

The Use Of Ground Source Heat Pumps in Irish Homes

Aidan Shanahan, K00259619



Aim of the Project

The purpose of this project is to compare the effectiveness of a ground-source heat pump in heating an Irish house and how much energy it will take to achieve that goal compared to traditional Irish heating systems such as condensing oil burners and traditional heat pumps. To compare the different systems the use of manual calculations and software such as REVIT will be used to calculate the difference in energy required to heat the same house.

Background

- Global Clean Energy Goals: Many countries aim to increase clean energy usage and reduce carbon emissions post-Paris Climate Agreement.
- Decarbonization Needs: Electricity, heating, and transport sectors must decarbonize; heating is a focus in the EU due to its high energy and carbon intensity.
- EU Trends: Renewable energy in electricity has grown, making low-carbon electricity a viable option for heating decarbonization.
- Heat Pumps as a Solution: Heat pumps can efficiently transform renewable energy into heat, aiding the heating sector's decarbonization.

Heat Pump Mechanics:

- Basic Function: Transfers heat from one location to another using refrigerants; operates similarly to refrigerators.
- Efficiency: Capable of achieving high Coefficient of Performance (COP) values, indicating efficient energy use for heating and cooling.
- Modes: Can provide both heating and cooling by reversing its cycle.
- Ground Source Heat Pumps (GSHPs): Utilize the earth's constant temperature for efficient heating and cooling.
- Environmental Impact: Generally low, especially compared to fossil fuel power plants.

Traditional Heating Systems:

- Types: Open fires, solid fuel stoves, oil-fired central heating, gas central heating, electric storage heaters, and air-to-water heat pumps.
- Comparison Focus: Initial and lifetime costs, efficiency, and reliability.

Research Methodology

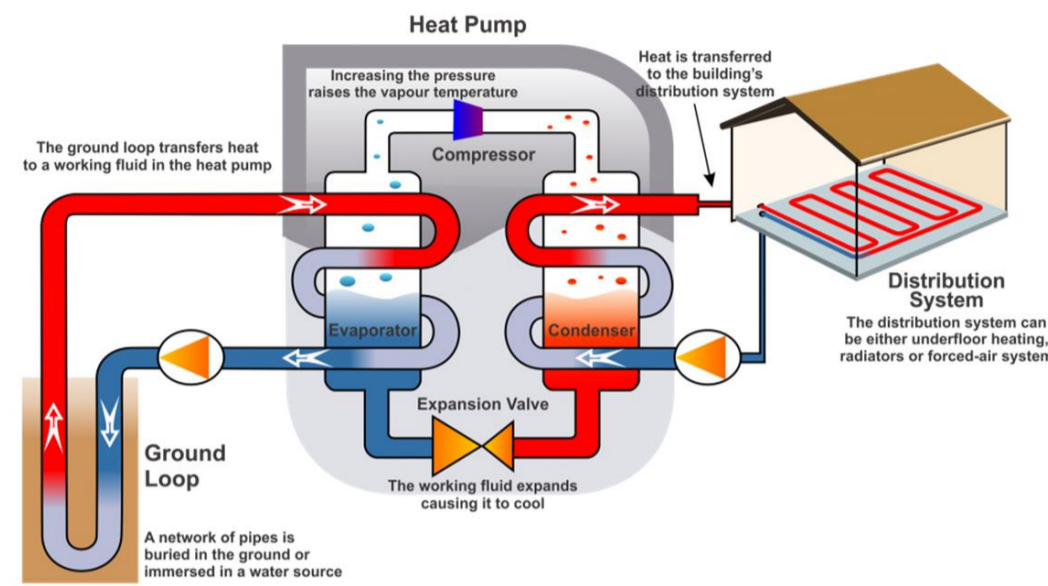


Figure 1: How a GSHP works (AHDB 2024)

This project aims to provide builders with an estimated cost of installing a vertical closed loop ground source heat pump for retrofitting existing Irish homes or for new construction in all regions of Ireland, taking into account the suitability of the ground and the required depth to attain an appropriate water temperature. Other factors to consider are the upfront cost, yearly heating costs, cost per KWH produced, grants, and maintenance expenses.

