Community Energy London

# Air source heat pump guidance

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June 2021

# Acknowledgements

I would like to express my deepest gratitude to the following people and community energy groups for their contributions and advice that have helped make this guidance what it is. These include:

Toby Costin (CREW Energy)

Giovanna Speciale (SELCE)

Mike Smyth (Schools Energy Co-op)

Alan Jones (SE24)

Dave Fuller (Repowering)

Rokiah Yaman (LEAP Micro AD)

Sydney Charles (En10ergy)

Tanuja Pandit and Martin Narraway (PUNL)

Thanks also goes to Syed Ahmed and Jamie Baxter. And I had great pleasure working with my fellow Project Officers.

Should groups have any comments on this guidance they should email directors@communityenergy.london

## Contents

## 1. Introduction

This guidance is for community energy groups looking to deliver an air source heat pump (ASHP) project in London. It should be read in conjunction with the Step by Step Project Guide found on the CEL website, which sets out the various stages to delivering a project from start to finish.

This ASHP guidance is full of information, tips, and tools groups can use to help them progress their projects. This guidance is not exhaustive but should give groups a good basis for their projects.

A list of contractors that groups have worked with before can also be found on the CEL website, to help groups when procuring various services.

Heat pumps are the primary technology choice for decarbonising heat in existing London buildings. ASHPs are the most common type of heat pump installed in London, and for this reason this guidance focuses on this technology.

### 1.1 Financial return

Heat pumps have been supported through government subsidy mechanisms for some time, but the next few years will see a change in these policies. The Domestic Renewable Heat Incentive (RHI) is available until March 2022, however the Non-domestic RHI has now ended. A new Clean Heat Grant programme is due to start in April 2022 for domestic and small non-domestic installations with a capacity of up to 45kW, replacing the Domestic RHI. This places larger heat pump projects under considerable uncertainty however, groups may be exploring opportunities for sub 45kW systems, which should allow them to access the Clean Homes Grant.

Regarding larger heat pump projects, heat pump costs and installation costs are expected to fall as a result of the government's future plans for heat pump roll out. Furthermore, should groups be able to secure grant funding towards the capital cost of installing a heat pump, and should they be installed alongside thermal stores, then projects can become more financially viable.

Some groups have chosen to take on more of a project management role where site owners directly fund the installation of the ASHP and groups manage the install. Alternatively, on residential projects groups can work with residents supporting the uptake of ASHPs in homes and assisting as required.

Where groups do raise finance to fund all or part of a project, or where they manage the operations and maintenance of an ASHP system, they may be paid back through the energy bill savings achieved by the site owner.

Groups will need to decide at the start, what kind of ASHP project they want to deliver.

When considering site suitability for an ASHP, groups should consider: leisure centres/gyms, schools and universities, care homes, warehouses, offices, hotels, supermarkets and retailers, places of worship, GP practices and so on. Site suitability is covered further in section 3.

## 2. About ASHPs

ASHPs absorb heat from the outside air to heat a building's space and hot water. ASHPs need electricity to run, however the heat output is greater than the electricity input.

The advantages of installing an ASHP:

- There is the potential to reduce the overall heating bills for a building.
- There may be some financial return for the group.
- Reduce building's carbon emissions.
- ASHPS have a long life - typically around 15 - 20 years.
- ASHPs are low maintenance.
- They can create a comfortable atmosphere/ keep the building at a stable temperature. ASHPs can provide cooling, as well as heating.

The disadvantages:

- At present, ASHPs have a higher upfront cost compared to gas boilers.
- They require major energy efficiency improvements alongside the ASHP installation.
- They may not always be compatible with the existing heating system, radiators in some rooms may require upgrading to provide necessary comfort for example.
- Although ASHPs are a fairly mature technology in some countries, in the UK they are still poorly understood. It can therefore be challenging finding skilled and knowledgeable installers.
- Noise - A typical unit emits 54 dB(A), although this falls to 41 bB(A) at a distance of two metres away.
- Seasonal fluctuations - an ASHP's efficiency can fall as the temperature gets colder.

