



Dr Paola Sakai

University of Leeds

Healthier & Resilient Food Systems Network

28th April, 2022

© Paola Sakai

Current challenges cannot be solved alone



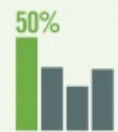
CHALLENGE



Urban areas consume **3/4** of the world's food and energy resources



The food system is responsible for **1/3** of the world's GHGs emissions



The UK imports more than **50%** of the food it consumes making it susceptible to system' shocks



UK obesity rates are at **28%** and health inequalities have grown in the North

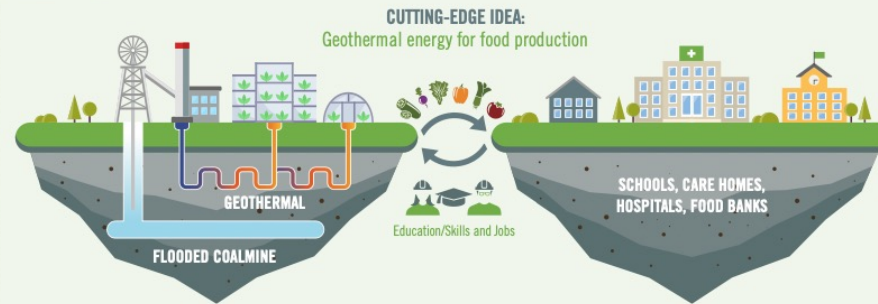


Aims to explore geothermal energy to heat glasshouses and vertical farms to produce nutritious food. We will examine ways in which sustainable entrepreneurs could channel this healthy food to schools, care homes, hospitals, and food banks to encourage a business ecosystem that fuels a resilient, clean and kind food system.

CHALLENGE



SOLUTION



AGENDAS



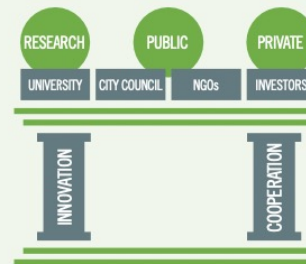
BENEFITS

ENVIRONMENTAL: Reduces our environmental impact as it reduces the use of fertiliser by up to 60%, reduces food miles and water usage can be reduced by up to 95%; increases climate-resilience and land productivity potentially by as much as three to four times more than conventional farming.

ECONOMIC: Promotes a circular economy, new opportunities to revitalize neighbourhoods utilising unconventional or vacant spaces, higher land productivity increasing affordability for the consumer, and financial benefit for the producer; reduces production costs by up to 50%, reduces the likelihood of yield reduction or crop loss as they are not weather dependent.

SOCIAL: Increases food security, increases the availability of fresh food, promotes price stability, rejuvenate neighbourhoods, promotes nutrition and reduces health inequalities, increases community development, creates jobs and learning opportunities for the community with a significant positive impact on wellbeing.

A PUBLIC-PRIVATE RESEARCH AND INNOVATION PARTNERSHIP has been created to explore cutting-edge technologies to produce food that is nutritious, climate-resilient, clean and just.



WE EXPECT TO GENERATE KNOWLEDGE to make the case and establish a living lab to generate greater evidence that attracts larger investments.



The lessons will be shared widely to help the UK and other places to transition to a low-carbon, climate-resilient and just economy.

Fieldwork

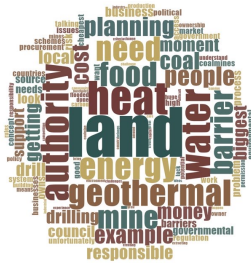
1. **Stakeholder Mapping Workshop:** 18 attendees
2. **Literature Review:** barriers and drivers, and identification of examples
3. **Interviews:** 52 semi-structured interviews, coded and analysed in NVivo
4. **GIS Analysis:** Calculation of Geothermal Potential and a novel 'Mine Water Geothermal Potential Index' combining several measures of geothermal energy potential. Multi-Criteria Decision analysis.
5. **Reaction Workshop:** 45 attendees, prioritisation of barriers identified in the literature and interviews, prioritisation of criteria to select potential pilot sites.

Stakeholder type & number of interviews



Benefits

Barriers



Environmental	Social	Economic	Political
Decarbonising the energy system	Benefit previous coal mining communities that tend to overlay with areas of deprivation	Circular economy	Local, regional, national and international importance
Net-zero food production system	Connect people with their heritage	Revitalise infrastructure and catalyse investment	Decarbonising the energy system
Carbon savings	Low-carbon energy and food in areas of food and fuel poverty	Futuristic technology - expected to be lower cost in the future	Just energy transition
Making local food production more climate friendly	Educational component	Enhancing skills and creating jobs	Decrease dependence on imports
Clean energy, clean crops, good yields, without need for chemical intervention	Nutritional and health benefits	Once past high capital costs -low maintenance costs	Combating Brexit impacts
Extended growing seasons - e.g. strawberries all year round	Empower local communities	Potential for surplus energy	Pioneering

- **Technical:** pests and diseases, and limited crop diversity, high risks, 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
- **Economic:** high startup 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
- **Environmental:** high electricity demand, risks of hitting pockets of methane



Action Plan towards a Pilot Project

An action plan was developed with the stakeholders to establish a pilot in Leeds and path the full-scale uptake of geothermal energy from mine water for vertical farming and glasshouses.