We will also take into consideration case studies done throughout Ireland and Europe as well as countries with similar climates such as New Zealand.

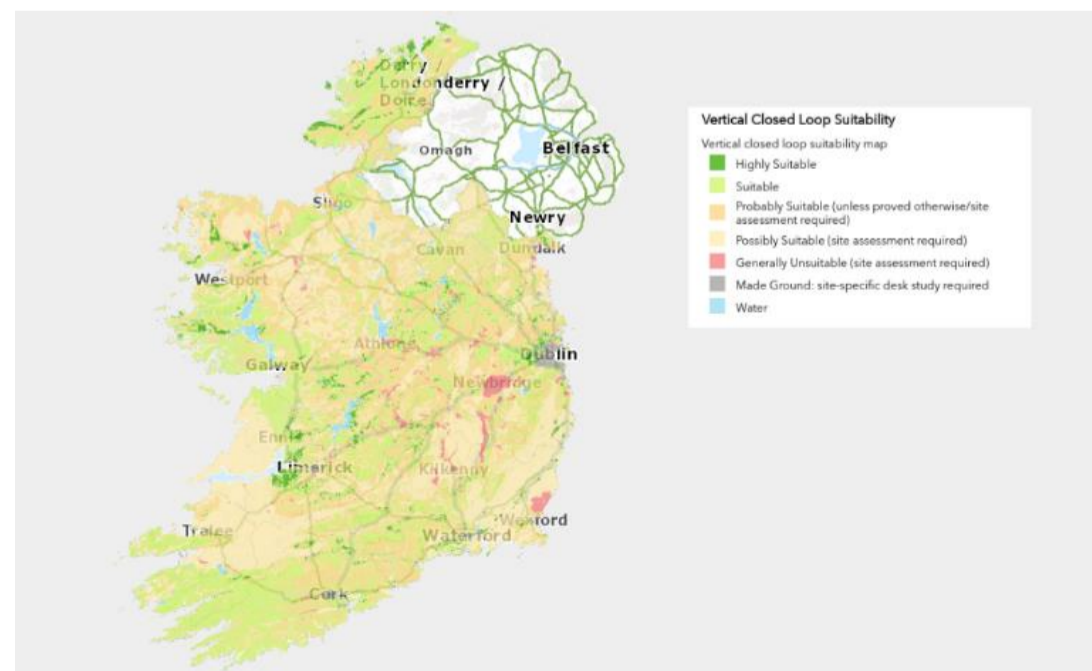


Figure 2: Map of suitability for vertical closed-loop heat pumps. From the Geological Survey of Ireland.

Results

Introduction

The study began by closely examining the performance indicators of GSHPs, which provided detailed insights into their operating efficiency and the economic and environmental consequences of their installation and use. The inclusion of homeowners' and industry experts' perspectives, gathered through case studies and results, provided further insight into the statistical data, revealing the human aspects of technology adoption. The case studies presented tangible instances of GHP implementation in various Irish households, providing a perspective through which theoretical discoveries were mirrored in practical situations.

Results

The analysis, based on various case studies, academic journals, and reliable websites, along with advanced assessments using the D.E.A.P software on a residential model created in Autodesk Revit, clearly shows that ground source heat pumps (GSHPs) are significantly more efficient than other heating systems. Ground source heat pumps (GSHPs) demonstrate exceptional efficiency rates, typically ranging from 300% to 500%. This variability in efficiency can be attributed to the specific geological properties and thermal conductivity of the ground. Unlike standard oil and gas boilers, air-to-water heat pumps (AWHPs) have a far lower efficiency rate of roughly 250%. In comparison, oil and gas boilers have efficiency levels of around 90%, which is considerably lower.

	Installation Cost (after grants)	Annual Energy Cost	Energy Cost Over 25 years	Annual Servicing Cost	Servicing Cost over 25 Years	Total Cost Over 25 Years
Electric Radiators	€1000	€3,500	€87,500	€0	€0	€88,500
Oil Boiler	€3000	€1,370	€34,250	€80	€2,000	€39,250
Gas Boiler	€3,000	€1,870*	€46,750	€90	€2,250	€52,000
Air Source Heat Pump**	€10,500	€875	€21,875	€70	€1,750	€34,125
Ground Source Heat Pump	€12,500	€700	€17,500	€0	€0	€30,000

Figure 3: Cost analysis of Heating Systems (IrishHeatPumps 2023).

