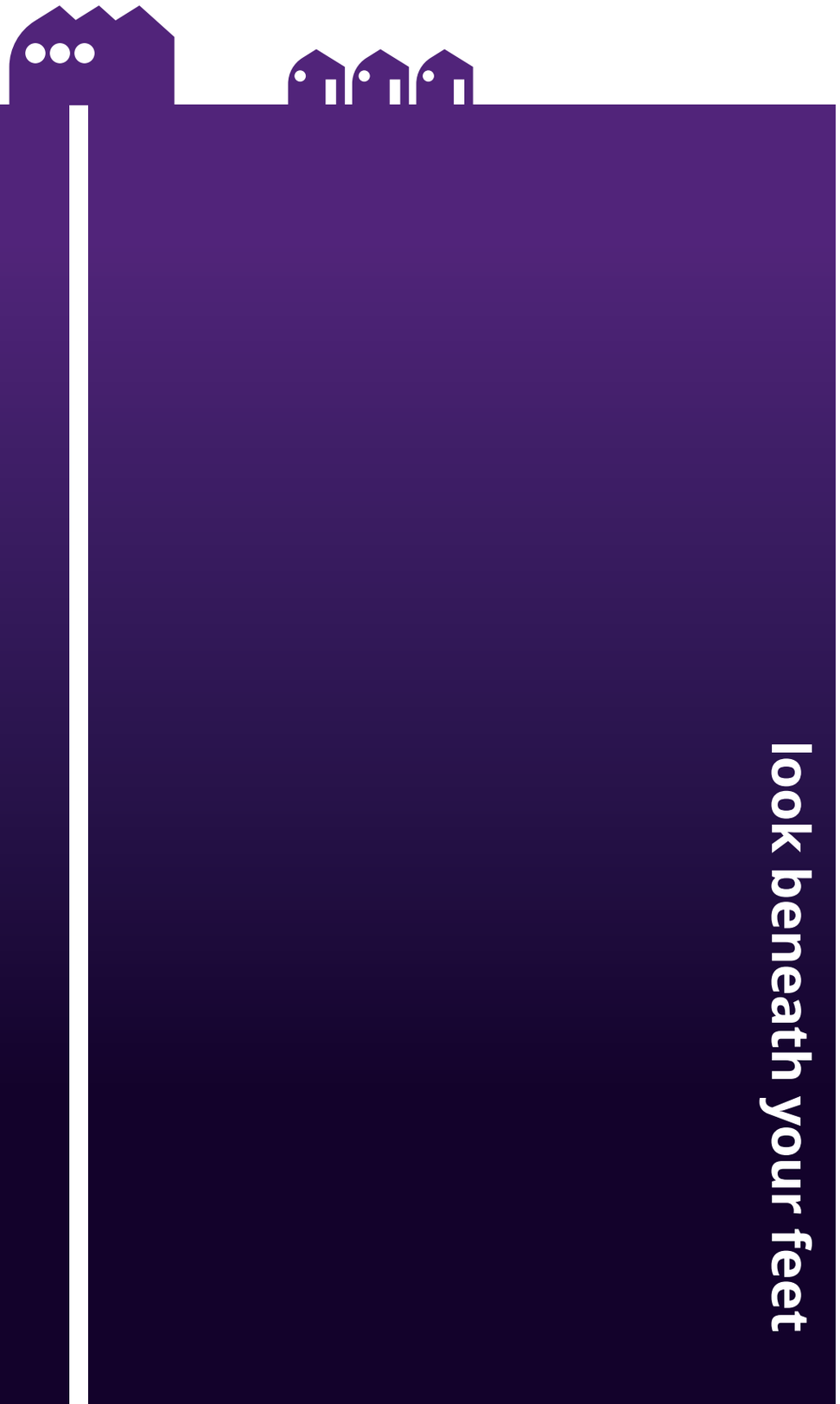
TownRock Energy

Geothermal Energy in the UK

What, where, how and why

For renewable heat

TownRock Energy



TownRock Energy is an award-winning geothermal energy consultancy based in Edinburgh, Scotland. We are the leading specialist in all aspects of the UK's geothermal resources.

