Low-carbon heating alternatives:
Can they serve a just and sustainable future?

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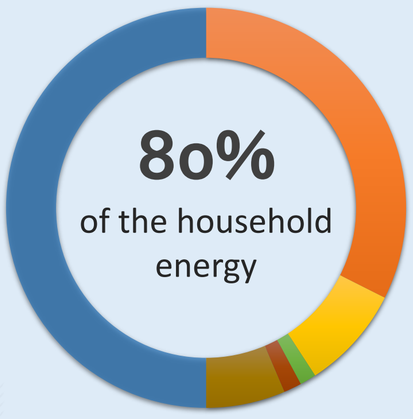
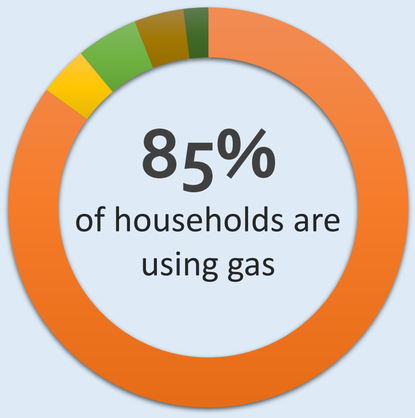
Background

Energy Sources



GHG Emissions



30% of household carbon emissions

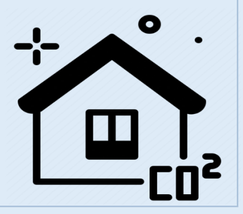
80% Non-fossil fuels target by 2050

Heating & Hot Water in UK Domestic Sector

* Clean Growth-Transforming Heat, 2018

80% reduction target by 2050

14% of all UK carbon emissions



Gaps & Challenges

There is still much uncertainty about the economic, environmental, and social implications of the heat decarbonisation.

Challenges

Financial Barriers:
High upfront costs, risk of fuel poverty, maintenance cost…

Technical Barriers:
Technology constraints, impact on power grid, building requirements…

Legislative Barriers:
Complexity of ownership, split incentives, rented sector uptake…

Knowledge gaps

Costs and emissions related to the life cycle stages of the energy systems are overlooked

Social complexities of heating systems such are often left behind in decisions and policies

Lack of quantitative research on fuel poverty and energy security

Aims & Objectives

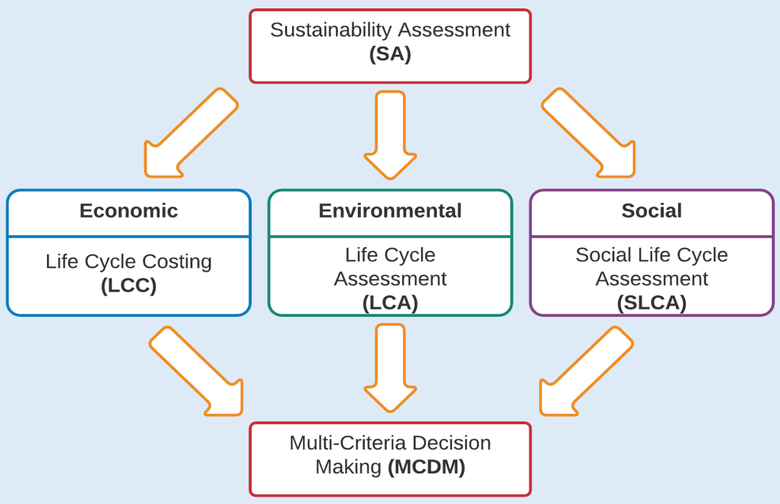
The research aims to develop a sustainability assessment tool to assess the capacity and readiness of low-carbon heating technologies for serving a sustainable and just transition.

Research Objectives

- Identify the low-carbon heating technologies in the UK building sector
- Identify and formulate the sustainability indicators of the building heating systems
- Development of the lifecycle sustainability assessment framework
- Applying the framework to the case study and assessment of UK decarbonisation scenarios

Methodology

A mixed method approach using a set of experts' interview, mathematical modelling and energy simulations is used.



