without further evidence on concerns around licences being revoked and costs or other impacts for residents relating to EA monitoring and reporting.

2.2.2 Use of gas boilers for top-up in a heat pump system

Hodkinson has designed the heat supply system as follows:

- Two-thirds of annual heat consumption to be generated by ASHPs;
- One-third of annual heat consumption to be generated by gas boilers.

The justification for this is the expected cost of heat to residents. It is well-understood that in peak heating season, ASHP efficiencies will drop and thus increase cost of supplying heat. To counteract this, the heat strategy relies on boilers to top up the ASHP heat, to ensure adequate temperatures and volumes of heat are met cost-effectively.

However, it is demonstrated by Hodkinson that the average cost difference for residents between the proposed strategy and an ASHP-only strategy is around ~£40/yr, or ~£3/month. This therefore does not justify on a cost of heat basis the reliance on gas boilers as part of the energy strategy. The use of open-loop GSHP would alleviate inefficiency concerns as its efficiency is not affected seasonally.

In addition, the use of gas boilers as part of the heat supply system under normal operating conditions is not considered best practice. The recommendations to ban gas boilers in new homes by 2025 in the Committee on Climate Change’s 2019 report “UK housing: Fit for the Future?” was adopted by the UK government as part of the Future Homes Standard. This has now become the Future Buildings Standard and is currently at consultation stage as part of updating the Building Regulations. The Vastern Road development would not be compliant with this national policy (based on proposals at the consultation stage), should

² <https://www.gov.uk/government/publications/scheme-of-abstraction-charges-2020-to-2021>

gas boilers be employed as part of the heating system, as it would not be “net zero-carbon ready” by 2025.

Furthermore, by the mid-2030s when the boilers are approaching the end of their useful life, replacement boilers are not expected to be allowed under new legislation proposed in the government’s recent “Powering our net zero future” energy white paper,³ thus there may be capital risk in adapting the heating system to accommodate more heat pump capacity (e.g. plant room modifications that would not be required were heat pumps present in the heating system from the outset). “Hydrogen-ready” boilers may provide a solution to avoid additional heat pump capacity, however the role-out of hydrogen and expected future cost of the fuel is highly uncertain and would likely be a limiting factor to this solution. The employment of gas boilers guarantees lock-in of fossil fuel use for Vastern Road for at least the next 10-15 years.

Deploying a fully-ASHP supplied heating system, therefore, is future-proofed against near- and medium-term changes to national net zero-carbon energy policy. Given Hodkinson have demonstrated similar annual heating costs for residents with a fully-ASHP heating system, the employment of gas boilers in the energy strategy is not valid.

³ <https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future>

3 Conclusions

The proposed Vastern Road energy strategy does not fully address all energy and carbon policy guidance within RBC's Sustainable Design & Construction SPD and is not future-proofed for incoming near- and medium-term national energy policy. The energy strategy does comply with Local Plan energy and carbon policies.

It is recommended that the Applicant complete the following to address the concerns regarding non-compliance with the policy guidance and future-proofing of the energy strategy:

- Provide evidence on open-loop GSHP to confirm justifications for discounting the technology are valid:
 - A site investigation to confirm the ground is contaminated to the extent that boreholes cannot be safely installed;
 - A desktop survey by a hydrogeological expert to demonstrate the lack of sufficient aquifer groundwater to satisfy the heat demands of the development;
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