Conclusion

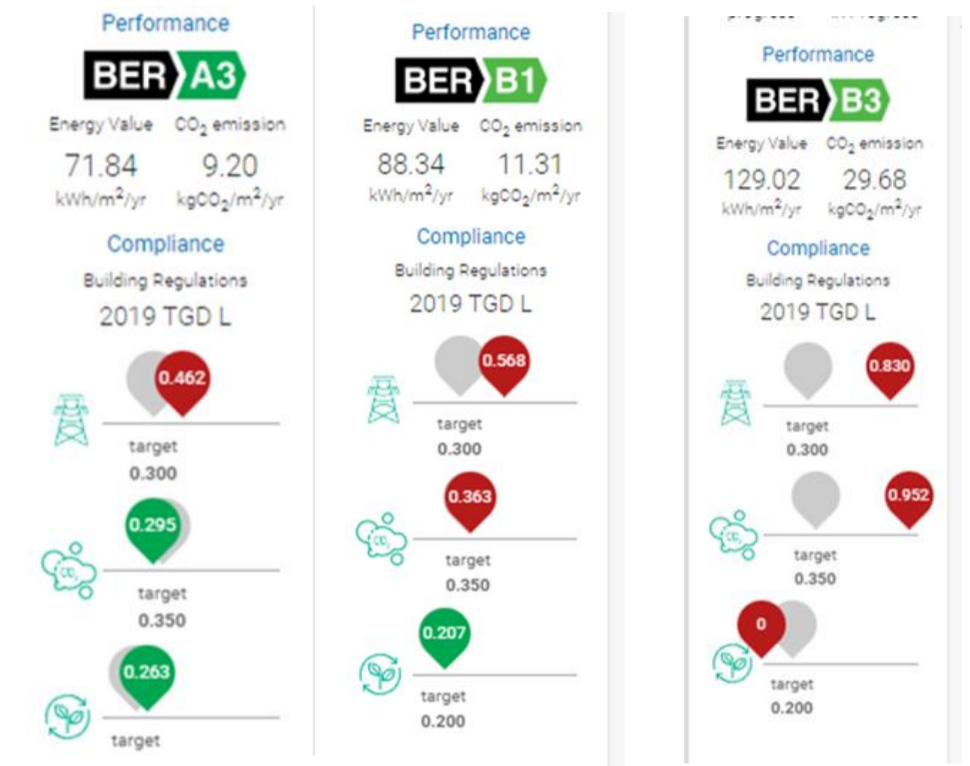


Figure 4: GSHP BER rating, air-to-water BER rating, Condensing oil burner BER rating

Conclusion An Investment with a Futuristic Approach

As we conclude this discussion, it is evident that although there are financial obstacles to adopting GSHPs in Ireland, the process offers the potential for sustainability, efficiency, and long-term economic advantages. This conversation, enhanced by concrete facts and knowledge from practical experience, highlights the importance of Ground Source Heat Pumps (GSHPs) as a crucial element of Ireland's sustainable heating solutions. They provide a promising opportunity for a more environmentally friendly and efficient future.

References

- IrishHeatPumps(2023)Annual Cost Of Heating in Ireland [Image online] available: <https://irishheatpumps.com/ground-source-heat-pumps-ireland/> [accessed 16 March 2024]
- AHDB (2024) How heat pumps work [Image Online], Available: <https://horticulture.ahdb.org.uk/knowledge-library/how-heat-pump-works> [Accessed 23 January 2024]
- Sustainable Energy Association of Ireland (2024) Domestic Technical Standards and Specifications. Pdf (1.6) <https://www.seai.ie/publications/Domestic-Technical-Standards-and-Specifications.pdf>
- Gaur, A.S., Fitiwi, D.Z. and Curtis, J., 2021. Heat pumps and our low-carbon future: A comprehensive review. Energy Research & Social Science, 71, p.101764.