- 1. Conduct a feasibility study** and research to assess the financial and non-financial benefits and build the business case. **Identify business models** that generate the income needed for financial sustainability but also affordability for hospitals, schools, care homes and food banks. **Choose a site** for the pilot considering the criteria identified.
- 2. Get senior leaders' buy-in** from Leeds City Council, Coal Authority, and University of Leeds to continue leading change.
- 3. Strengthen and develop partnerships,** advancing the existing Public and Private Research and Innovation Partnership to overcome economic, social, technical and regulatory barriers. Key partners include Leeds City Council, the Coal Authority, University of Leeds, landowners, the LEP, Angel investors, and strategic partners (e.g. STC, Yorkshire Water, Feed Leeds), among others. **Appoint a board** to take ownership and responsibility for the business case, communication strategy, and attracting investment.

<https://eprints.whiterose.ac.uk/185993/>

Policy Leeds UNIVERSITY OF LEEDS

Using geothermal mine water energy for food production in Leeds Note No. 4, SRI 30 21 April 2022

Paola Sakai, Franca Hoffmann, Ben Carver

Using geothermal energy from unused coal mines for food production in vertical farms or glasshouses may increase food resilience in a low carbon way. An action plan to establish a pilot in Leeds was developed with stakeholders. There is an opportunity for Leeds to spearhead this approach for the UK and internationally.

Action plan

- 1. Conduct a feasibility study** and research to assess the financial and non-financial benefits and build the business case. **Identify business models** that generate the income needed for financial sustainability but also affordability for hospitals, schools, care homes and food banks. **Choose a site** for the pilot considering the criteria identified.
- 2. Get senior leaders' buy-in** from Leeds City Council, Coal Authority, and University of Leeds to continue leading change.
- 3. Strengthen and develop partnerships,** advancing the existing Public and Private Research and Innovation Partnership to overcome economic, social, technical and regulatory barriers. Key partners include Leeds City Council, the Coal Authority, University of Leeds, landowners, the LEP, Angel investors, and strategic partners (e.g. STC, Yorkshire Water, Feed Leeds), among others. **Appoint a board** to take ownership and responsibility for the business case, communication strategy, and attracting investment.

Further information

Technology, energy generation or new 'clean' energy...
Develop an engagement strategy to develop social...
Engage early knowledge sharing to ensure continued...
Further information...
Coordinating authors: Paola Sakai, University of Leeds...
Email: p.sakai@leeds.ac.uk

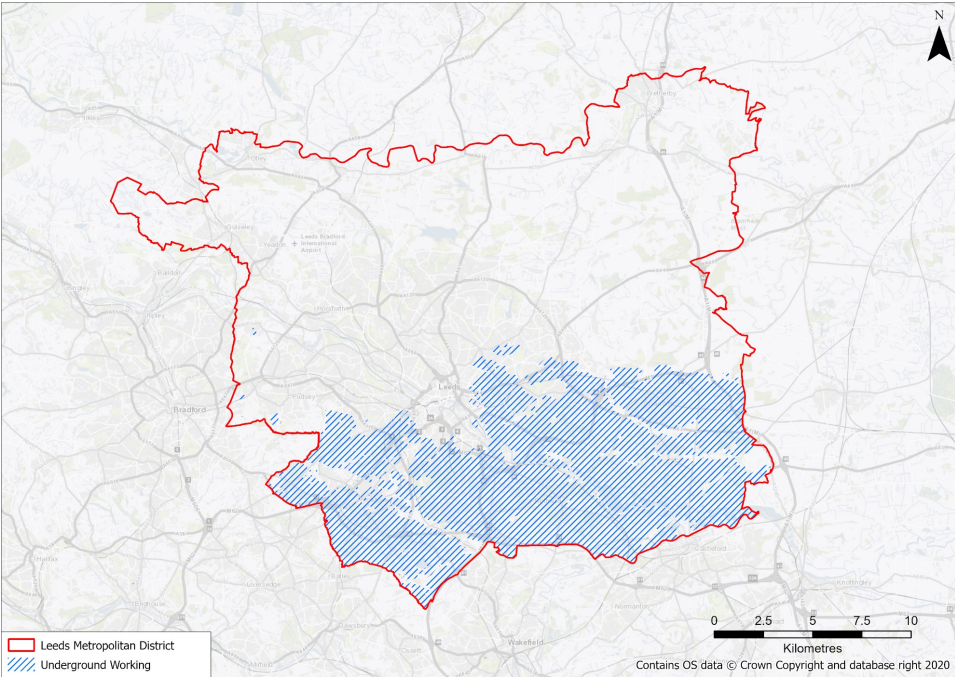


Site selection

Matching geothermal potential with opportunities to decrease climate vulnerability and create climate-resilient development