Our mission is to access the abundant geothermal energy of the subsurface to provide up to 24 hour renewable heating and cooling to industrial, commercial and domestic energy users, often saving over 90% of carbon emissions versus gas.

We are a passionate, innovative and diverse company that strives to minimise the energy industry's negative impact on the environment. We support all sustainable methods of non-fossil low carbon energy generation in order to help mitigate the effects of climate change. We try to integrate other renewable technologies into our geothermal systems to minimise emissions and fuel costs.

Our focused, dedicated team prides itself in its straight-talking approach to this frequently misunderstood renewable technology. We help our clients and partners understand how to unlock the value within the geological asset beneath their site.

For more information about our products and services and to meet the team visit townrockenergy.com

look beneath your feet

For renewable heat

Geothermal energy has the potential to be the most significant and sustainable source of heating and cooling globally by 2050

The Earth is constantly generating its own heat, primarily from the decay of radioactive isotopes, and will continue to do this effortlessly for billions of years to come.

This very low carbon energy source has already been tapped into all over the world, but we have only scratched the surface as regards unleashing the full potential of geothermal energy.

Some countries in Europe have made more progress than others. Over a third of Paris is heated by geothermal energy. Germany has matured its geothermal heat and power industry to a point that private insurance companies often cover the drilling risk, and has created tens of thousands of jobs. The Netherlands has created over 600 jobs in only the very early stage of its decade-old geothermal sector, and it is growing rapidly.

The UK continues to burn natural gas for heat, even though it has to import over 40% of the fuel used – but the UK geology is capable of being harnessed to produce a booming geothermal industry akin to the Netherlands.

The team at TownRock Energy has travelled the world to understand best practices and policy for developing geothermal energy, and is now focused on demonstrating the viability of geothermal energy in the UK. We are helping the UK to meet its net-zero carbon 2050 target.

Benefits of Geothermal Energy

1. Very low carbon, renewable, heating and cooling provision, with attractive profits and 40+ year lifetime

2. Only requires electricity to operate, which can be sourced from local renewables or the grid

3. Often near to areas of heat demand, no visual or noise impact, and generally supported by local communities

4. Government capital grant support available and attractive Renewable Heat Incentive (RHI)

How does Geothermal Energy work?

Geothermal energy – the use of naturally occurring heat from buried rocks – is a proven sustainable technology. The UK's geothermal resource is significant and remains largely untapped at present.

In locations such as Iceland magma is near the surface and large quantities of steam can be produced from relatively shallow wells to turn turbines that generate electricity. The UK does not have active volcanoes, but there is enough geothermal heat available – the wells just need to be drilled deeper.

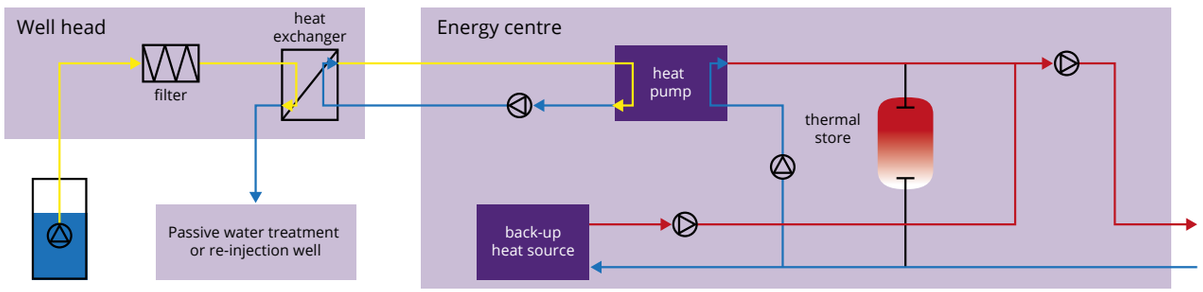
A geothermal heating and/or cooling system typically involves a production well to deliver warm water from the rocks beneath the site; a heat centre, pumps and pipework to deliver thermal energy to the end user; and a re-injection well to dispose of water and maintain resource pressure.

