By Rachel Feeney, Energy Manager at Erda Energy

Energy Efficiency in Ground Source Heating

Achieving our Net Zero goals heavily relies on energy efficiency. While installing innovative renewable and low-carbon technologies is essential, ensuring their efficient operation is equally crucial. Ground source heat pump (GSHP) systems can often be challenging to operate in the first few years after commissioning. Even with the right resources and expertise, these systems may encounter energy "drifts" if not looked after properly through ongoing monitoring and preventative maintenance.

In my time at Erda, we've developed and implemented numerous energy saving strategies for our systems. Regardless of a great design and installation, the system's success relies on effective operation. Without it, the system won't fulfil the targets set during the design phase.

Below, I will introduce a range of energy savings strategies that should be considered for all GSHP systems.

The most common energy efficiency opportunity

Increasing the efficiency or Coefficient of Performance (CoP) applies universally to any energy system. In the context of GSHP systems, CoP represents the ratio of useful heat energy generated to the electrical energy consumed. CoP can be calculated as system CoP or Heat Pump (HP) CoP. System CoP encompasses various components within the system, such as circulation pumps or other system elements. In contrast, HP CoP is calculated using the electrical energy used by the HP and the unit's thermal output.

Typically, the CoP for a GSHP system falls within the range of 3.0-4.0, although it can vary significantly. To increase the CoP, consider strategies to raise the temperature of the ground. This will lessen the amount of work needed from the HP and thus help increase the CoP. By putting more heat back in to the ground in the summer months, the system can be better prepared entering the heating system and should reduce the workload of the HPs. Finding a beneficial thermal balance with the ground can greatly improve the efficiency of the system.

The no cost energy efficiency opportunity

Unfortunately, everything has a cost associated with it. However, one of the easiest ways to increase the efficiency of a HP system is to adjust the setpoints. For a Domestic Hot Water (DHW) cylinder, maintaining a temperature range of approximately 55°-60°C is recommended. Even a slight increase in this setpoint can lead to increased energy use. The reasoning behind this is that the higher the temperature threshold, the more strenuously the HP must work to maintain that temperature, leading to increased energy usage. It seems like common sense that setpoints would be set to the appropriate temperatures, however there's nothing that should be overlooked when it comes to the efficiency of a system.

The same goes for adjusting the dead-band on the system. If the system is set to maintain a temperature of 55°C, with a 1°C dead-band on either side, the HP unit would need to start up frequently to maintain the setpoint. Widening the dead-band to 3°C would result in the unit running less frequently in the inefficient operation zone of the compressor, potentially resulting in decreased energy consumption. Every aspect, even minor adjustments, can play a crucial role in optimising overall system efficiency.

The low cost/most surprising energy efficiency opportunity

Implementing energy savings strategies can be quite expensive, due to the cost and time it takes to develop and implement software / patches. However, there are simpler and more cost-effective approaches to enhance system efficiency.

One strategy involves adjusting setpoints based on the seasons. This may include a site visit for a manual change or for more advanced systems, by remotely modifying the system settings. The warm-up time for a building depends on its thermal properties, including factors like insulation, size, and solar gain. Achieving thermal comfort with a desired inside air temperature of 19°C can be accomplished by adjusting the flow temperature based on seasonal variations. For instance, a flow temperature of 40°C during winter and 35°C in spring may comfortably maintain the desired indoor temperature. Making these subtle adjustments, instead of having the system operate at a constant 45°C, not only enhances the system's efficiency but also leads to cost savings.

To even further enhance the system's efficiency, one can implement an advanced building warm-up and night setback strategy. Many Building Management Systems (BMS) are initially configured for gas boiler systems, allocating a standard 2-hour warm-up period before occupants enter for the day. However, a more adaptive approach involves monitoring the Outdoor Air Temperature (OAT) a few hours prior to the morning warm-up. For example, if the OAT is below 0°C, indicating a need for maximum warm up time, the system can be programmed accordingly so that the occupants' thermal comfort is met by the time they enter the building space. Alternatively, on mild days, buildings might only need a fraction of the time to reach desired setpoint and can eliminate that extra energy used in the morning that the system would use to maintain the setpoint. This is where I've seen a substantial amount of savings which far exceeded predicted savings especially during the milder months of the year when the systems require less time to warm the building.

You can also implement a similar energy saving strategy at the end of the day when returning the system to night setback mode. If the building time has 2 hours left in its opening time on a mild day, then it may be safe for the building to transition to a setback mode. This approach optimises energy usage while continually meeting the buildings' thermal needs.