Groups are encouraged to read this guidance in full to fully understand the complexities around making an ASHP project viable, and generating some financial return.

## 3. Suitable sites

ASHPs work best in buildings:

- That are well insulated. Such buildings are able to be heated by lower temperatures, increasing ASHP efficiency. These buildings also retain heat for longer, and reduce the size of the ASHP needed and hence the capital cost of the project.

- Off the gas grid, although they can replace oil, gas or electric heating. Savings from replacing oil or electric heating will most likely be the greatest, making the ASHP more economically viable, although sites with gas central heating can still make a saving where the heat pump is a certain efficiency (around 325%, where the boiler being replaced is 85% efficient). It is unlikely in London that buildings will be off the gas grid.
- With high cooling demand (if the chosen ASHP does cooling as well).
- That have aging communal and district heating systems which need to be upgraded.
- Where major building refurbishments are taking place. By combining the ASHP installation with the wider building and heating system upgrades it can make the financial case more attractive.

ASHPs further need to be:

- Fitted to an outside wall or placed on the ground with plenty of space around the unit and a good flow of air.
- Paired with underfloor heating systems or 'oversized' radiators.

Once you have found a suitable building, talk to the site owners to understand:

- Who owns the grounds/building?
- How much are the current energy bills and what is the current fuel type?
- The heat demand profile of the building and if there is a valid Display Energy Certificate (DEC) or Energy Performance Certificate (EPC).
- Has such a project been tried before? Are there any existing feasibility studies to build on?
- Is there support for the project from the organisation's Board/ Director or similar?
- Are there any access difficulties now or in the coming years?
- Are there any other obvious crucial barriers e.g. land/building lease restrictions?

In addition, groups might need to consider:

- The visual and noise impact of ASHPs on building users, although these can be subjective.
- If there are opportunities for other renewable electricity generation assets onsite e.g. solar PV, that could help power the ASHP and reduce $CO_2$ emissions further.

Once you have found a site you will need to secure it. A key challenge includes the complexity and costs associated with putting in place such a legal agreement, which involves risk for the site owner over a period of many years. Pure Leapfrog explains the various legal documents that might be required.

Site owners/ managers will need to set aside time for site meetings and visits, they should be made aware of this in advance and be happy to do so.

### Additional support:

- Check out Forum for the Future's tool 'Power Paired' to identify potential interested sites, or contact your local council for an idea of what buildings might be attainable and likely to get planning permission.
- EPCs can be found registered here, and the GLA's London Building Stock Model may provide further energy and carbon data.

## 4. Feasibility

When finding a suitable site, groups will need to complete an initial feasibility study to work out project costs, as well as an idea of how much energy a system will produce and the savings that could be made.

Once a site is found and secured, then a full feasibility study will usually need to be undertaken before applying for planning and securing capital funding.

An installer or project developer can help groups with feasibility studies. It is important that ASHP systems are designed correctly, in order that the system purchased is as efficient as possible and the costs of both installing and running the system are correctly anticipated. The electricity running costs to operate the ASHP will be dependent on the size of the building, how well insulated it is and what room temperatures need to be achieved.

Groups will need to understand all costs and potential income to determine if the ASHP project is viable. Create a balance sheet of costs and income, including the repayment of loans if secured.

**Costs:** Make sure these are as accurate as possible. Include the cost of: community consultation, project development, planning, grid connection, the equipment and installation, civil works such as increasing the size of plant rooms, commissioning, ongoing running costs, and maintenance and operational costs such as ground rent, insurance, and community fund payments (if applicable) and any other costs incurred. Groups can find out more about the different types of insurance for community energy projects here.

The average installed cost for an ASHP is between £900 and £2,900 per kW, according to this report from The Carbon Trust. ASHPs of the same type and size can still vary substantially in terms of efficiency, build quality, applications, features, noise and aesthetics.

