Value of Active Buildings in the Future Great Britain's Energy System

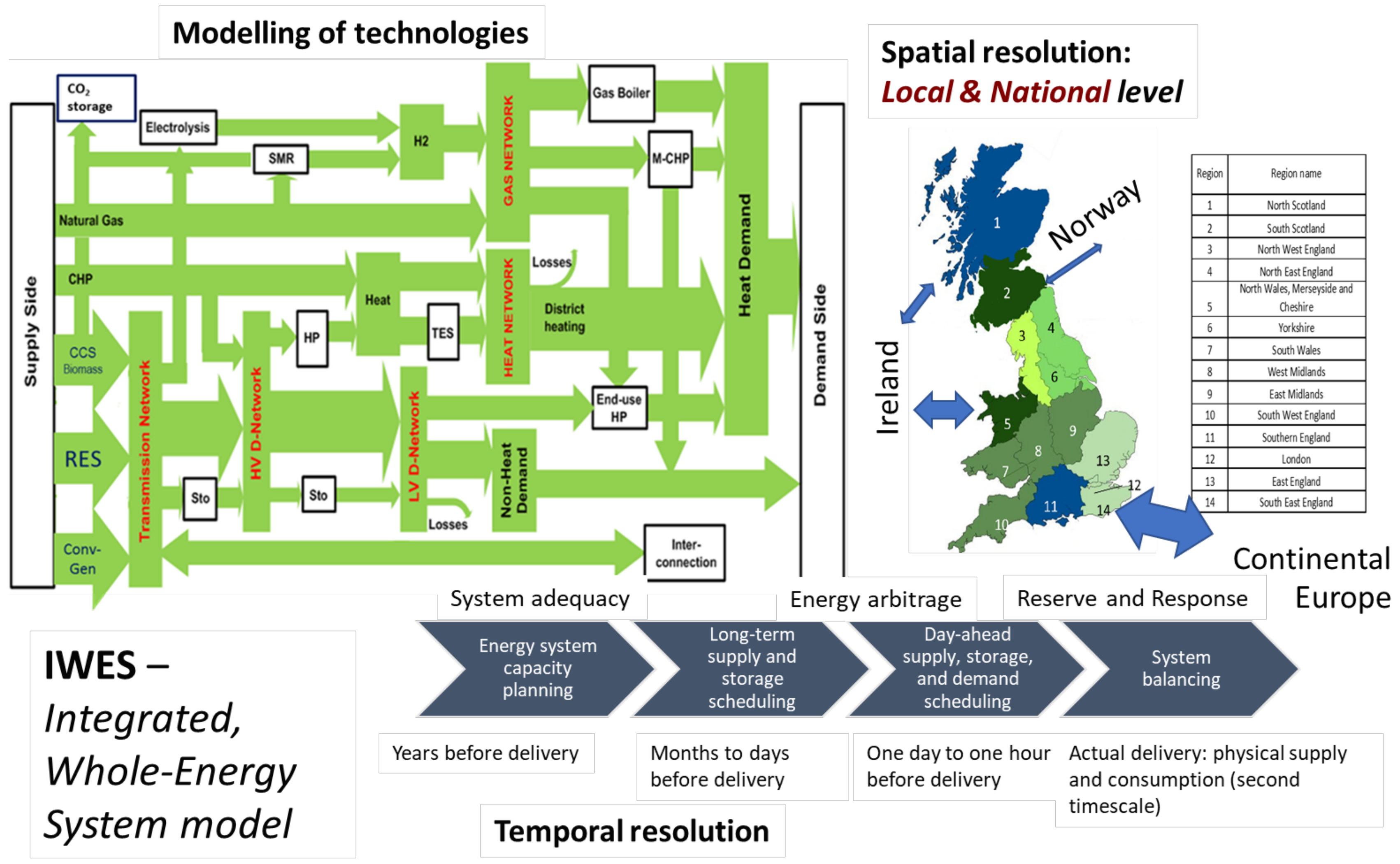
ACTIVE BUILDING CENTRE RESEARCH PROGRAMME

Introduction

The slogan 'Think globally, act locally' has been an integral part of developing business strategies and climate actions, but how relevant it is in the context of Active Buildings (AB)? The transformation from passive to AB enables heat and electricity demand or generation to be controlled and adjusted. The objective is often to minimise peak demand, improve self-consumption of energy generated locally from solar PV or solar thermal, and reduce the building's carbon footprint. The key question is whether **minimising the impact of increased electrification or distributed generation connection on the local energy system using the AB's flexibility will be the best strategy or shall we optimise the AB's flexibility from the whole-system perspective?**

