



Enabling geoexchange in cities: success factors from UK examples

David Barns

Priestley international centre for climate,
Faculty of engineering & Physical Sciences, Univ. of Leeds, Leeds, LS2 9JT, UK
d.g.barns1@leeds.ac.uk

7th International Conference on Smart Energy Systems

21-22 September 2021

#SESAAU2021

The Problem



UNIVERSITY OF LEEDS

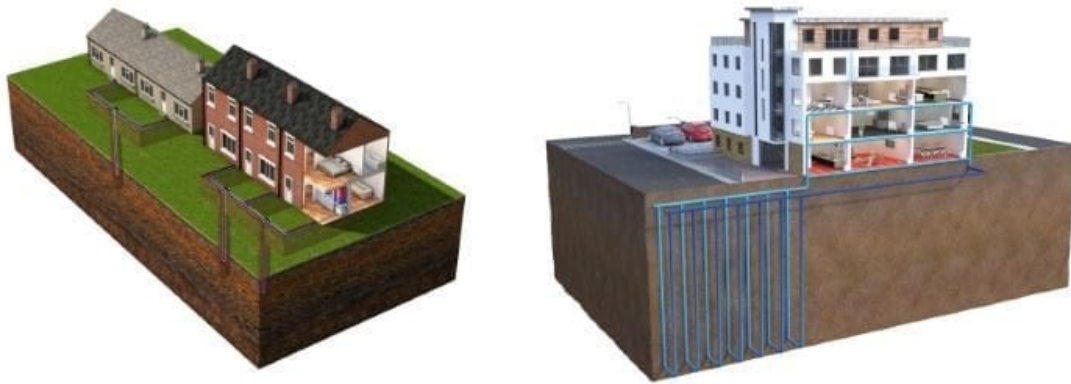


- Globally heating and cooling accounts = 50%+ global energy consumption, $\frac{1}{3}$ carbon emissions
- In the UK, 84% of homes have natural gas boilers, under 2% low carbon heat, housing stock worst in Europe
- UK target 900,000 heat pumps/year by 2028. Currently 30,000 compared to 1.6m gas boilers in 2020
- New build may be key to unlock cost reductions. Geoxchange offers a low carbon alternative but currently a niche technology in UK
- Local authorities have limited powers to set local policies for new developments

What is geoexchange?

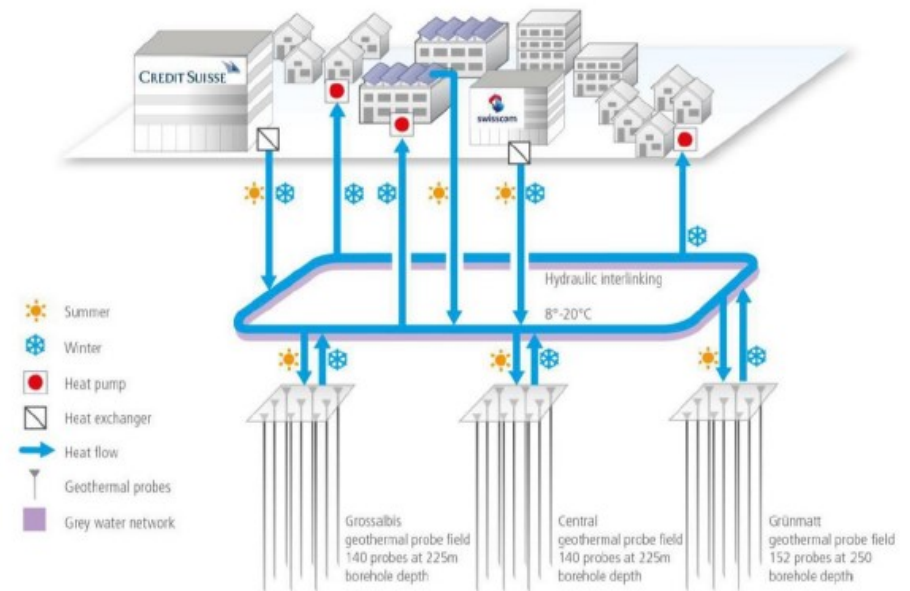


UNIVERSITY OF LEEDS



- Ground-coupled thermal storage
- Ground acts as a thermal battery
- Summer heat stored for winter use
- Maintains performance through 'active' recharge