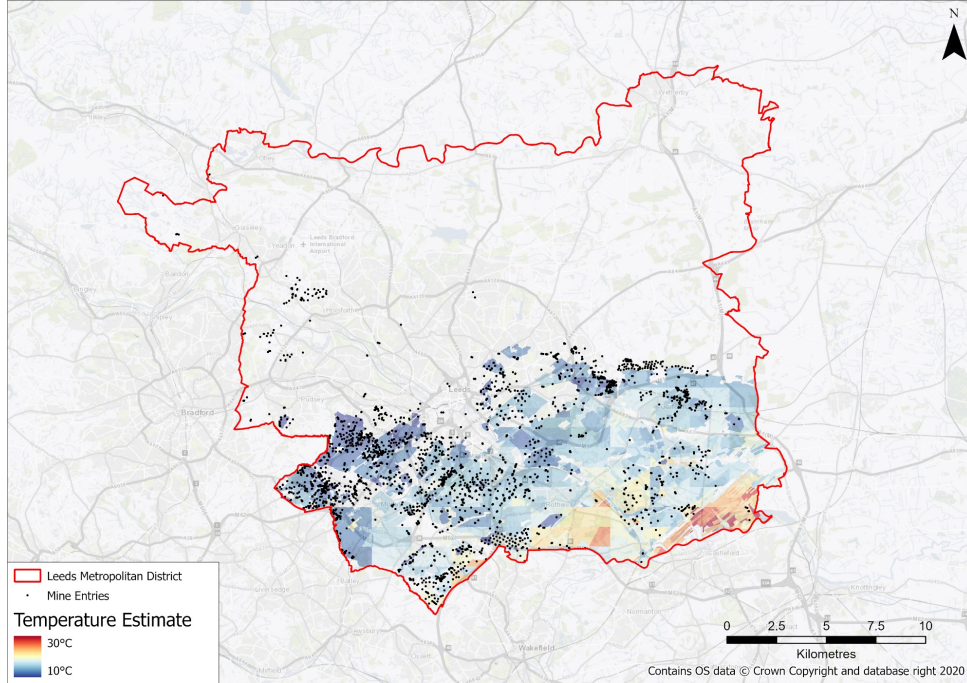
Where is the greatest potential for geothermal energy from mines?

Underground Workings



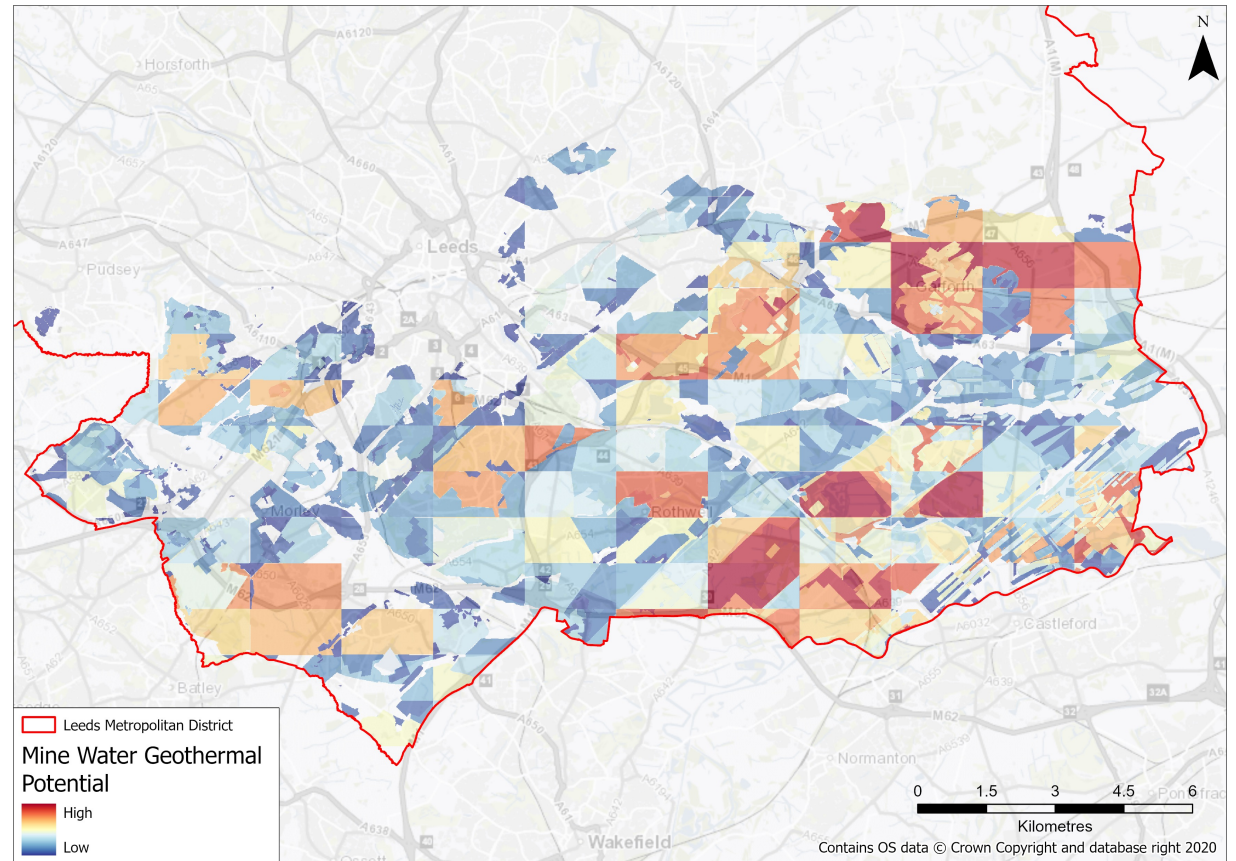
© Paola Sakai, contains data ©Copyright Coal Authority (2021)

Temperature estimate



© Paola Sakai, contains data ©Copyright Coal Authority (2021)