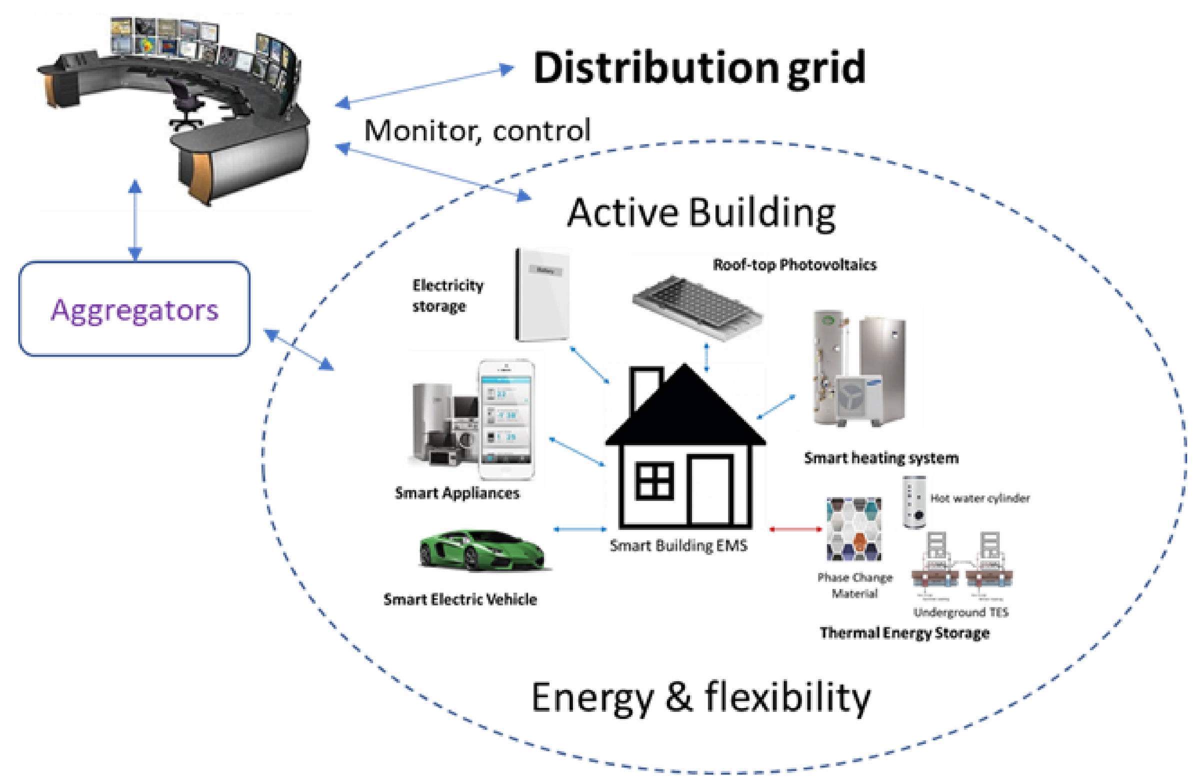
Modelling approach

To study the interaction across multi-energy vectors (electricity, heat, hydrogen) and analyse the impacts of local or whole-system optimisation for AB's flexibility on the UK energy infrastructure, a set of case studies were simulated and optimised using the Integrated Whole-Energy System (IWES). The IWES model incorporates spatial and temporal details to determine the optimal investment and operating strategies for all system components to achieve the carbon target. The model is shown below.



IWES – Integrated, Whole-Energy System model

Local-system approach



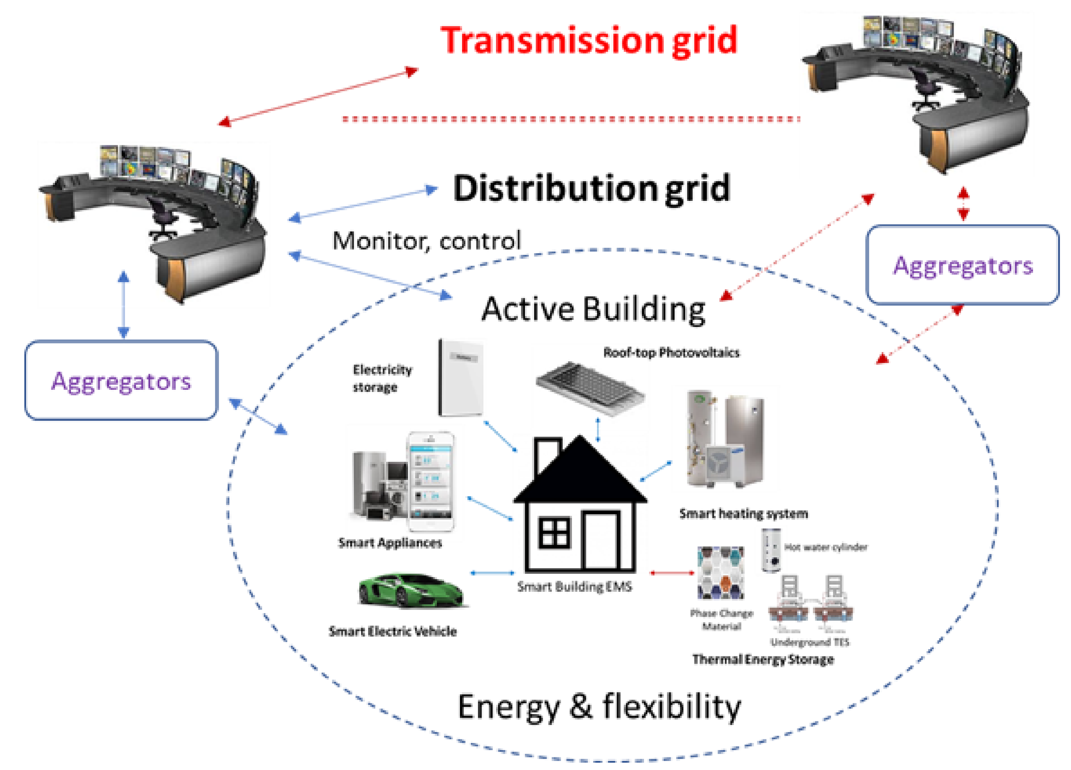
Objective:

