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.