The production well will typically be drilled into the ground to a depth of 50–3000m where the rock contains large quantities of groundwater. Some project developers are considering wells as deep as 9000m, and as drilling technologies improve and costs come down this may become common.

When the hot groundwater reaches the surface, it passes through a heat exchanger which transfers most of the heat into a separate loop of pipe containing clean water. The temperature of this clean loop can then be increased further by use of a heat pump to match customer requirements. The heat pump can be centrally located in an energy centre, or located in each building, depending on the customers needs.

After passing through the heat exchanger, the groundwater is piped to the injection well (or surface disposal facility) and pumped back into the ground (or treated before pumping into the sea). The injection well will typically reach similar depths to the production well, and be spaced some distance away from the production well to allow the groundwater to heat back up before returning back up the production well.

The spacing between the production and injection can be achieved by directional drilling from a single well pad if the aim is to minimise surface pipework.



Schematic a geothermal well doublet connected to a heat pump energy centre

The **carbon footprint** for a standard gas boiler is **210–380gCO_2eq/kWh**

45% of UK energy use is **heating**

25% of UK homes sit above coal mines

In the UK the temperature at 1km is typically **30–50°C** and increases linearly with depth

Earth's core is **6000°C**

Heating accounts for **32% of UK carbon emissions**

UK abandoned mines contain **75 billion m³** of water

7 million UK homes could use **mine-water heat** instead of gas

x10,000

Geothermal Resource Types

Geothermal Energy is often misunderstood by people who do not have a background in geoscience, and for good reason! The term which refers in general to thermal energy from the ground covers a wide array of different resource types. This diagram illustrates the different types of geothermal resource found in the UK and most other countries.

Ground-Source Heat Pump

A ground-source heat pump extracts primarily solar thermal energy, and some geothermal energy, from the very shallow surface. Systems can be closed loop (pumping fluid through buried pipes) or open loop (pumping water through porous rocks via a production and injection well).

Surface-Water Heat Pump

Bodies of water on the surface, including lakes, rivers and even the ocean, can be great sources of renewable heating and cooling.

Minewater

Abandoned coal mines in Scotland's central belt and across large areas of England and Wales are full of warm water. These legacies of the fossil fuel age can be recycled into vast sources of low-carbon heating and cooling at relatively low cost. Heat exchangers quantities of low carbon heating and cooling at low cost. Heat exchangers and heat pumps are usually used to elevate the temperature of the water to be delivered to the customer.

Aquifers

Aquifers are rocks with pore-spaces and natural fractures that exist across much of the UK generally, and in particular can overlap with onshore oil fields. Geothermal aquifers are often referred to as Hot Sedimentary Aquifers (HSAs).