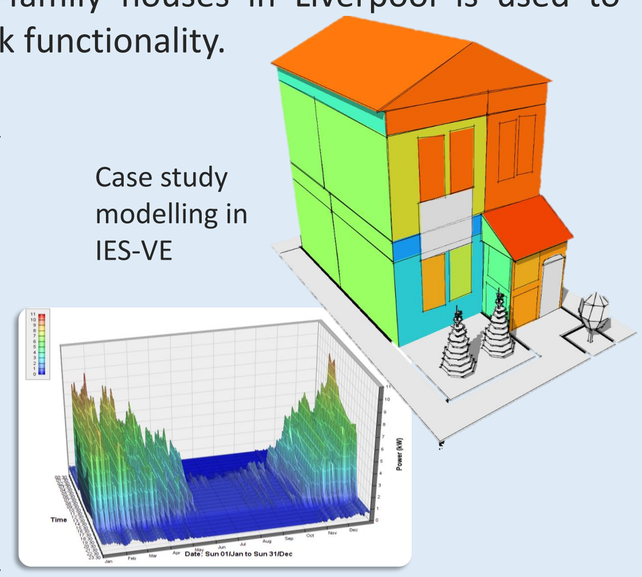
Case Study

The case of typical single-family houses in Liverpool is used to demonstrate the framework functionality.

Benchmark building specification

Property type	3-bedroom detached
Gross floor area	102 m2
External wall U-value	0.15 W/m2K
Floor U-value	0.11 W/m2K
Roof U-value	0.11 W/m2K
Openings U-value	1.19 W/m2K

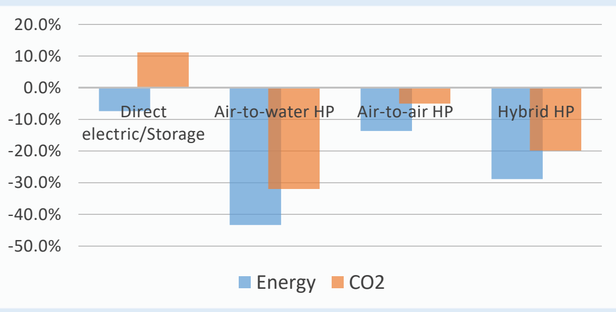
Case study modelling in IES-VE



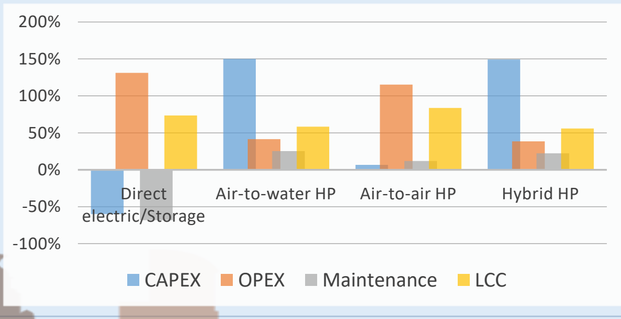
Results

Heating Source	Heating System
Gas boiler (basic system)	Central water radiators
Direct electric heater	Local unfanned electric
Air-to-water heat pump	Central water radiators
Air-to-air heat pump	Central single duct VAV
Hybrid heat pump	Central water radiators

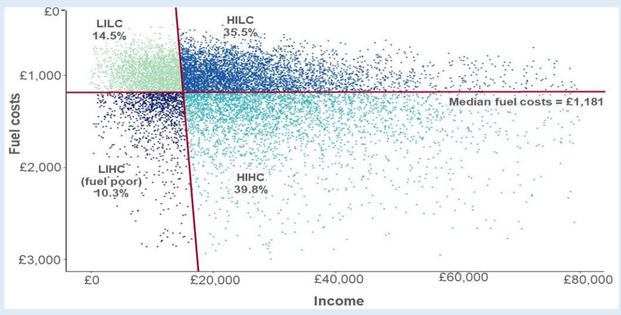
Variations of environmental factors



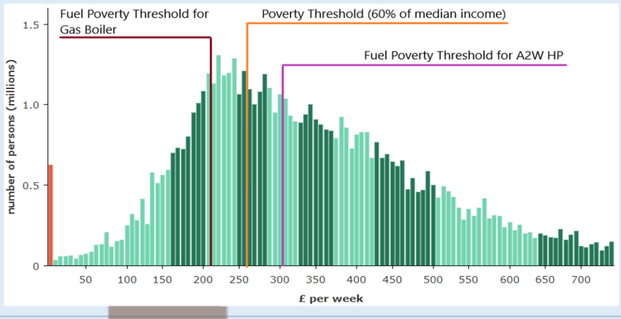
Variations of cost factors



Current fuel poverty indicator



Impact of heating system on fuel poverty



Initial Conclusions

Initial results raise doubts about the sustainability and fairness of some alternatives such as heat pumps which are mostly promoted in the UK strategies.

For example, our results show that HPs could expose more 6.5 million household to the risk of fuel poverty.

Your knowledge and experiences will help us to improve the project. To contribute please contact us via **M.H.Abbasi@2019.ljmu.ac.uk**