Minimise whole-system cost using the AB flexibility

AB functionalities:

- Modulate demand and generation (arbitrage)
- Provide system ancillary services
- Balancing (frequency response and operating reserve) services
- Network congestion management for both local and national gird

Whole-system approach



Objective:

Minimise reinforcement cost of local distribution network using the AB flexibility

AB functionalities:

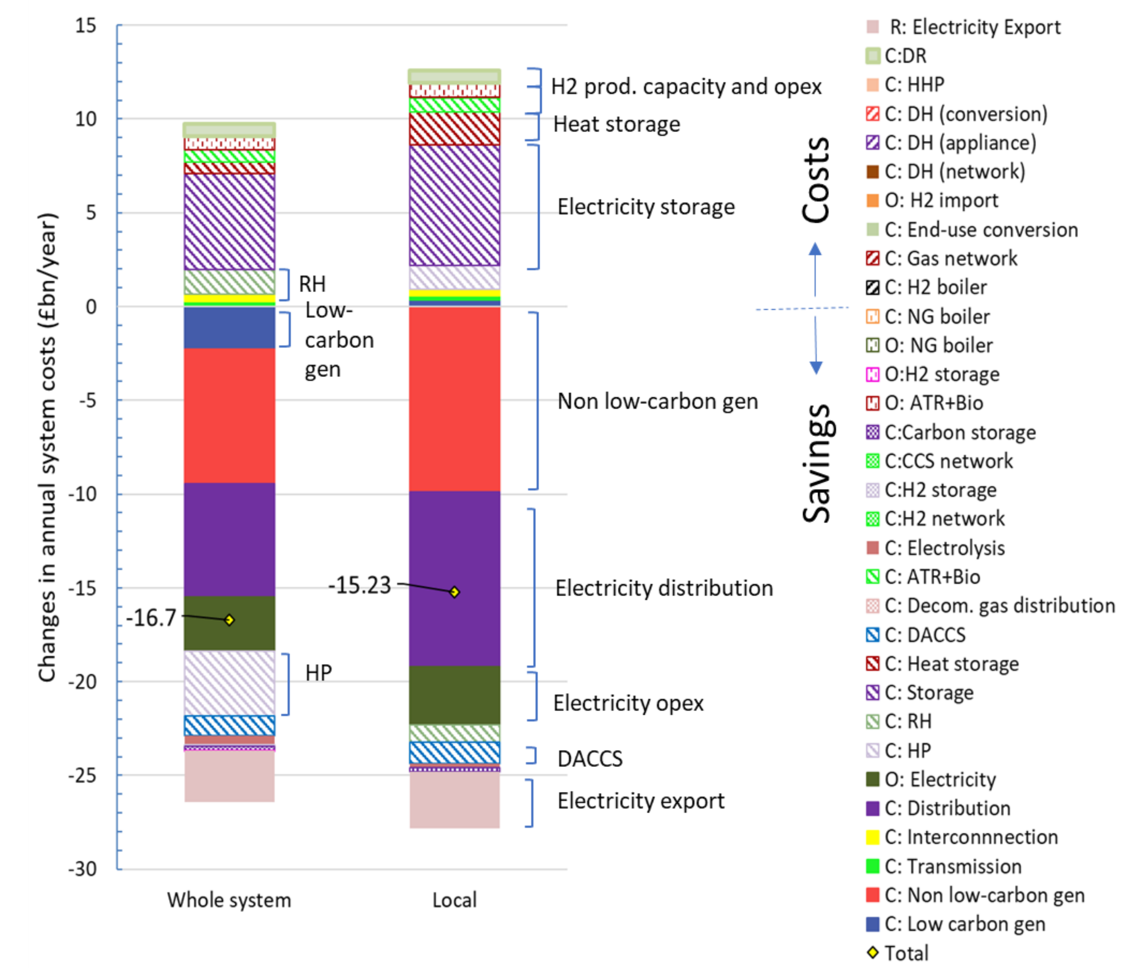
- Minimise peak demand
- Improve self-energy consumption at the local grid system
- Provide flexibility to alleviate local network constraints