Granites

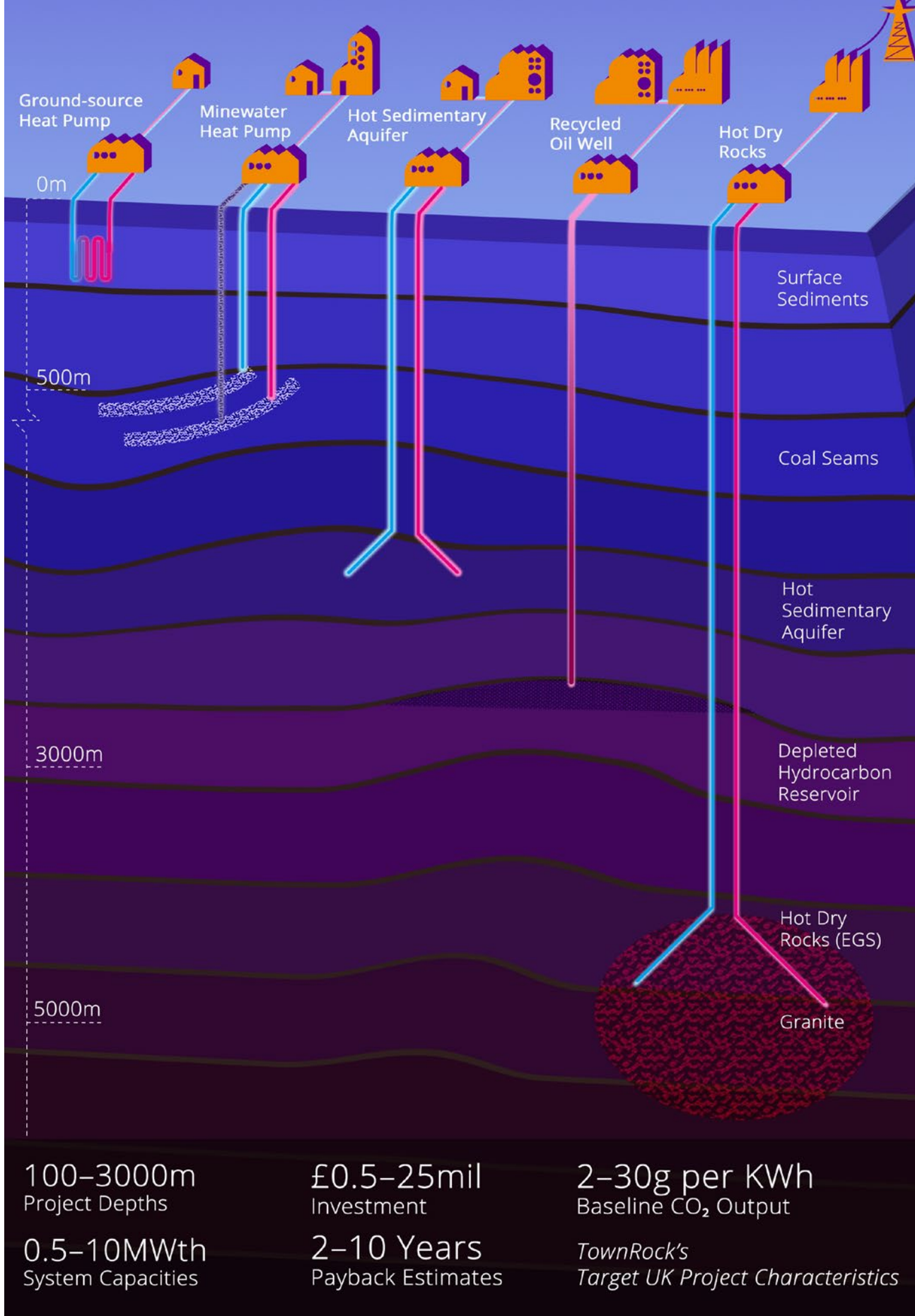
Heat from radiothermal granites in the highlands of Scotland, the north east of England, and Cornwall can be converted into electricity by the use of Engineered Geothermal System (EGS) technology, with lots of heat as a useful by-product. This is often referred to as Hot Dry Rock geothermal, which targets naturally occurring fractures.

Disused Oil Well

When oil and gas wells are near the end of their economic life, they often produce large quantities of hot water. When local heat demand exists, or if a business which requires low cost heat (such as a heated greenhouse operator) wants to invest locally, the oil well can be recycled into a geothermal well giving it a low-carbon afterlife.