The most overlooked energy efficiency opportunity

While parasitic power tends to equate to a small portion of the overall energy consumption of a GSHP system, reducing it can enhance the system's efficiency even further. It's not uncommon to encounter systems where parasitic power accounts for more than 5% of the total energy usage. Ideally, a well-managed GSHP system should aim for a parasitic load representing approximately 2-3% of its total energy consumption. Is there a reason why the main power supply to the plantroom has crept up over the last few years? Is someone leaving lights on or drawing power in other capacities? Even the slightest energy-saving measures contribute positively, so it's crucial not to overlook the small energy loads.

Top tip

Get creative! If there's an idea you have that may save energy, don't hesitate to explore it! Even small savings add up over time so continue to implement and revise the system but always make sure it can revert back to a safe operating mode if needed. Recognise that each system is unique, responding in its own way to energy-saving strategies. Building characteristics vary from site to site, so test, try again and repeat until the system's efficiency begins to improve.

To close, it's not too late to turn a system around. Any underperforming GSHP system simply needs a plan in place to improve its efficiency. While the journey towards improvement may take some time, I am excited to watch systems improve in the years to come.

Author's Profile:

Rachel has been working for Erda Energy, a geo-exchange solutions company, since 2018 and is currently employed as an Energy Manager. Rachel has a passion for the environment and helping clients get closer to their Net Zero goals. She lives in London and loves trail running in the Surrey Hills.

By Kiro Tamer, Director at Keenos Energy and Environmental Services Limited (KEES)

Energy Efficiency in Air Source Heat Pumps

INTRODUCTION

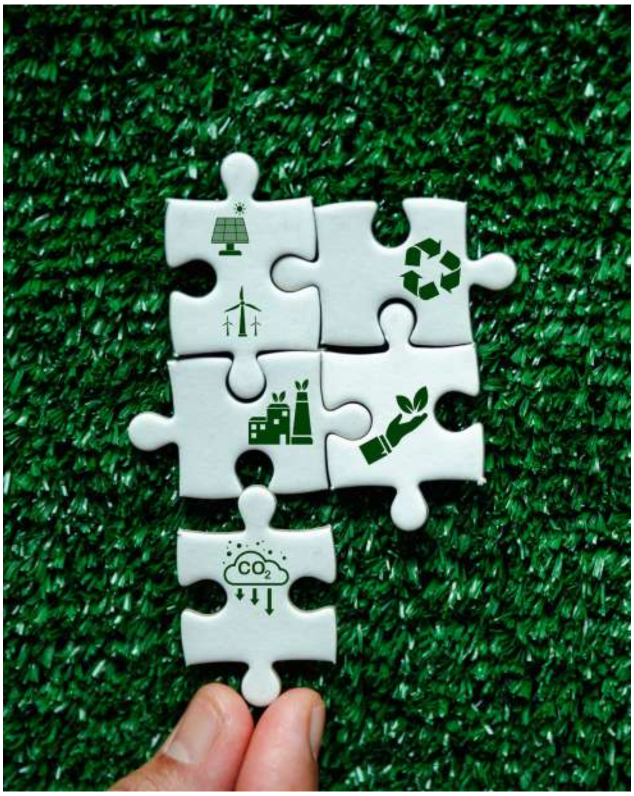
Non-residential buildings remain a significant challenge in the UK's journey to net zero, currently ranking as the ninth highest-emitting sector. In 2023 alone, they were responsible for approximately 5% of the UK's total emissions, equating to 20.8 $MtCO_2e$.

The good news? Air source heat pumps (ASHPs) are a viable solution for the vast majority of these buildings. They can be installed at the individual building level or scaled up to serve entire heat networks—though the right mix will depend on local conditions and infrastructure readiness.

The public sector is leading the way, decarbonising heating earlier than the commercial sector. With long-term commitment and funding, it plays a critical role in building supply chain confidence and anchoring investment in heat networks.

However, a key barrier remains - the high cost of electricity relative to gas. To enable broader uptake, the Government must urgently review the distribution of policy costs, and reduce the burden on electricity and consider targeted support to accelerate commercial sector adoption.

In the meantime, energy efficiency measures are an effective and cost-saving solution that should be deployed immediately. These



measures not only improve the performance of buildings but also complement the deployment of heat pumps by reducing overall energy demand, ultimately leading to lower emissions and operational costs.

The ASHPs' performance can be improved, not by changing the unit itself, but by optimising the system context around it. For example, reducing the flow temperatures in existing heating systems can significantly boost ASHP Coefficient of Performance (COP). Most ASHPs operate best at lower temperatures in comparison to a gas boiler (35-45°C vs 60-75°C), therefore if a building can be made or updated to be as energy efficient as possible, consequently an air source heat pump will operate efficiently.