Equipment and installation costs can also include: other energy efficiency measures (these may be significant), buffer tanks, new heat emitters (radiators or underfloor heating), heating and smart controls, metering, costs associated with any changes to the electricity connection or a new distribution board, and thermal stores.

There may also be a cost to disconnecting from the gas supply.

**Income:** A well designed high efficiency ASHP system should provide energy savings for the site owner. The site owner should also ensure that the building is on the most competitive electricity tariff or a time of use tariff, to minimise ASHP running costs.

Additionally, if the ASHP is replacing all of the gas heating, then the site owner will no longer need to pay a gas standing charge, and the site owner will no longer need to pay for maintenance of the gas boiler.

Anecdotally, where the feasibility study indicates a possible annual fuel saving of less than 20% and the consumer's main objective is financial benefit, then the proposal may not be viable. If at this stage the project looks unviable it must be stopped or re-designed to reduce cost or boost savings. However, the group or site owner's motivation might differ from this.

**Additional support:**

- The feasibility stage of the project will likely require funding. The London Community Energy Fund may be able to cover this.
- CREW Energy and many of the more established groups have financial and feasibility models for heat pumps that they would be happy to talk about, or possibly share. Find details of groups on the CEL website.

## 5. Planning

The installation of an ASHP falls under permitted development rights for domestic properties or a block of flats. Permitted developments will still need to observe a number of conditions and limits, as set out on the Planning Portal website. Where an installation falls outside of this criteria, planning permission will need to be obtained.

Listed buildings, historic buildings or buildings in designated areas such as Sites of Special Scientific Interest (SSSI), Areas of Outstanding Natural Beauty (AONB) and National Parks are likely to have planning restrictions associated with them. Development in these areas will require additional consultation and will likely require more detailed background information to be supplied as part of the planning process.

Some London planning authorities have published Planning Policy Guidance on renewable energy systems, which may cover heat pumps. Such guidance, if it is in place, should be checked ahead of any feasibility study and planning application. In addition, many planning departments welcome early informal discussions.

If other ASHP projects have been proposed, or built in the area, the local authority website will contain details of the planning application, and any objections or restrictions. This can be a valuable source of information and can help to identify where there may be serious planning barriers and the basis for this.

Check if any plans or drawings of the building already exist. It may be useful to have the site plan, elevations, and possibly pictures of the local area. For historic buildings it may be necessary to write about the history of the building, its significance and the impact of an ASHP and how the introduction of the ASHP will improve the thermal efficiency of the building.

If planning is rejected, consider if it is worth appealing.

## 6. Grid connection:

When installing an ASHP, an installer may need to apply for a connection with the Distribution Network Operator (DNO) prior to installation of the device. The DNO may want to check if the electrical connection is sufficient, and if not, will determine what the costs and timescales associated with upgrading the supply to the building will be.

Systems over 15kW may require a three phase electrical supply.

Depending on the project's location, groups can book an appointment with UKPN to discuss grid connection here, or find guidance from SSEN on this here.

## 7. Operations and maintenance

Usually the group will be responsible for the operation and maintenance of the ASHP for the length of time agreed in legal documents.

**Monitoring:** Groups must have electricity meters installed with ASHPs to monitor the electricity used to power the system, as well as heat meters to monitor how much energy is generated.

Many manufacturers have also developed systems to monitor the operation of an ASHP, helping site owners understand how to most effectively use their system and detect any problems. If the output of the ASHP is low or if electricity bills suddenly become very high for example, then there may be an issue.

Regular monitoring of the effectiveness of the ASHP may be required to ensure the system is achieving its desired impact. Some level of monitoring may also be required by your funder. CEL's Monitoring and Evaluation Toolbox, found on its website, can help groups further on this aspect.

**Finances:** The group should make sure they apply for any applicable support mechanisms by any associated deadlines.

Proper management may well need to be in place for the lifetime of a project to oversee spending and the process of collecting and distributing income, and managing liabilities as applicable.