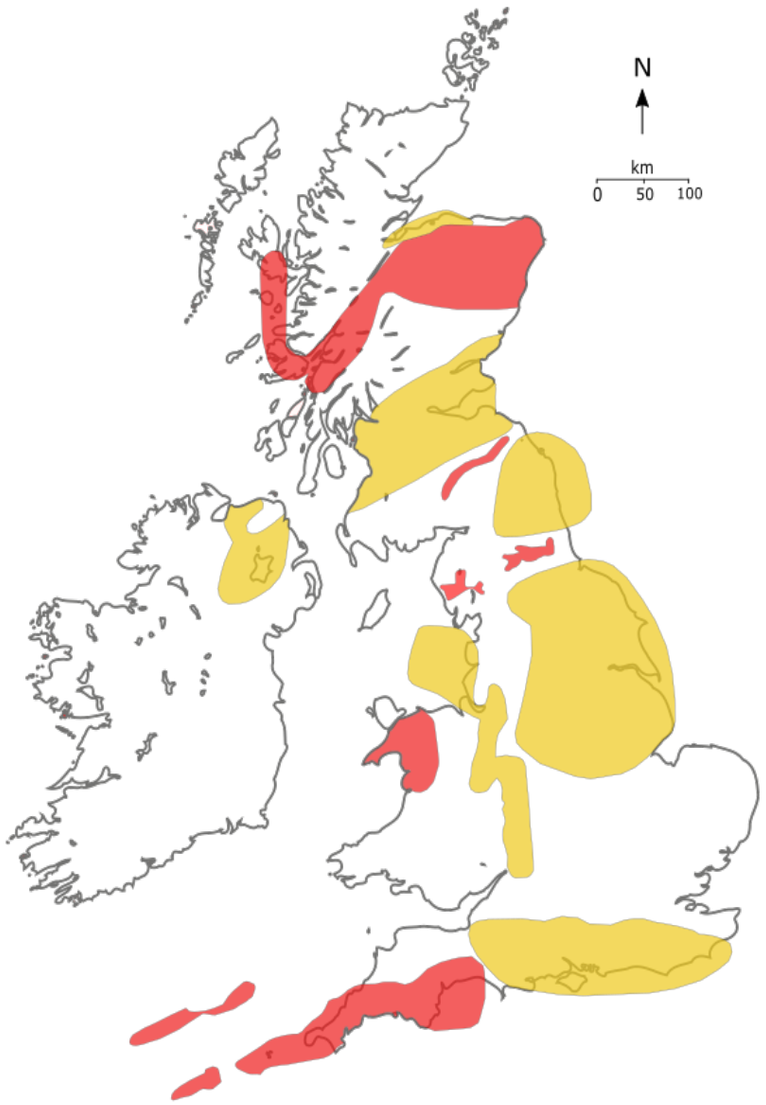
CCG Well

TownRock Energy's Cyclic Circulating Geothermal (CCG) well produces warm water and injects cold water via the same well, and can be deployed in any geology. An effective technological mitigation option when an aquifer or granite production/ injection well encounters low flow.



Where are geothermal resources available?

Ground-source heat pumps can be installed nearly everywhere in the UK. This map highlights the areas of greatest geothermal energy potential. Aquifer and minewater resources. Aquifer and minewater resources are found in the sedimentary basins and granite ‘Hot Dry Rock’ resources are found in the granite batholiths.



Sedimentary Basins areas include HSA's and flooded mines

Granite Batholiths

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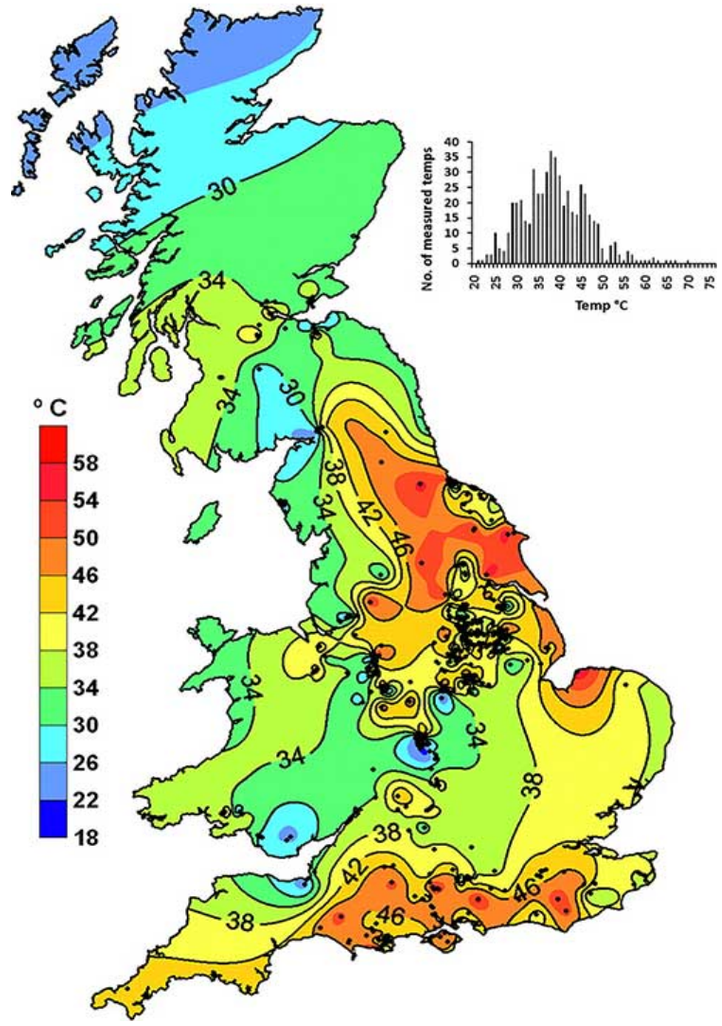
Temperature at 1 km depth