Mine water geothermal potential index



© Sakai et al. (forthcoming), contains data ©Copyright Coal Authority (2021)

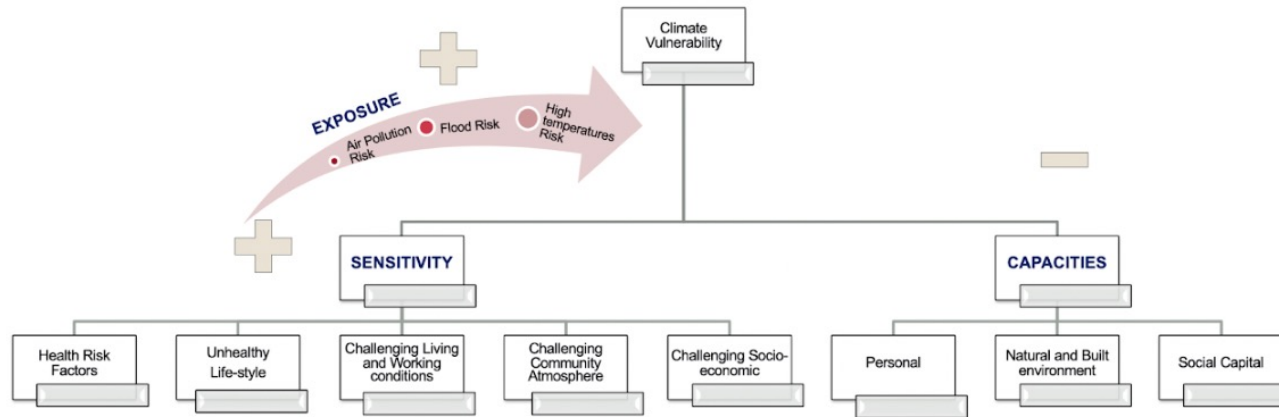
Where is the greatest potential to create climate-resilient development?



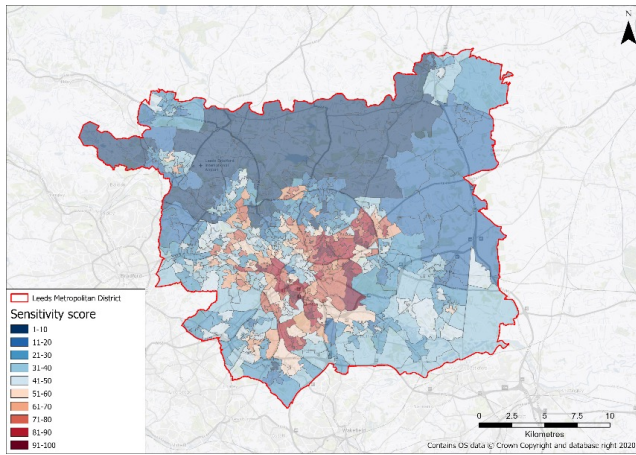
Any risk can become severe where there is high **exposure**, high **sensitivity** and low **capacities** to cope and adapt