**Maintenance:** Ensure there is adequate space around the ASHP so that it can be easily accessed for maintenance, servicing, adjusting set points, time settings and/or flow valves, and reading meters.

Groups can carry out their own maintenance annually to some degree, by checking that grills and evaporators are free of leaves and other debris, and removing nearby plants.

Alternatively, groups may decide to put a maintenance agreement in place with an installer.

Moving parts such as the compressor can become worn out over time. Check warranties before replacing parts.

### Additional support:

- Wrike, and even Google and Trello, can be used for project management.
- Xero and Quickbooks can be used for accounting.
- CREW Energy has a template heat pump agreement covering maintenance and is happy to be contacted to discuss this.

## 8. Decommissioning

The project should set aside income to build up a fund to cover decommissioning costs. Certain heat pumps contain refrigerant gases which are covered by F Gas regulations which govern how a heat pump must be disposed of. Some of the other equipment may have a scrap value.

## 9. Equipment explained

ASHPs work best with low temperature heating systems (typically 35-40°C), such as underfloor heating or large radiators, and are designed to work more or less constantly.

A group might also choose to install a thermal store alongside an ASHP. A thermal store (hot water storage) holds excess heat to be used at times when it is required. Thermal stores can also help prevent heat pumps cycling on and off when heat demand is low and occasional, reducing running costs and maintaining the life span of the ASHP.

ASHPs can run alongside other heating sources (gas, oil or electricity) as part of a bivalent system or a hybrid system. This helps the heating system cope with times of very cold weather, however means there is still an element of a fossil fuel heating system being used. Electric immersion heating is normally used as a top-up for hot water anyway.

ASHPs can also be paired with solar thermal systems to heat the water, and/ or solar PV to generate the electricity used to run a heat pump.

## 9.1 Heating controls

By installing and using heat controls alongside an ASHP the end user can use the heat in the most effective way for them. These include: thermostatic radiator valves (TRVs), programmers, weather compensators, optimised or smart controls, hot water controls and smart meters.

Smart tariffs are linked to smart controls whereby the operation of the ASHP is influenced by the ‘spot’ price for the fuel or possibly another metric such as demand on the grid at the time. In this way, ASHPs can be used to produce heat at the cheapest times and the heat can be stored for when it is required, increasing savings further.

## 9.2 Terms explained

The heat-load profile of a building should be well understood before detailed design of an ASHP is undertaken. This involves understanding the total amount of heat or fuel used in the building throughout the year, and how this is spread over the course of a day, week or month. To avoid unnecessary capital costs, the ASHP should not be under or oversized for the building. This will be worked out by the installer before installation using analytical software, historic energy bills, smart meter readings and temperature sensors. Groups might see the following terms used as part of an ASHP’s design or performance estimate, and it is helpful to understand what these mean or how they are worked out.

**Peak heat load:** This is measured in kW and determines what size ASHP is required to heat the building. It is determined by calculating the heating requirement of the building at an agreed external design temperature. This temperature must be specific to the site.

**Total heat load for the year:** This is measured in kW and worked out from fuel bills.

**Coefficient of Performance (COP):** This is the efficiency of a heat pump, found by dividing the useful heat output by the energy input. The COP should be as high as possible with 5 being exceptionally good. A higher COP will be more expensive in the first instance but cheaper overall.

**Seasonal Performance Factor (SPF):** This is the performance of an ASHP, found by taking the total heat load over a year and dividing this by the total electrical input. An SPF of 3 indicates that the system will give an average of three units of heat energy for every one unit of electricity used. An ASHP should have an SPF of at least 2.5.

If the system is set up so that the temperature of water circulating through the ASHP is as low as possible, but still giving adequate heat output to the room, then the end user should be getting good 'fuel economy.'

