Written evidence submitted by Dr Paola Sakai

Summary

This response addresses six of the points provided in the terms of reference with a particular focus on mine energy systems for food production in controlled environment systems.

This response is drawn from the knowledge gained from an ongoing research endeavour by a Public Private Research and Innovation Partnership created to explore innovative technologies to produce food that is climate resilient, clean and just. 1/3 of the UK's GHGs emissions are related to the food and drinks sector[1]. Technologies such as mine energy systems to decarbonise the sector represent an important contribution to the net-zero agenda. Countries, such as the Netherlands and Iceland, successfully use geothermal energy in food production, but this has not been done in the UK. The evidence that underpins this response explored the barriers, opportunities and gaps to deploy this technology in the UK. It provides specific steps to unlock investment opportunities in mine energy systems for food production.

This evidence offers insights from a literature review on barriers and drivers and identification of examples, 52 semi-structured interviews with experts from the industry, academics, Local, Regional and National Government, Civil Society, NGOs, and Finance and Investment, a spatial analysis of the geothermal potential, and a reaction workshop in March 2022 (45 experts)[2] . It also builds on previous work led by the School of Earth and Environment[3]. The findings provide evidence on the challenges and opportunities to use the heat stored in the water of disused mines to provide heat to glasshouses and vertical farms to produce nutritious food in a controlled environment system. We took a system's approach and explored business models where sustainable entrepreneurs could channel this healthy food to schools, care homes, hospitals, and food banks to encourage a business ecosystem that fuels a resilient, clean and kind food system.

Evidence shows that there is an urgent need for a governing body for geothermal energy in mine energy systems that remove information barriers and level the playing field for all actors. The mine legacy has a great potential to create localised social and economic co-benefits along with the net-zero strategy. In addition, using geothermal mine water energy for food production is a novel idea, meaning that the UK has an opportunity to lead the way both nationally and internationally. There is a need to provide grants and encourage partnerships that add to the exploration of this great opportunity.

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[1] https://wrap.org.uk/sites/default/files/2021-10/WRAP-UK-Food-System-GHG-Emissions-Technical-Report_0.pdf

[2] Sakai, P., Hoffmann, F and Carver, B (2022) Using geothermal mine water energy for food production in Leeds. Policy Leeds. University of Leeds https://doi.org/10.48785/100/92

[3] Sakai, P., Bliss, T., Woodcock, S., Goldring, A. (2020) Growing a resilient food system in Leeds. Policy Leeds, SRI Briefing Notes Series. ISSN 2056-8843 No. 28 https://doi.org/10.5518/100/62

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About the author

Dr Paola Sakai is a Lecturer in Sustainability, Economics and Policy working at the University of Leeds. She is a research associate of the Global Food and Environment Institute, Geosolutions Leeds, among others. She previously held an UKRI Research and Innovation Fellowship and a Michael Beverley Innovation Fellowship which led to her food and geothermal systems research strand. In the last three years, Paola has been investigating how to develop the economic case for investing in climate resilient urban infrastructure at a city scale, exploring the synergies between disaster risk reduction and improvements in productivity, economic growth, employment, environmental quality, and human well-being. The case study is Leeds seeking to draw lessons that can be applied more broadly to other cities in the UK and abroad. She is an expert on the vulnerability and resilience of SMEs to climate variations and extremes, the economics of climate change adaptation and collaborative urban strategic planning for climate resilience.

Response to selected questions posed by the inquiry

What role can geothermal technologies take in the transition to net zero in the UK?

Geothermal technologies such as mine energy systems used for food production has a great potential to contribute in the transition to net zero in the UK and around the world. Utilising the heat stored in the water of disused mines to heat glass houses or vertical farms means that food will be produced with nearly zero carbon. This technology applied to food production can also generate carbon savings by reducing food miles, can free-up land that can be used for biodiversity; energy consumption and water can be reduced by 30% and 95%, respectively by using an efficient net-zero food production system. 35% of the UK's GHG emissions comes from the food and drink sector - including emissions overseas from imported food. Efforts to decarbonise the food system are urgently needed. A zero-waste food system with mine energy system can support a more efficient and sustainable food system in the UK and set the example abroad.

What barriers (technological, regulatory, or otherwise) are there to deploying operational geothermal technologies in the UK?

