Appendix R – LZC Technology

A brief description of the identified main technologies is provided with a summary of the key pros and cons, particularly in the context of the site.

Table 1: Primary LZC Technology List

Technology	Description	Pros	Cons
Combined Heat and Power			
Gas CHP (Combined Heat and Power)	CHP or cogeneration refers to the simultaneous generation of heat and electricity from the same process. At commercial and residential scale, it is typically a gas fired combustion engine driving an electrical generator Because CHP is a form of decentralised energy system that uses the heat produced during the generation of electricity process, they can reach an overall generational efficiency in excess of 70% at the point of use. In contrast, the efficiency of a conventional coal-fired or gas-fired power station, which rejects this heat, is typically around 50%.	A mature and economically effective technology Revenue from sale of both Electricity & Heat When displacing marginal gas fired plant generates lower carbon electricity. Ability to set up private wire networks to commercial customers	Economic viability is heavily dependent on the revenue stream from the sale of generated electricity. Requirement for flue systems at the energy centre to exhaust combustion gases. Gas-fired CHP systems typically have higher NOx emissions than individual gas boilers and post combustion treatments (e.g. catalytic and non-catalytic abatement technologies) can be used (and will probably be required by planning) to ensure air quality is not significantly affected. Carbon savings will reduce over time as the grid decarbonises.
Heat Pumps			

Ground or Water Open Loop – Heat Pumps	Heat Pumps Operating on an Open Loop Principle draw water from either a large waterbody or below ground aquifer and pass the water across a heat exchanger before discharging the water. Efficiency is determined by the fluid temperature but can be in the region of a 2 to 3.5 CoP (Coefficient of Performance[1]).	Higher average coefficient of performance (COP) in relation to ASHP or Closed-Loop heat pumps. Able to generate both Heating and Cooling (but cooling less relevant to Wood Green). Coupled with large thermal storage able to generate heat at very low carbon emissions by running only during periods of high renewable input into the grid. Zero Emissions at point of heat generation	Requires an abstraction and reinjection license from the EA, in addition there are risks around coordination with Thames Water, as they are abstracting drinking water in the locality. This may impose restrictions on the temperature differential and maximum abstraction, limiting HP output. Potential for significant capital outlay to tap into low grade heat source. Economically challenging due to price difference between gas and electricity and end of RHI subsidies in 2021. While the New River runs on the west side of the Masterplan area, and there is a water treatment works on the west side of the railway, these are not identified as potential heat sources on the National Heat Map.
Ground or Water Closed Loop – Heat Pumps	A closed loop system extracts heat through the use of a secondary medium (called refrigerant. The refrigerant (e.g. glycol mix) is circulated around either a borehole array or a coil connected to the evaporator side of the heat pump. This can be laid in the ground or in water body.	Does not require licensing or permitting for extraction from water bodies. Similar benefits to an open loop heat pump, however the efficiencies tend to be slightly lower.	Significant space is required to capture low grade heat using a horizontal collector array. Due to limited space, vertical boreholes can be drilled instead; Barratt Gardens also known as Wood Green Common is located about 350 meters from the Clarendon Sq. Energy Centre and has an area available of approx. 1 hectare. The area is managed by the LBH. It is estimated that potentially 0.5-2 MW of heat could be extracted from this area by approx. 75 to 300 x 150m deep vertical boreholes. This dependent on the ground conditions and the extent of the gardens that could be bored into.

[1] Coefficient of Performance of a Heat Pump is a ratio of useful heating provided by the heat pump to work required i.e. the electricity consumed by the heat pump.

Air Source Heat Pumps (ASHP)	Air Source Heat Pumps (ASHPs) extract heat from the ambient air (or waste air), even when temperatures are as low as -5°C.	High CO2 reduction potential, as electricity grid decarbonises. Non-requirement for flue systems to exhaust combustion gases. Opportunities to utilise warmer air such as from TFL tube shafts (which can provide cooling to the tube).	Not always effective at providing heat during periods of exceptional cold weather (<0°C). Air is a diffuse source and so is less suitable for a centralised heating plant for DH. In order to absorb enough energy from the air the collector coil will need to be very large. Can create localised cooling spots if deployed in great capacity. Less efficient than GSHPs if using ambient air If using warm air (e.g. from tube), has higher performance but commercial arrangements and capital costs increase significantly. LU recently completed an opportunity assessment across all of the tube shafts in London and did not consider any in Wood Green to be viable in the short-term
Energy from Waste			
Waste Heat EfW (Energy from Waste)	Energy from Waste (EfW) is the process of generating energy from the primary treatment of household and municipal waste. Where there is residual waste (i.e. remaining waste that cannot be economically or practically reused or recycled),	High carbon savings potential. No requirement for any flue systems at energy centre (takes heat from existing process). Maintenance of the generation sits with the EfW operator	Requires a significant length of pipe to connect (Edmonton is 5km –from WG, 3km – from Tottenham Hale – Straight line distances) Needs a significant critical mass of connecting loads (and/or significant grant funding) before it becomes economically viable (significant critical mass may be available in near future in Haringey when coupled with grant funding to allow this but introduces dependencies).