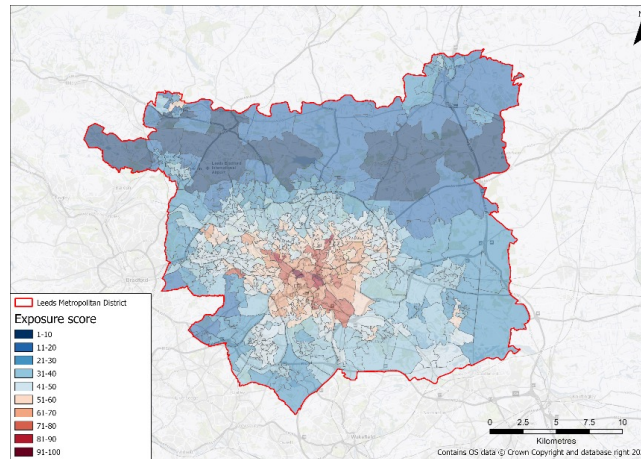
CVI



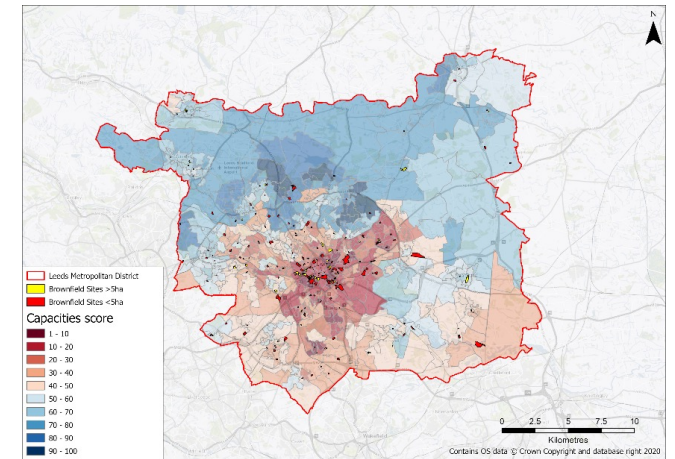
Sensitivity



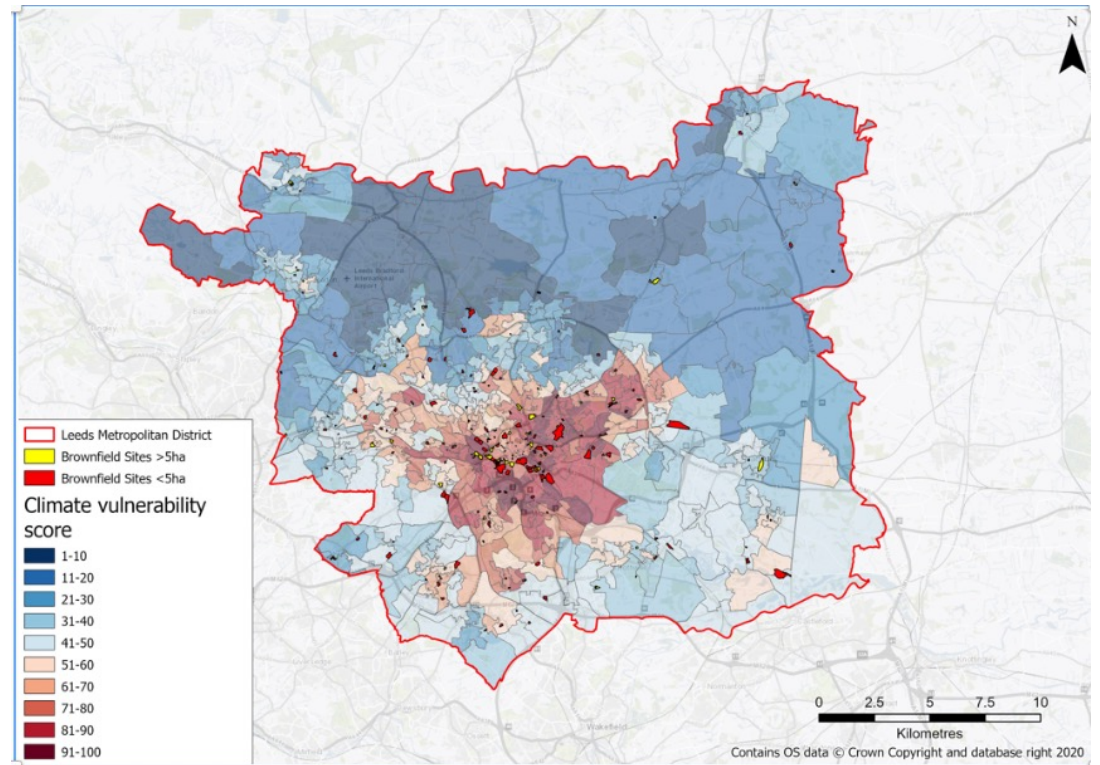
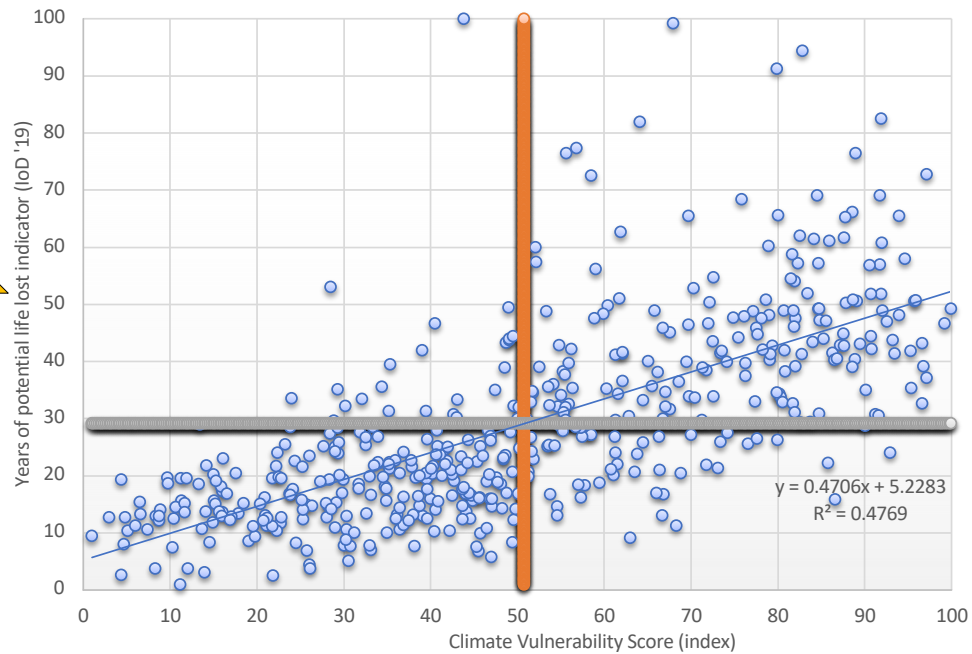
Exposure