Technical: lack of geothermal energy data, unknown state of the abandoned mines, uncertainty of water flow and underground occurrences, lack of ability to store and transport energy at scale; for controlled environment agriculture (CEA): pests and diseases, and limited crop diversity, high risks,

Economic: high start-up and operating costs, lack of incentives, high risks and lack of insurance, long return periods of investment, procurement system that prioritises low cost, food prices are already low

Social: social acceptance, fear of risks, a need for skilled labour,

Regulatory/Policy: zoning and certification, lack of national policy and blurred regulation, Unfavourable terms for investment, pressures for land, easier to stick with business as usual

Are current government support schemes sufficient to grow geothermal energy deployment in the U.K.?

No. There is an urgent need for incentives, support, and grants for research and development for this geothermal technology for food production.

What environmental concerns are associated with geothermal technologies, and are they appropriately accounted for in regulations?

Environmental concerns associated with mine energy systems are risks of hitting pockets of methane.

What risks are there to investors, operators, and consumers of geothermal energy? How can these be mitigated?

To mitigate the risks to consumers: Develop an engagement strategy to develop social acceptability and prevent misinformation among the public. Engage community leaders or local ambassadors and organise events with residents to provide a space for knowledge exchange and the consideration of concerns.

To mitigate the risks to investors: set up a governing body like in the oil industry that sets out rules and levels the playing field

To mitigate the risks to operators: provide reinsurance schemes like in other countries. Employ early knowledge sharing on an international level with the industry, academia, relevant institutions and organisations to facilitate knowledge and data flows. Increase engagement with current professionals from the oil and gas industry, particularly around modelling and drilling.

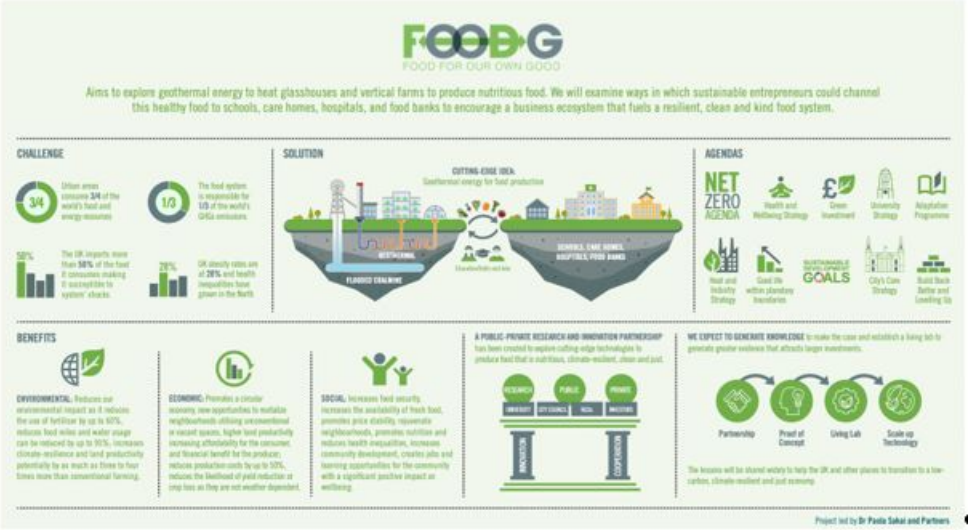
What economic impact could the deployment of mine water geothermal systems have on the areas in which they are deployed?

There are clear benefits of using mine water geothermal systems to the areas in which they are deployed. Coal mining has a long history in various parts of the UK, while coal pits and collieries have closed and the majority of the above-ground infrastructure is gone, the below-ground workings pose a great potential to regenerate areas left behind.

As an interviewee mentioned: "Really positive thing that can come out of a kind of industrial legacy that's happened in the UK" (Aca-4). The places where the mines are located are correlated to the areas that show higher levels of deprivation. And, is this vulnerable population the one more susceptible to systems' shocks. A clear example was the impact of Covid-19 on first lockdown, for instance in Leeds, where the shortages of stock showed inability of people to access nutritious food.

Considering that the UK imports more than 50% of its food, and that more than 70% of total agriculture is rainfed and climate variability is already impacting food security, investing in technologies that can increase the climate resilience of the food system of those geographical areas that have been left behind, and doing this with technologies that can contribute with the net-zero agenda seem a great opportunity.

By exploiting clean energy from an existing resource, this technology presents a strong contribution to the **Net-Zero Strategy**, the **Climate Resilience Programme**, and the declaration of a climate emergency by many councils. By localising food and energy production, prioritising vulnerable members of the population, advancing local skills, jobs and knowledge and using the mining legacy to benefit "forgotten communities", adds value to the health and well-being, National Food Strategy, as well as the **Levelling Up White Paper**. It is also a prime opportunity to capitalise on the market opportunity of Controlled Environment Agriculture in some regions, such as North and West Yorkshire (UK DIT) and decarbonise the region.



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