Box 2. Technical Background– LZC Plant

The table outlines the at high level the key characteristics of each of the three main LZC options.

Technology	Description	Spatial Impact	CO_2 Savings (short Term)	CO_2 Savings (Long Term)	Air Quality Impact	Economic	Risk
CHP	CHP or cogeneration refers to the simultaneous generation of heat and electricity from a single process. CHP engines typically burn gas and as such require a gas supply and flue (exhaust). Electricity is either sold to the grid or local customers - typically commercial, via a private wire network.	Requires an acoustic enclosure, ventilation and flueing plant which can take significant space per kW of thermal output.	Whilst the electricity grid is decarbonising CHP is able to displace CCGT plant.	Once the electricity grid decarbonises past a certain point, the CHP has less opportunity to displace 'dirtier' technologies and offers no carbon saving.	CHP burns significant volumes of gas onsite, resulting in associated negative air quality impacts.	High capital and operational costs. Additional revenue stream from electrical sales, although without a private wire system this profitability of this is limited.	Due to the decarbonisation of the grid and proposed changes is building regulations, the use of CHP and the ability to remain attractive to new customers
Energy Recovery Facility	Energy from Waste (EfW) is the process of generating energy from the primary treatment of household and municipal waste. Waste is incinerated and the heat used to drive steam turbines. A small proportion of steam may be tapped off at the turbine at a lower temperature, to obtain heat to distribute around the heat network.	Least spatial requirement needed, as heat generation is offsite.	Low carbon factor due to carbon impact only due to electricity output reduced by steam turbine.	Low carbon factor due to carbon impact only due to electricity output reduced by steam turbine.	From a local (to the heat network) perspective there is no air quality impact from EfW	Given the cost of heat remains low (1-2p/kWh, + standing charges), significant margin can be made on the sale of heat.	Significant commercial and technical dependencies on a 3rd party supplying heat.
Heat Pumps	A heat pump uses the principles of the refrigeration cycle in reverse to raise the temperature of low-grade heat source to a useful temperature. Heat Pumps are powered predominately on electricity and have efficiencies or CoP (coefficients of performance) in the region of 250%-350% depending on the temperatures in and out of the unit.	Requires additional external space in addition to external to capture low grade heat	Whilst the electricity grid is decarbonising there are periods Heat Pumps will operate during periods of predominantly 'fossil fuel-based generation	As the electricity grid continues to decarbonise, heat pumps will run off a increasingly large proportion of renewable energy.	Heat pumps use electricity which has no air quality impact at the point of use.	Due to the spark gap (cost difference between electricity and gas). Heat pump is costly to run.	Depending on the low-grade heat source there are risks around licensing and approvals for abstracting the low-grade heat from ground water or waste heat flow.

Box 3. Technical Background - Private Wire and CHP Carbon Savings

Private Wire

Private wire networks - also known as behind the meter generation - result in the avoidance of several costs associated with using the public distribution and transmission grid as electricity is generated locally and sold directly via the private wire. The avoided costs therefore include those related to low-carbon subsidy programmes. While this is economically advantageous for the private wire customers, particularly because these costs are forecasted to increase over time, this can potentially result in an unintended negative consequence for the public, which would need to compensate for any potential loss in income dedicated to the low-carbon subsidy programme. As well as transferring the cost for decarbonisation of the grid to the public, the private wire system also financially incentivises the operator to run the CHP system even when the supply from the grid is 'green' (i.e. electricity is generated by mostly renewable sources) to maximise the revenues of the scheme through electricity sales.

CHP Carbon Savings

The environmental benefits of gas-CHP arise when the carbon intensity of grid electricity is higher than that generated from the CHP itself. However as more and more renewables are deployed and the grid decarbonises further, the periods in which this benefit occurs is reduced.

This erodes CHP's long-term carbon saving potential and conflicts with a long term zero-carbon strategy. However, in the short term - whilst there is still marginal gas fired plant (CCGT) supplying baseload electricity to the grid there is still a carbon benefit to deploying CHP