Capacities



Climate vulnerability of Leeds

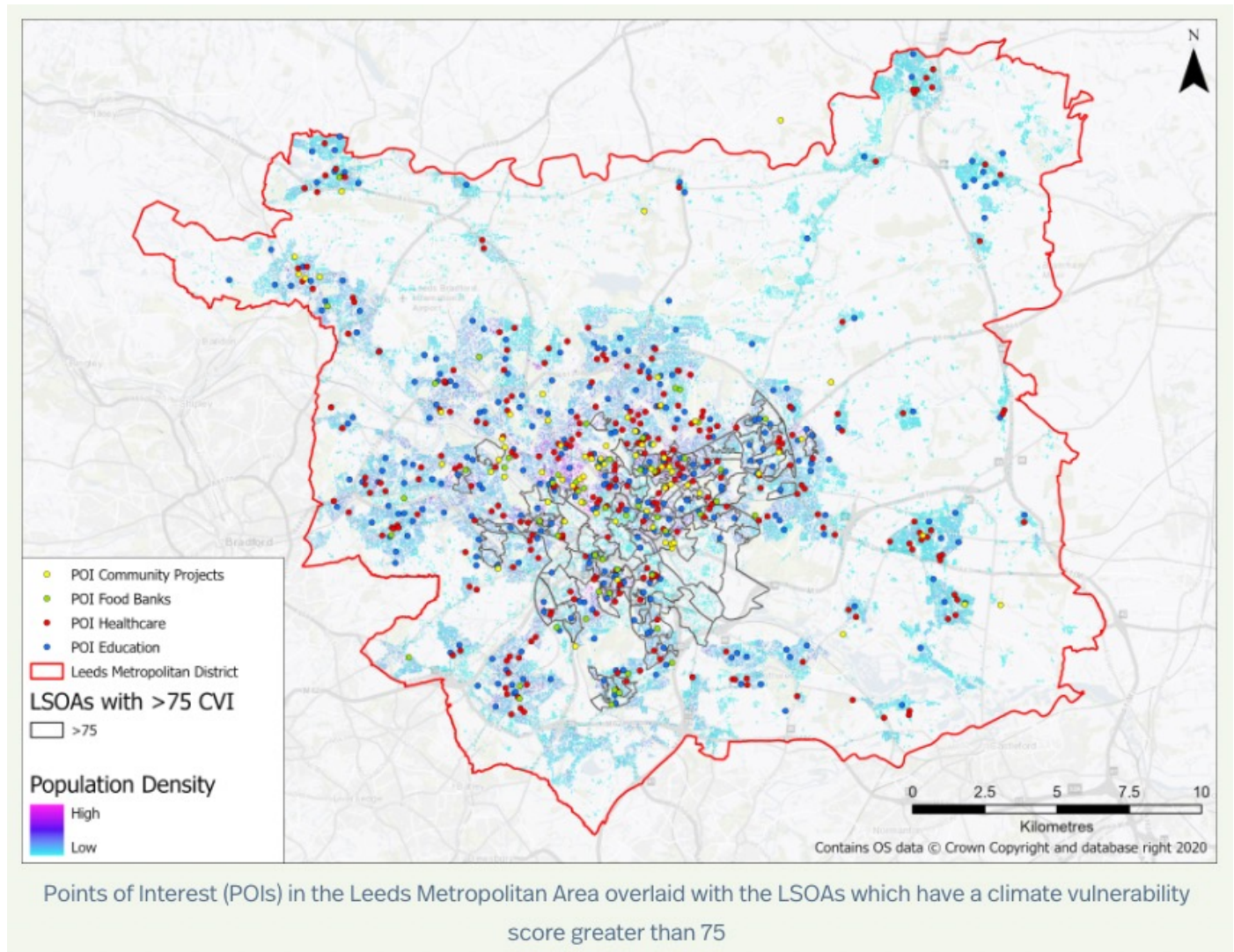


© Paola Sakai

The higher the vulnerability, the higher the years of potential life lost

Points of interest

Community projects
Food banks
Health care
Education



Multi-Criteria Decision Analysis

Is a decision-making tool that enables you to compare different factors and criteria

