

Heat Mapping and Energy Masterplanning of Heat Use across Worcestershire including a 'Pre-Feasibility' Study of Geothermal Potential in Offenham

Executive Summary

January 2017

For Wychavon District Council



Severn House
Lime Kiln Close
Stoke Gifford
Bristol
BS34 8SQ

T 0117 9062300

F 0117 9062301

Executive Summary

Wychavon District Council commissioned Mouchel to undertake a heat demand mapping and energy masterplanning study across Worcestershire, including a pre-feasibility study for a deep geothermal energy scheme in Offenham.

Heat demand mapping across Worcestershire included the identification of heat demand “hot spots”. These are areas with concentrated heat demand that have the potential for the development of a heat network which were then considered further as part of the energy masterplanning stage.

Prior to undertaking the detailed energy masterplanning, the identified heat demand “hot spots” were filtered to prioritise the detailed assessments. A range of available low-carbon energy sources have been assessed which could potentially supplement the currently preferred gas fired Combine Heat and Power (CHP) plants. CHP technology currently is a very common energy source for district heat schemes in the UK and is a very efficient form of generation of heat and electricity.

Additional detailed assessments were undertaken for the potential use of deep geothermal heat. The Worcester Basin, which underlies Worcestershire, is a geological structure offering significant, currently unexploited geothermal heat potential. The deep geothermal heat potential is relevant for proposed heat network schemes in southern Worcestershire, particularly for Worcestershire’s energy intense Agri-Tech sector. Numerous geothermal greenhouse schemes in the Netherlands have proved successful in using similar developments. The results of the pre-feasibility study for a geothermal scheme in Offenham show that heat network schemes are potentially viable in southern Worcestershire.

Table 1.1 summarises the identified heat demand “hot spot” areas that have the potential for the development of local heat networks. These areas are subdivided into corresponding town centre, deep geothermal (Offenham), development sites and other potential local heat networks.

Table 1.1: Identified potential Heat Network Schemes in Worcestershire

Type of site	Name	Size (annual MWh heat)	CAPEX (£M)	Payback (years)	Net Present Value £k (negative £k)	Internal rate of return (IRR)	Comments
Urban heat networks (assuming 30 years life cycle, base cases)	Bromsgrove:						A standalone scheme at Aston Fields is less likely to be financially viable. Worcester Rd. main looks most attractive.
	• Town Centre& NHS	18,200	3.1	23	18	3.5%	
	• Worcester Rd.	2,100	1.7	7	3,343	15.2%	
	• Aston Fields	11,100	2.8	25	(347)	2.8%	
	• Buntsford	10,800	2.3	22	347	4.3%	

Type of site	Name	Size (annual MWh heat)	CAPEX (£M)	Payback (years)	Net Present Value £k (negative £k)	Internal rate of return (IRR)	Comments
	Redditch: <ul style="list-style-type: none"> Northern NHS and Industrial 	123,000 268,000	11.9 19.6	23 21	176 2,833	3.6% 4.4%	The Redditch Eastern Gateway development offers additional opportunities on the Northern network to be explored when detail becomes available. Financial performance of the NHS & Industrial main can be improved through phasing but existing waste incinerator is to be considered.
	Kidderminster: <ul style="list-style-type: none"> Central; Southern 	63,000 56,000	7.9 6.5	23 21	21.3 956.4	3.5% 4.4%	Inclusion of planned and future developments (KEG) could significantly improve viability.
	City of Worcester: <ul style="list-style-type: none"> Northern and Industrial University and City Centre Southern / NHS 	30,500 30,000 22,000	5.5 6.6 4.3	20 22 21	1,268 25 509	4.8% 3.5% 4.2%	Opportunities related to linking networks to the development sites Worcester 6 and Worcester South should be considered.
Deep Geothermal (assuming 20 years life cycle)	Offenham	23,000	6.2	6	9,579	15.4%	Study suggests a range of different schemes could be viable: Offenham, Throckmorton, Worcester South, Pershore and Broadway.
Development sites	Worcester 6	N/A					Potential considered as part of the Worcester Northern network.
	Worcester South	N/A					Feasibility recommendations included under the deep geothermal schemes.
	Throckmorton	N/A					Feasibility work recommended under the deep geothermal scheme recommendations.

Type of site	Name	Size (annual MWh heat)	CAPEX (£M)	Payback (years)	Net Present Value £k (negative £k)	Internal rate of return (IRR)	Comments
	Hartlebury Estate			N/A			No specific feasibility work recommended but Council should encourage dialogue between Severn Waste and Wienerberger.
Other local heat networks	Pershore, Evesham, Great Malvern, Droitwich			N/A			Potential for smaller local heat networks exists.

Table 1.1 lists a wide range of heat network projects that have the potential for future development. In order to prioritise these projects further, the Council should focus feasibility studies on schemes that meet the following criteria:

- Majority of the initial energy customers are from public sector management or ownership;
- Where key stakeholders have already shown interest to develop or join a heat network;
- The potential for phasing and expansion is identified. Particular interest should focus on development sites; and
- Where opportunities for the involvement of renewable energy sources and electricity sales (private wire) exist.