Performance can be further improved with thermal storage integration. Pairing ASHPs with well-timed thermal storage (like smart cylinders or phase change materials) can optimise when heat is generated, taking advantage of off-peak electricity or solar surplus, which is great for grid balancing and cost savings.

OTHER ENERGY EFFICIENCY OPPORTUNITIES

The no-cost energy efficiency opportunity

Far too often, building systems, whether heating, cooling or lighting are running outside of occupancy hours or at unnecessarily high levels. Reviewing and adjusting time schedules, setpoints and sensor calibrations can result in substantial

Source: https://www.theccc.org.uk/publication/the-seventh-carbon-budget/

savings without spending a penny. For example, reducing heating setpoints by just 1°C can cut energy use by up to 8%. Similarly, tightening up HVAC operating hours to match actual occupancy can save thousands annually in large buildings.

Another no-cost win is engaging building users. Encouraging small behavioural changes like switching off equipment, closing windows when heating is on or reporting faults can significantly reduce waste and improve system performance. In essence, energy efficiency often starts not with new tech, but with better use of what's already in place.

The low-cost energy efficiency opportunity

Improving system insulation is a low-cost yet highly effective energy efficiency opportunity for ASHPs.

Most ASHPs operate at lower temperatures than traditional boilers, making them more sensitive to heat loss in pipework, cylinders, and distribution systems. Simply insulating exposed pipes, valves and hot water storage tanks can significantly reduce thermal losses, and improve system performance. This small investment helps maintain desired temperatures with less effort from the heat pump, boosting its COP and reducing electricity consumption.

Another low-cost measure is optimising zoning and control systems. Installing or upgrading smart thermostats and thermostatic radiator valves (TRVs) allows more precise heating control, ensuring the ASHP only heats occupied or necessary areas. Together, these minor upgrades can deliver notable efficiency gains, prolong equipment life and reduce energy bills without major capital expenditure.

The most common energy efficiency opportunity

The most common energy efficiency opportunity with air source heat pumps is improving the buildings' thermal performance to match low-temperature heating.

> **"Energy efficiency measures not only improve the performance of buildings but also complement the deployment of heat pumps by reducing overall energy demand."**

ASHPs are most efficient in well-insulated, airtight buildings. Yet, many are installed in properties with poor insulation, draughts or oversized radiators designed for high-temperature systems. The opportunity lies in retrofitting the building envelope—adding insulation, sealing gaps, upgrading windows and improving zoning to reduce heat loss, and allowing the ASHP to operate at lower flow temperatures.

This alignment between building fabric and heat pump performance is often overlooked but is crucial in achieving real efficiency. Without it, the system may work harder than needed, cost more and deliver less comfort.

The most overlooked energy efficiency opportunity

The most overlooked energy efficiency opportunity is early-stage, integrated design coordination between the ASHP system and the building fabric.

Too often, air source heat pumps

are specified after key building design decisions, such as insulation levels, glazing, zoning and heating distribution have already been made. This leads to systems that are mismatched to the thermal performance and layout of the building, resulting in inefficiencies, discomfort and higher running costs.

By integrating ASHP planning at the concept design stage (e.g., RIBA Stage 2), developers can size systems correctly, optimise emitter selection (like underfloor heating or low-temperature radiators), and ensure the building envelope supports efficient low-temperature operation. This holistic approach can significantly improve COP, reduce oversizing and extend equipment lifespan. In essence, efficiency isn't just about the pump, it's about how the building and system work together from day one.

Another aspect which can be overlooked, is the sizing of the heat pump. Naturally, an ASHP has to be sized to accommodate the coldest days, but this can result into oversizing them and resulting in higher electrical demand.

A hybrid system, either with an electric or gas boiler, may be a good solution to provide the additional heat on the coldest days of the year.

Top Tips

Treat the air source heat pump as part of a whole building strategy, not a bolt-on solution. That means designing or retrofitting the building to operate comfortably at low flow temperatures (ideally 35–45°C), which is where ASHPs are most efficient. Focus on insulation, airtightness, proper zoning and systems compatibility, and integration early in the design process. This approach prevents oversizing, reduces running costs and maximises comfort.

And on a final point, ensuring that your electricity supply is 100% renewable will make ASHPs a truly renewable heating solution.

Author's profile:
Kiro is a former Head of Environmental Sustainability at Keltbray and Director of KEES Services. He has over 10 years of experience in energy and carbon management. Kiro is a qualified ESOS Lead Assessor, Chartered Environmentalist and ISO 50001 Energy Management Lead Auditor.