Criteria

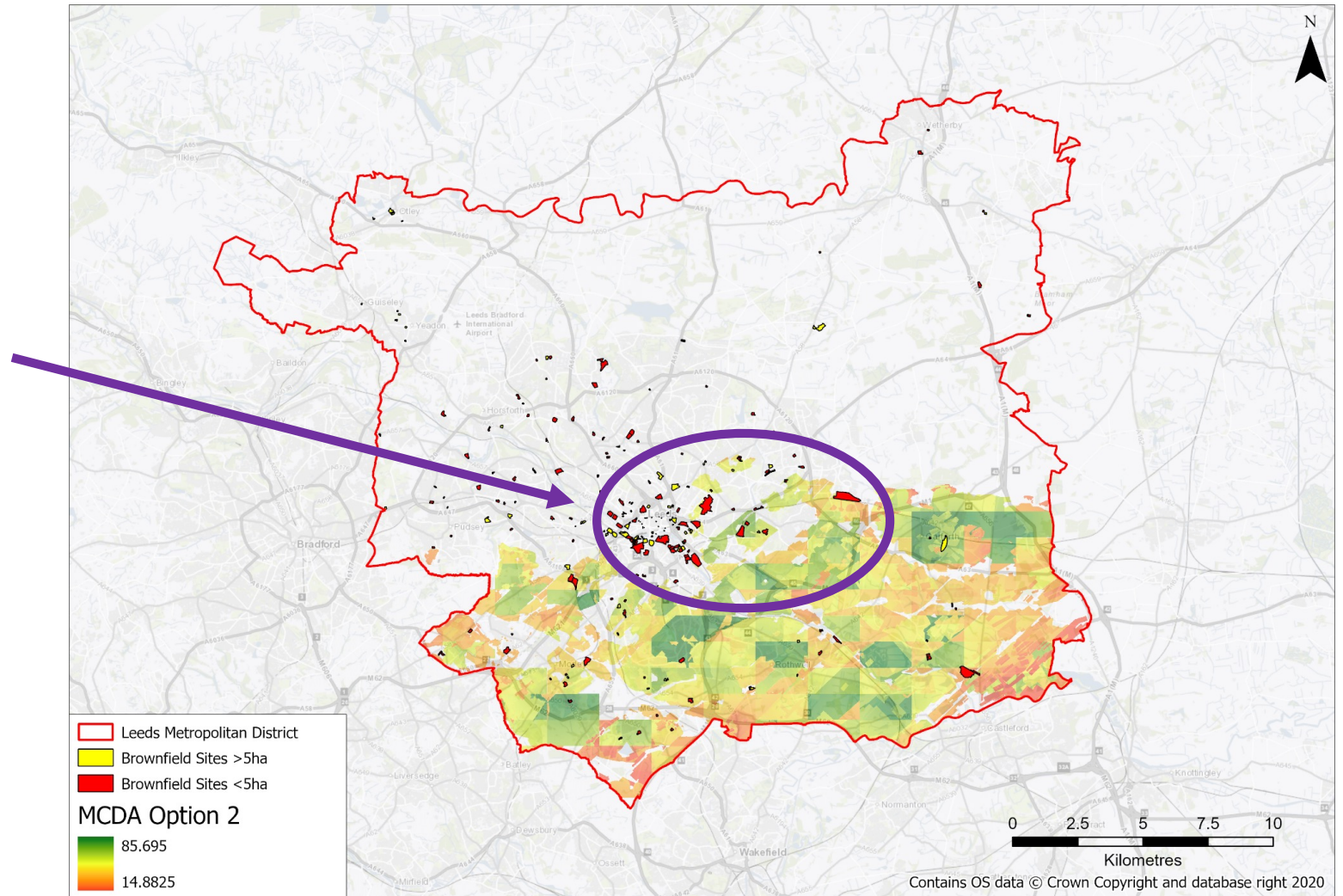
- Thermal potential
- Distances to POIs
- CVI –opportunity to increase climate resilient development
- Brownfield sites
- Economic viability
- Population density
- ...

Options

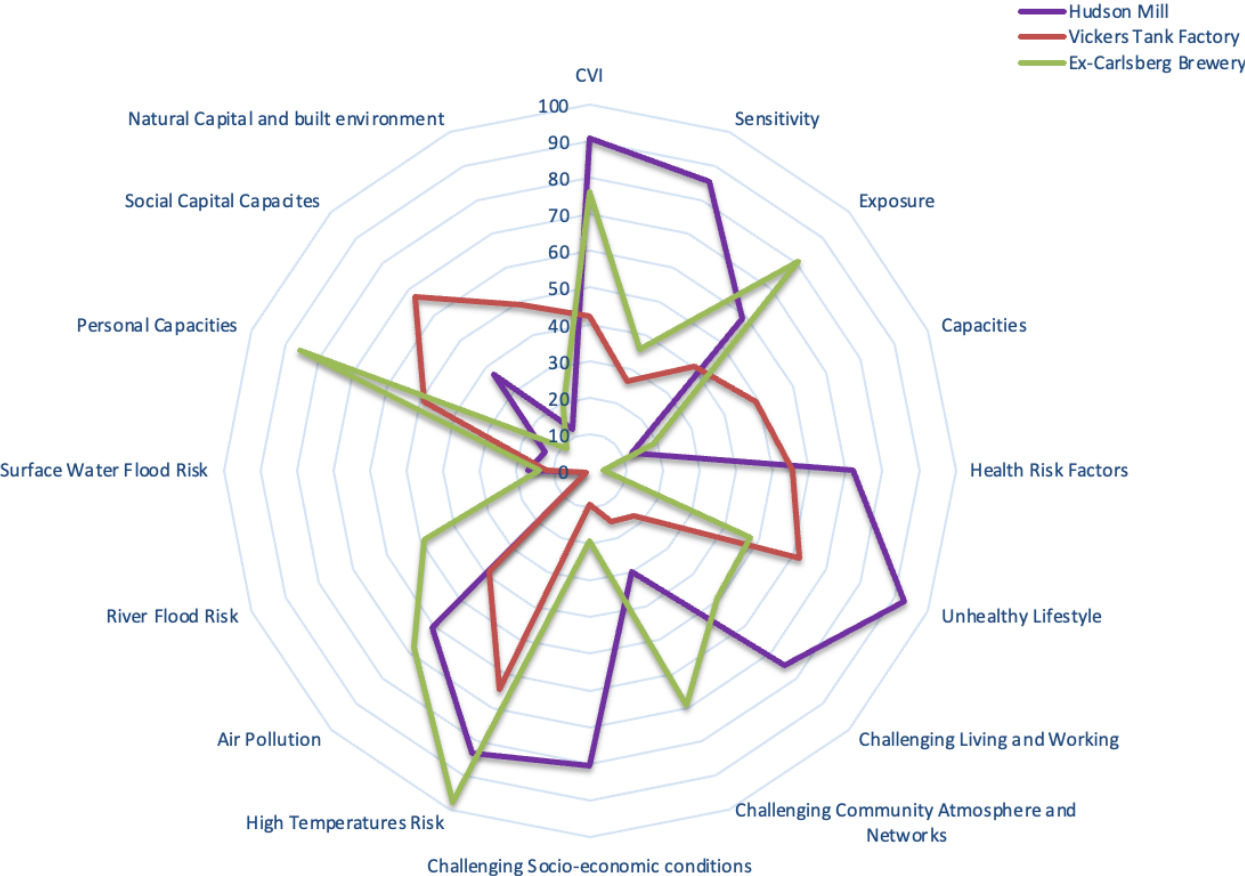
Criteria	Weight
1) Thermal potential, CVI, distances to POIs	33.33% each
2) Thermal potential, CVI, distances to POIs	50% thermal 25% each
3) Thermal potential, distances to POIs, CVI disaggregated	50% thermal 20% -Unhealthy Lifestyle 30%- all the rest