- Combined with 5th generation heat network
- Balance a range of heat and cold users
- Provides heat and cold through distributed heat pumps



Case study of two major UK cities – Leeds & Bristol



UNIVERSITY OF LEEDS

- Comparative case study to explore why geoexchange is happening in some cities
- Analysis of 30 residential developments through desk research and interviews
- Planning applications, policies, interactions with planning authority, enforcement, outcomes
- Heating approaches included:
 - Geoexchange (8), direct electric (8), gas communal (4), Passivhaus (3), gas boilers (3), connect to city district heat (2), ASHP (2), Unknown (1)

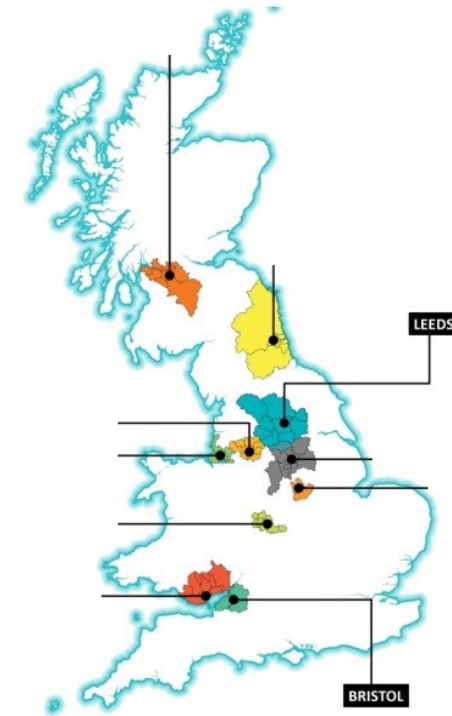


Figure 5 Core Cities (Irvine, 2017)



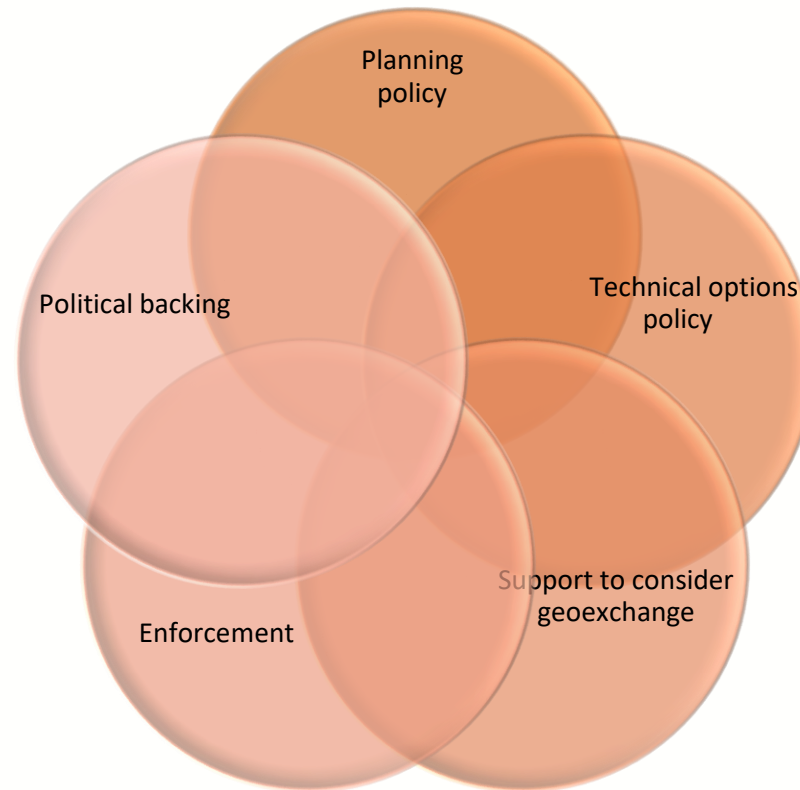
- Carbon reduction policies don't lead to low carbon heat technologies on their own
- Developers want lowest cost, lowest hassle heating option
- Developers have considerable scepticism about city district heating plans and bad prior experiences
- Energy consultants play important role but don't feel they can push for low carbon options
- Developers likely to move from gas boilers to direct electric heating unless compelled to choose other options – new building regulations will push this further



