Sustainable heating for your home –

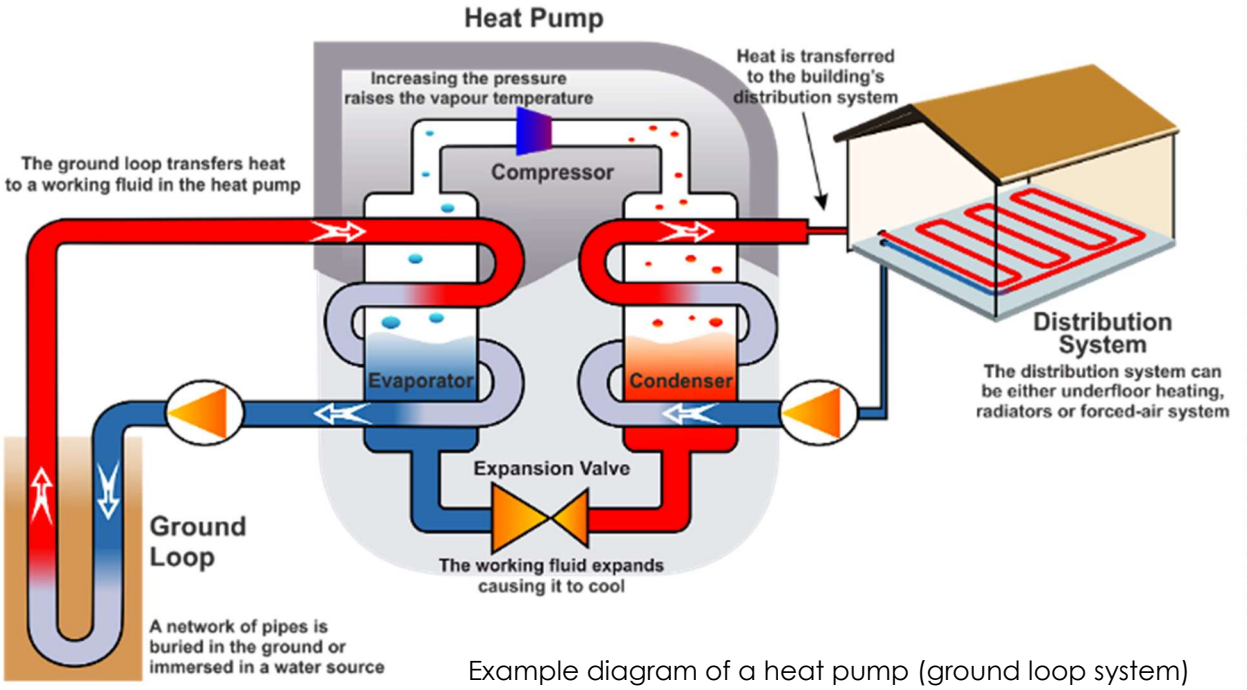
d) heat pumps

Sustainable heating has a number of technological solutions, which will not all be of equal interest to every householder. This factsheet deals specifically with heat pumps. Other parts are:

a) Introduction to current and developing technologies
b) Liquid fuel replacements
c) Log-gasification and wood pellet boilers
e) Electric boilers and electric heating

❖ How heat pumps work

- Heat pumps work like refrigerators in reverse. They extract heat from outside, and then through a series of pumps and compressors, the heat energy from a low temperature source is upgraded to useful heat for warming buildings.
- Domestic heat pumps normally get their energy from one of two sources – from the ground (ground source heat pump or GSHP) or from the air (air source heat pump or ASHP).



Example diagram of a heat pump (ground loop system)
Reproduced from Greenmatch:
https://www.greenmatch.co.uk/blog/2016/01/how-a-ground-source-heat-pump-works

The Rural Community Energy Fund

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❖ Heat pump costs and efficiency

- Subsidy payments are available for air and ground source heat pumps (10.92p/kWh and 21.29p/kWh respectively) through the Renewable Heat Incentive (RHI) scheme (see Part a of this factsheet for more details).
- Air source systems take their warmth from the outside air and can work at air temperatures as low as -15°C. Typical installation costs are £9,000 to £11,000 [1].
- Ground source systems need a buried heat coil under a garden or field, and extract heat from the earth. They cost more, typically £14,000 to £19,000 [4] for a domestic system fully installed. GSHPs are more efficient due to the constant sub-surface temperature and are cheaper to run.
- GSHP systems typically supply water-based radiator systems, while ASHP systems can provide air to water or air to air heating.

Typical GSHP internal installation (left) and ASHP external unit (right)
Reproduced from https://www.cse.org.uk/

- Given the high installation costs, a vital factor is the efficiency and how this translates into running costs. Heat pumps are more cost-efficient than fully electric alternatives, as they multiply the heat output from each kWh of electricity. The efficiency of heat pumps is measured by the Coefficient of Performance (COP). A COP of 3 means three times more heat is produced than is consumed in electricity.

[1] Energy Saving Trust, https://energysavingtrust.org.uk/

- To be able to run a heat pump system cost effectively at normal daytime electricity rates (16p/kWh typically) you would need to make sure you get at least three times the heat out of the system that you put in – so each kWh of heating costs a little over 5p.
- GSHP systems are the most efficient, as the ground temperature at depths of 1 metre or below is relatively stable. A COP of 4 should be possible.
- For ASHPs, a COP of around 3 is more typical. Heat efficiency varies with air temperature and the COP falls as outside temperatures drop.
- Humidity levels also affect the COP of ASHPs. They perform better in more humid air than in dry air, as saturated air carries more energy. Likewise, GSHP ground coils are best laid beneath a garden or open ground with free drainage, rather than under a car park where water cannot drain through the soil, as dry soils hold less energy.

❖ Additional practical considerations

- Heat pump efficiency declines as the gap between input and output temperature grows. To maximise efficiency (ASHP and GSHP), an output temperature of 35°C is optimal but most existing domestic heating systems operate at 60°C at least, which would generally mean that the COP is lower.
- To address this, it is common to replace existing radiators with larger versions. This enables you to operate the system at a lower circulation temperature while still getting the right amount of heating into you home. However, it also increases the installation costs. Space for the larger radiators may be a problem as well.
- Heat pumps work well with underfloor heating, with a large area of warm surface rather than relying on smaller higher temperature radiators (see Factsheet No. 1, What Makes a Home Warm). This is unlikely to be practical except for new builds or major refurbishment involving floor removal.
- Heat pumps are also typically slower working systems than oil boilers. They function best when operating over longer periods, building up and then maintaining a good working temperature.
- This means that they are better suited to well insulated properties that can retain warmth, allowing the heat pumps to operate at their most efficient setting.
- Finally, heat pumps can work very well with an additional thermal heat store, where the heat pump heats a buffer tank first, which then provides the home heating output. This can enable heat pumps to operate overnight, at cheaper rate electricity, but it does mean that you need greater internal space to store all the equipment.

- Overall, heat pumps are generally seen as effective options for new developments. It is unlikely that retro fitting heat pumps to many existing properties within Barningham would prove feasible or cost effective. However, there may be individual cases were this is possible, and expert advice on a case-by-case basis should be sought.

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