Example Potential Site

For example, through the MCA; this site would be an example of a site with potential



Climate Vulnerability of possible sites



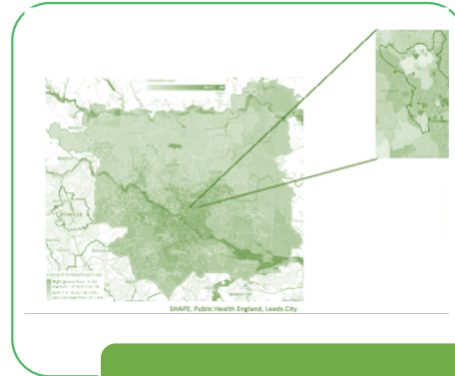
Next steps



VISION

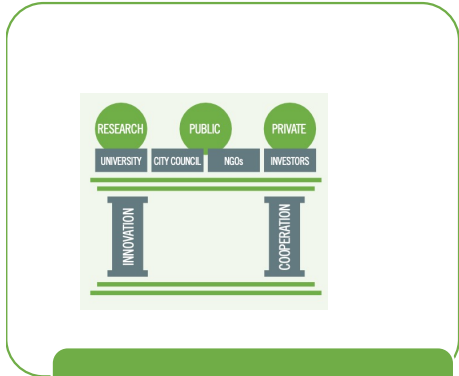


Proof of concept

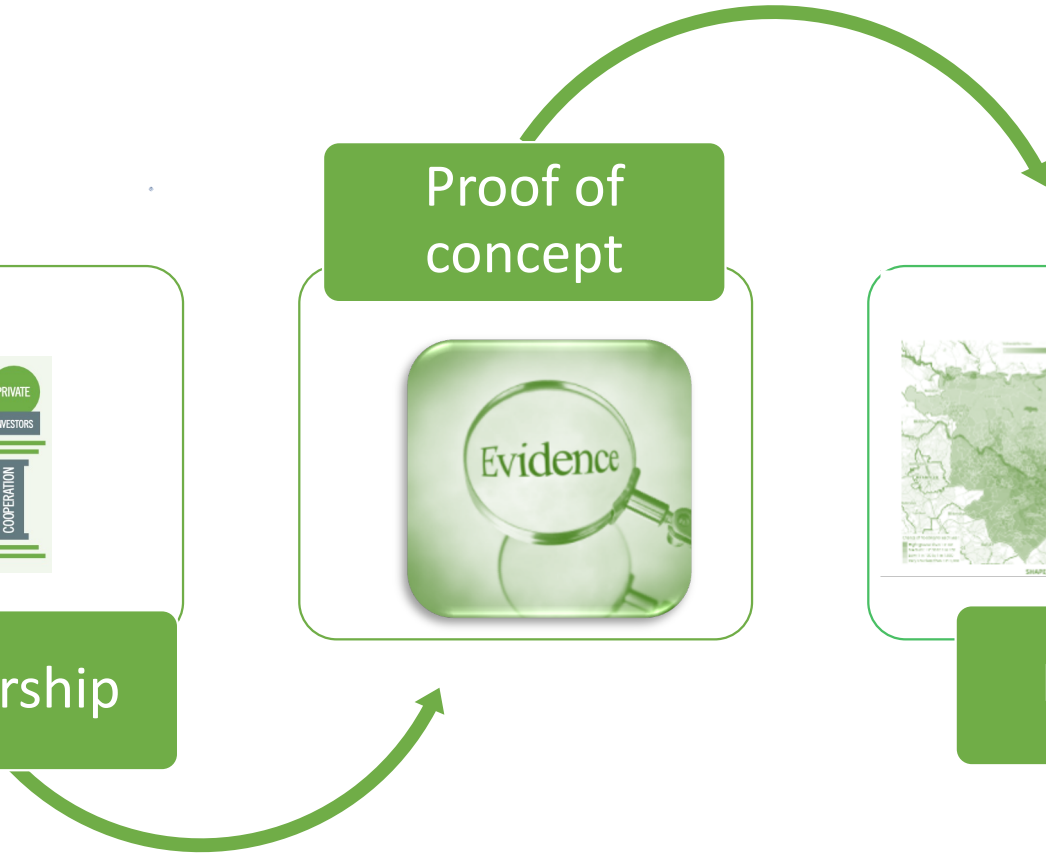


Living lab

Scale up technologies



Partnership



Thank you



Dr. Paola Sakai

P.H.M.D.Oca@leeds.ac.uk

 @PaolaSakai

© Paola Sakai

Michael Beverley
Innovation



Global Food and Environment
Institute



Universidad Nacional
Autónoma de México



Priestley International
Centre for Climate