framework of geoexchange-friendly conditions



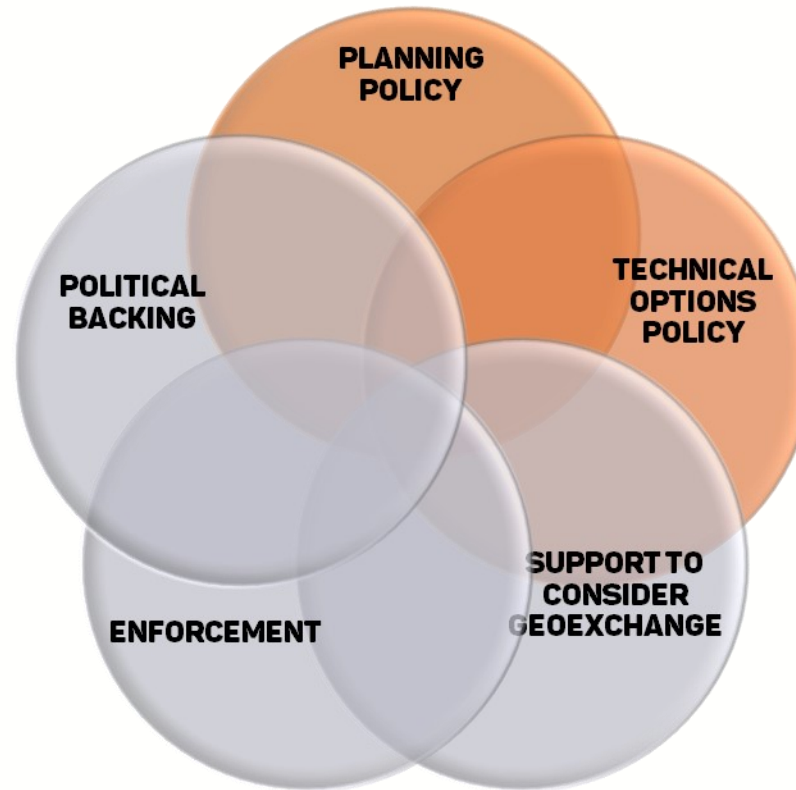
UNIVERSITY OF LEEDS



Findings – when most conditions are not met



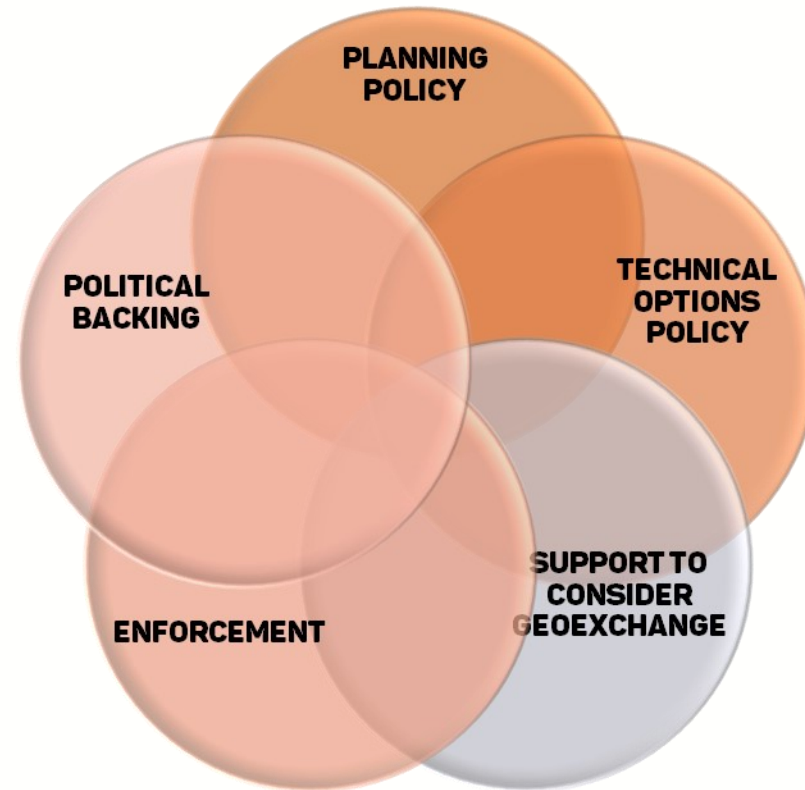
UNIVERSITY OF LEEDS



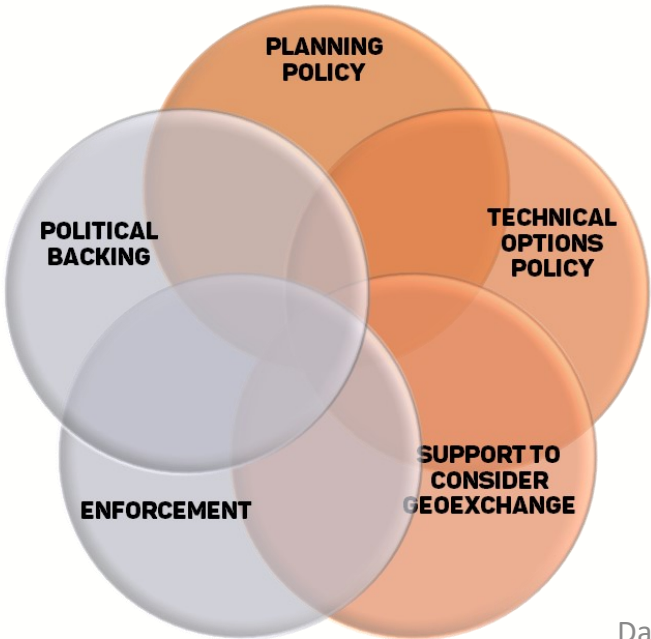
Findings – when most conditions are met



UNIVERSITY OF LEEDS