The flow of heat from deep underground to the surface of the planet also varies from place to place, which in turn affects the temperature of the rocks. Extensive datasets have been collected from boreholes, wells and mines, and this dataset has been interpreted across the UK, showing the temperature at 1 km depth.

If the actual temperature of water that flows from the production well matches or exceeds the temperature required by a customer, then there is no need to use electricity to run a heat pump, increasing the average system coefficient of performance (COP) from 4 to 20 or better.



Map sourced from: Busby, J. et al. 2011. The measured shallow temperature field in Britain. Quarterly Journal of Engineering Geology and Hydrogeology, 44 (3). 373-387

How does our process work?

We work with a diverse and wide array of clients, so our services are customised to fit each client's needs. However, we apply a consistent approach to our site evaluations in a phased process that minimises risk and maximises the client's return on their investment.

Project phase	Outcome	Timeframe
Phase 1. **Basic Site Evaluation**	We can help you discover if you have a geothermal resource beneath your site, for free.	1–2 weeks
Phase 2. **Pre-feasibility study**	High level assessment of business case and identification of grant funding sources.	2–4 weeks
Phase 3. **Feasibility Study**	We will deliver to you the comprehensive, geological, engineering, legislative, ownership and economic feasibility, with risk register. This phase also includes regulatory engagement and funding acquisition	4–16 weeks
Phase 4. **Investment Grade Business Case**	We will prepare a comprehensive business case, covering all aspects expected by an internal or external investment audience, to help you secure a mix of capital funding for the project.	8–24 weeks
Phase 5. **Construction**	Once capital is secured the boreholes can be drilled, and the surface infrastructure installed. We will contribute project and stakeholder management at this stage to ensure the project remains on time and budget.	6–18 months
Phase 6. **Operation**	We will ensure that the project continues to operate smoothly during its lifetime, and will budget for, and manage, operations and maintenance activities so that the project remains profitable through its full life cycle.	25–50+ years

All timeframes are estimates based on previous projects

There is substantial grant funding support available to projects using highly innovative and low carbon technology. A grant may help support your project through phases 2, 3, 4 and 5.

What next?

If you are interested in exploring the geothermal potential of your site, call us on **07841 910719** or email **david@townrockenergy.com** to arrange a site visit

TownRock Energy

"Throughout the project I was impressed with the professionalism and quality of the work that TownRock Energy produced and even more so by the dedication and commitment the team demonstrated, really going 'the extra mile'."

Euan Harrison

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32% of the UK's carbon emissions are produced by fuel for heating.

The estimated **carbon footprint** for **geothermal energy** is over **90% less than an average gas boiler***

If you're looking to reduce your carbon footprint and eliminate your reliance on fossil fuel, geothermal energy is a substantial, economic and future-proofed way to do it.

*Estimated footprint for a gas boiler is 210–380gCO_2eq/kWh for geothermal the figure is 2 to 30 gCO2eq/kWh