Based on the technical and financial assessments undertaken in this study and considering the overall Council objectives, the following potential urban and geothermal heat networks are of specific interest and should be considered for the first round of feasibility work (see Tables 1.2, 1.3 and following bullet points).

Table 1.2: Recommendations for potential urban heat network schemes

Network Name	Size (annual MWh heat)	Estimated CAPEX (£M)	Annual CO ₂ saving (t pa)	Majority of heat demand in public sector	Private Wire potential	Phasing and development potential
Bromsgrove: (Worcester Road Industrial Estate network)	2,100	1.7	378	No	Yes	Yes
Redditch (NHS and Industrial network)	268,000	19.6	48,240	No	Yes	Yes
Worcester (Southern NHS network)	22,000	4.3	3,960	Yes	Yes	Yes
Worcester (University & City Centre) network	30,000	6.6	5,400	Yes	Yes	Yes

- Bromsgrove: The Worcester Road Industrial Estate scheme has good potential for the establishment of a local district heat network with a small energy centre. The close proximity heat demand profile promotes an ideal network arrangement. The NHS and Town Centre network has potential with good heat demand profiles however the distances between the demand clusters provides a more challenging aspect to delivering the scheme;
- Redditch: The NHS & Industrial main provides good scope for the establishment of a district heat network with the initial stage centred around the hospital targeting the new residential and employment development area close to the hospital as the catalyst to the new district heat network. Expansion to the existing industrial and commercial customers may follow post establishment. The Redditch Eastern Gateway development could offer significant opportunities to extend the proposed schemes and improve overall viability and may provide a potential location for an additional energy centre;
- Worcester:
 - The Southern district heat network has the energy centre located in the NHS Acute Hospital and around 80% of the identified heat requirement is from major public sector and school sites with the potential expansion into the mixed development area at the former DEFRA offices. The NHS hospital has a requirement for electricity

that could be provided by a private wire system from the on-site energy centre. The route does not have complex crossings of rivers or railways and follows public trackways or highways; and

- The University and City Centre district heat network is centred on the high heat demand of the St John's and Severn Campuses of the University of Worcester. The campuses also have a requirement for electricity that could be provided by a private wire system from the on-site energy centre. The proposed route uses existing crossings for the River Severn and main railway line.

Table 1.3: Recommendations for potential deep geothermal heat network schemes

Network location	Target heat customers	Particular drivers
Offenham	Greenhouses/Agri-Tech	Detailed work undertaken so far and existing high heating and cooling demands
Throckmorton	Agri-Tech/new developments	Existing nearby energy projects, future developments and available seismic data
Worcester South	New housing developments	Known geology from Kempsey borehole and potential example for other development sites and for the wider Worcester area
Pershire	Public sector	Located within area of highest deep geothermal heat potential
Broadway	Hotels/tourism	Alternative business case making use of the heat and the water itself

- Offenham: The pre-feasibility study demonstrated that significant potential for a deep geothermal scheme to supply the local Agri-Tech sector exists and stakeholder discussions have confirmed local interest. Particular advantage is the proximity of high heating and cooling demands;
- Throckmorton: The area around the Throckmorton airfield is already characterised by a diverse number of existing energy schemes (solar, anaerobic digestion, landfill gas) combined with high heat demand from large greenhouses and the potential development of the airfield itself. Detailed geological information are available from a number of deep seismic survey lines and Council ownership of landfill sites offer opportunities for an energy centre location. Throckmorton proves an ideal test area for combining (hybrid) renewable energy solutions;
- Worcester South: This large development site offers an ideal site for a detailed evaluation of a heat network scheme focusing on the comparison of a deep geothermal heat based scheme versus a conventional gas CHP scheme for a known or indicative development proposal. The historic Kempsey borehole and nearby deep seismic survey lines can be used to confirm the geological conditions in the area. A detailed feasibility study

could act as an example for other future development sites in Worcestershire;

- Pershore: A high concentration of public sector heating and electricity demand was identified in Pershore town centre, centred on the Council offices and the Community NHS Hospital that could make a small local heat network viable (micro network). Similar to Worcester South, feasibility work should focus on an evaluation of competitiveness between a conventional energy source (gas CHP) and a renewable source such as deep geothermal or specific heat pump applications using shallow groundwater or sewer heat. Pershore is located within an area that has the highest deep geothermal heat potential in Worcestershire; and
- Broadway: This touristic location in the Cotswolds offers a very different deep geothermal energy opportunity. Local hotels have not only a significant heating and hot water demand but some hotels also have spa facilities, i.e. the geothermal water itself has a significant value that could make a small heat/hot water network viable. The hydro-chemical properties of the water could also be of interest, offering hotels the possibility to broaden their offers to visitors.

This project provides a high-level review of the heat network opportunities in Worcestershire and is in main parts based on assumptions. Feasibility work should focus on gaining more detailed energy data (heating, cooling and electricity) and a better understanding of the heat customer's energy systems, contractual arrangements and potential refurbishment plans. Consideration of all of these factors will significantly improve the accuracy of the technical and financial evaluations and help to prioritise developments further.

Key risks of the next stage of work relate to the ability to engage with key stakeholders to make information available, allow access to their facilities and to show interest in joining a potential scheme. Highly variable energy prices, political priorities and changes of incentive schemes pose risks and opportunities that will need to be considered throughout the development process.