Findings – when most conditions are met

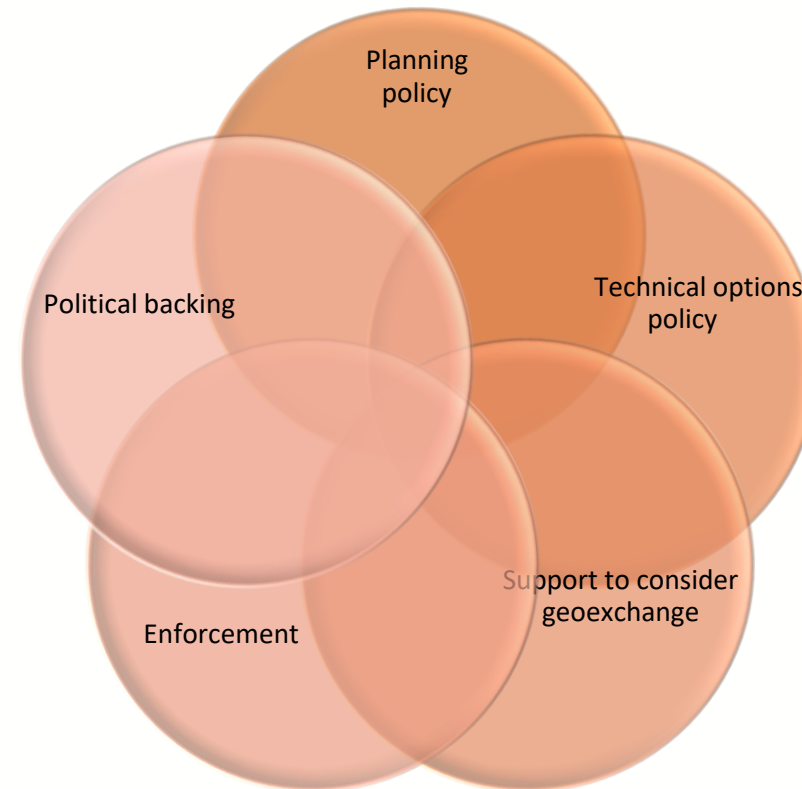


Outcome – framework of geoexchange-friendly conditions



UNIVERSITY OF LEEDS

- Planning policy, +
 - Geoexchange eligible, +
 - Default ineligible, +
- Intervention
 - Support to consider geoexchange, +
 - Enforcement, +
 - Political backing, =
- ...Geoexchange