Key findings

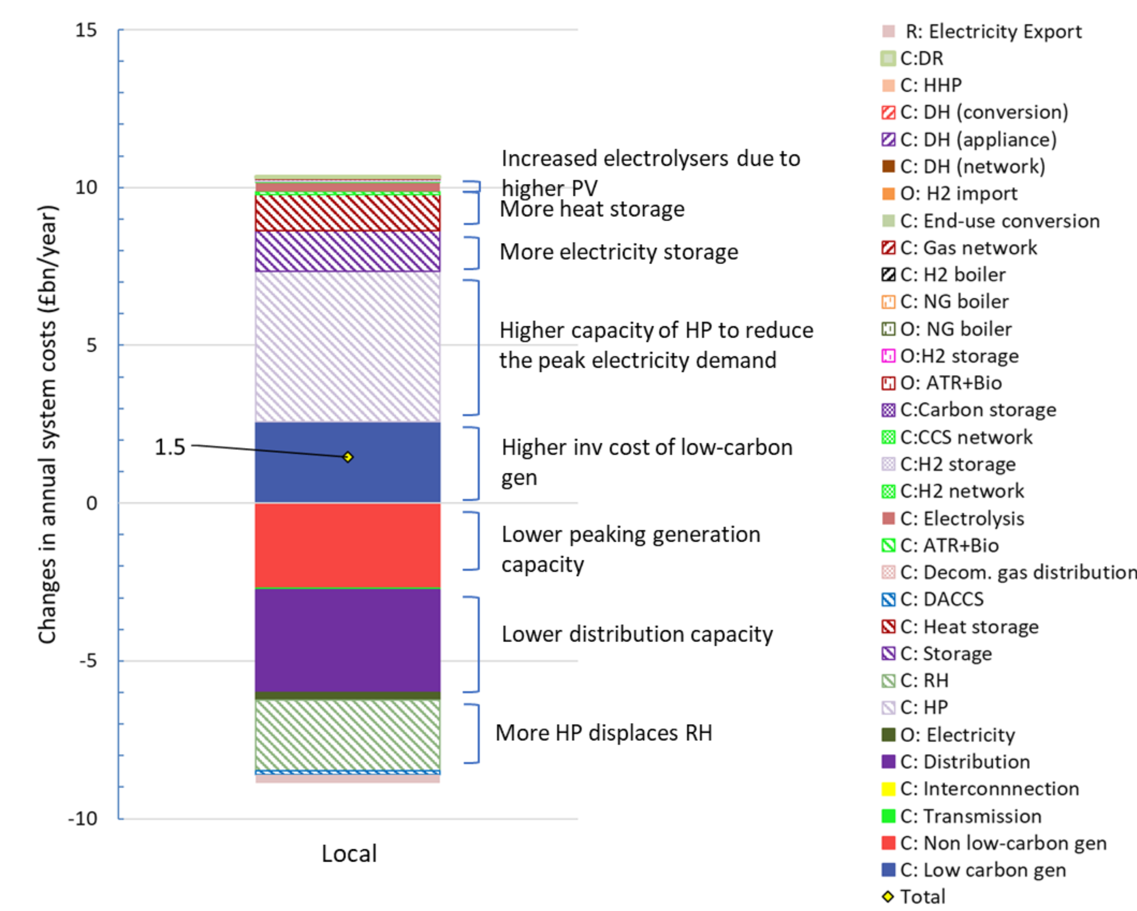
- Benefits of system flexibility: 15 - 17 £bn/year
- If the flexibility from AB is used only to minimise local system cost, it will increase the annual system cost by £1.5bn/year.

	Whole-system approach	Local prioritisation
Peak electricity	More distribution networks (to access flexibility from ABs)	Less distribution networks
Electricity distribution	Larger capacity	Less capacity
Generation	More large-scale low-carbon generators at Tx More peaking capacity	More smaller low-carbon DG (e.g. PV) at Dx Less peaking capacity
Contracted capacity of flexibility assets (e.g. demand response, energy storage)	Lower	Higher
Heating appliances	Optimal mix between low-cost resistive heating and high-cost heat pumps	Heat pumps

System benefits of Active Buildings' flexibility



Impact of local optimisation



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