## 10. Case studies and advice for different types of buildings

### 10.1 Schools case study

**Montessori school, nr Lewes:** BHESCo installed several renewable energy technologies and energy efficiency measures, including a 7kW ASHP, at this Montessori school near Lewes.

The building was previously reliant upon Liquid Petroleum Gas (LPG) to provide heating and hot water. To identify the most cost-effective and suitable solution for the energy needs of the school a survey was completed. The data collected was analysed to calculate the anticipated annual energy demand of the school, and the reduction in energy demand expected from installing different technologies.

The energy efficiency measures installed meant an immediate cost savings to the school. A portion of these savings is now used to repay the initial cost of the ASHP project on a monthly basis, plus an additional 5% which is passed on to shareholders as annual interest. After the upfront cost is repaid in its entirety, the school will become the owner of the equipment and will be able to enjoy 100% of the savings for its remaining operational lifetime. Lifetime financial savings: £49,260. Lifetime $CO_2$ savings: 1,191 tonnes.

### Advice for projects on schools

- Installing an ASHP at a school can be a great way to engage school children and parents in learning about energy and climate change, support environmental behaviour change and can be tied into the curriculum.
- Different types of schools often need a different approach of engagement and decision-making. It can sometimes be easier to get an agreement from Academies rather than council-maintained schools, due to the levels of 'sign off' required.

Councils should have a strong motivation to decarbonise school buildings, as schools typically contribute a significant element of their overall estate carbon-impact.
- Working with faith schools has proved very challenging in terms of sign off from the diocese, which can take months and even years.
- Consider when you can get access for the installation. You may only be able to carry out work on site after 4pm or in school holidays. It can be a long process in organising work-on-site with health and safety a particularly critical issue.
- Schools will not use as much energy out of school hours, you will have to make assumptions on energy consumption for these times when working out project feasibility.

### 10.2 Community buildings case study

**The Unity Centre, Lewes**: At the earliest stages of development of this centre, BHESCo were engaged to design a low carbon heating and ventilation system for the building. To assist with this, BHESCo commissioned a heat load survey, following which BHESCo installed a 22kW ASHP with underfloor heating and LEDs. Funding was obtained through grants, donations and community finance. BHESCO also entered into a 10 year contract to maintain the system. Once the loan agreement has been paid in full, all associated equipment and any income will be transferred to The Unity Centre. Annual savings: £1,731. Annual $CO_2$ savings: 3.4 tonnes.

### Advice for community buildings and civic centres

- Ownership and decision making can be tied up with the local Council. Site managers can be very cautious.
- Understand early on when work can be carried out. These buildings are very busy with multiple users, so planning is key.
- Community sites sometimes require multiple layers of consent and those involved may need education on the benefits of ASHPs.
- Try to find someone on the client side who is keen and committed to the decarbonisation agenda and who will help to drive the project forward and get approvals internally (an internal champion).

### Additional support

- The CEL map shows all community energy groups' projects in London.
- The Options Appraisals report from Carbon Trust provides a number of case studies on heat pumps installations. Case studies 14 and 15 are particularly excellent examples of the kinds of projects groups might encounter, and include brilliant summaries of costs and figures.

## 11. Further resources

- CARES Toolkit although a little out of date is still a good resource for groups
- Resources from the Centre of Sustainable Energy
- High granularity projections for low carbon technology uptake - electric vehicle, heat pumps and solar PV, publication by Regen
- Resources from the Heat Pump Association and the Heat Pump Federation
- Heat pump retrofit in London report from Carbon Trust
- Best practice guide to domestic heat pumps from MCS and RECC
- The Public Sector Decarbonisation Scheme provides grants for public sector bodies and schools to fund heat decarbonisation and energy efficiency measures. Groups can assist and encourage organisations to apply. The scheme is currently closed, but may open again in future.

## 12. Version control

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| **Date of issue** | 23.06.2021 | | | |
| **Author** | L Haskell | | | |
| **Version no** | 1.0 | | | |
| **Amends** | N/A | | | |