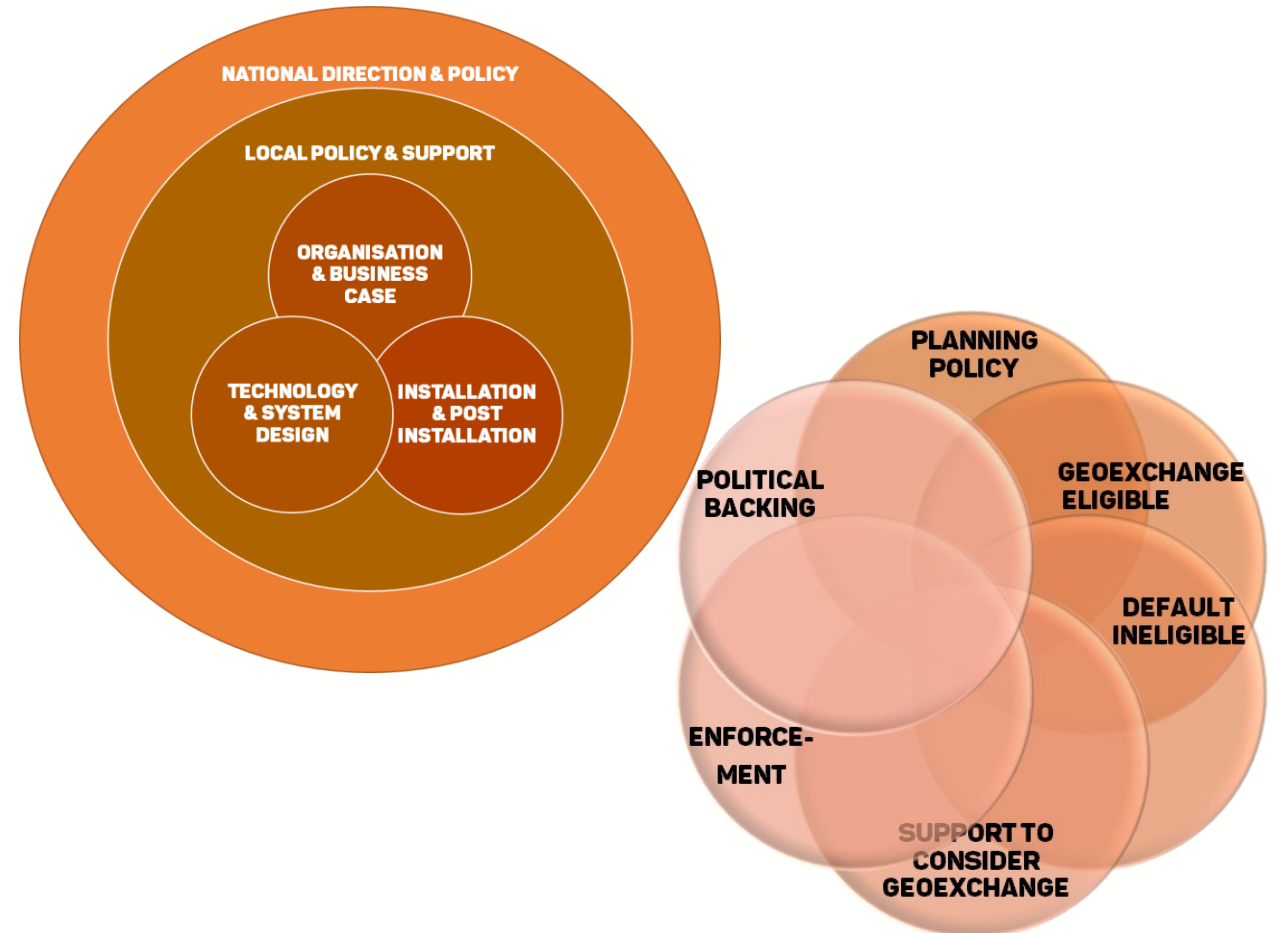


Conclusion and next steps



UNIVERSITY OF LEEDS

- Under the same regulatory framework, city authorities can deliver different outcomes in heat decarbonisation
- Georexchange requires (most of) a set of conditions to be met
- If only some conditions are met, developers default to conventional technologies
- What's next – policy briefing, engagement with local and national policymakers, local authority climate officers, developers





Thank you for listening

David Barns

d.g.barns1@leeds.ac.uk

[@dave barns](#)