Optimization of Residential Energy Networks and Systems

ACTIVE BUILDING CENTRE RESEARCH PROGRAMME

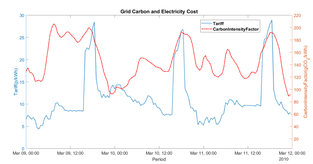
Introduction

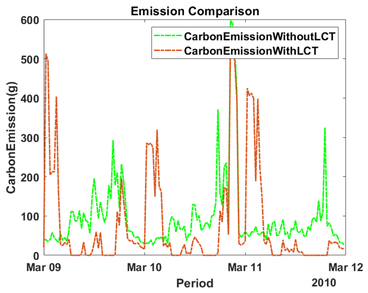
Is it possible for individual dwellings and communities to reach net zero carbon emission with lower cost by 2050? While many factors may influence this important question and is subject to the national grid projections of future scenarios, one way of assessing its feasibility is by modelling individual dwellings and communities with available datasets using different optimization techniques and machine learning algorithms. The following ongoing studies focus on three different aspects that can help us dive deeper into the future of the energy systems and networks.

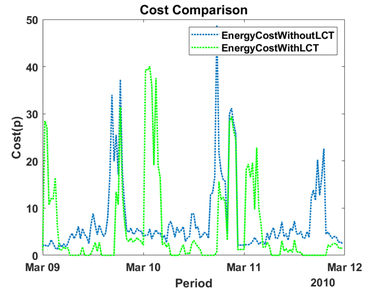
Multi Year Low-Order Community Energy Modelling

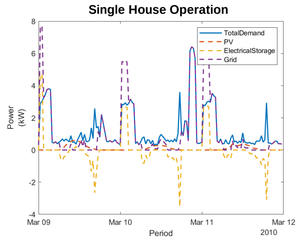
Half-hourly community energy flow modelling and optimization with varying levels of low carbon technology and building enveloping interventions to achieve the lowest carbon emission and energy cost over a given period.

ScenarioNo	Annual_CarbonIntensity_gperkWh	Annual_ElectricityCost_GBP	Annual_Income_GBP	Scenario Description
Scenario 1	187.9509913	2090.15	0	All Electric with 100% EV
Scenario 2	174.3040398	1845.15	0	All Electric with 100% EV,100% HP
Scenario 3	174.2552043	1700.72	31.53202379	All Electric with 100% EV,100% HP, 100% PV
Scenario 4	166.3438135	1453.47	10.50825618	All Electric with 100% EV,100% HP, 100% PV,100% ESS



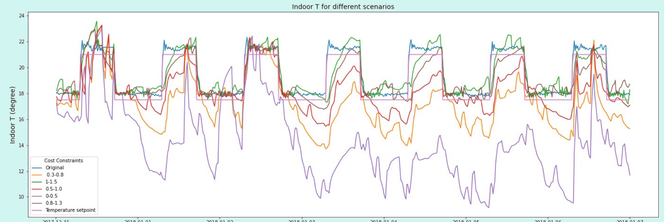


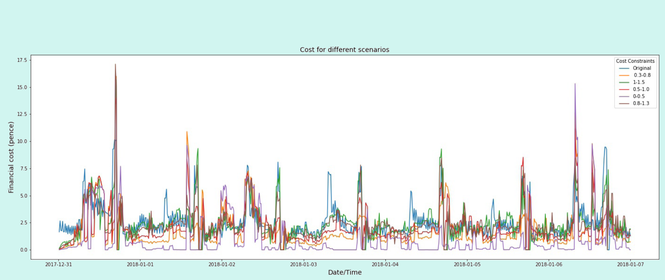


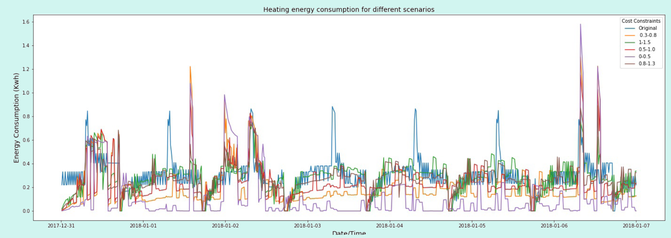


Data-Driven Model Predictive Control

The online Cluster, Classify, Regress (CCR) model is developed to control the building systems (e.g. battery, ground source heat pump, thermal storage).



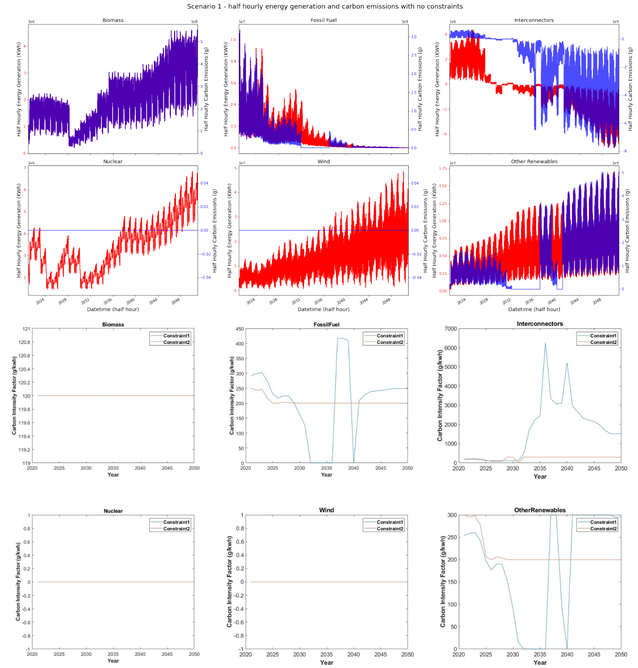


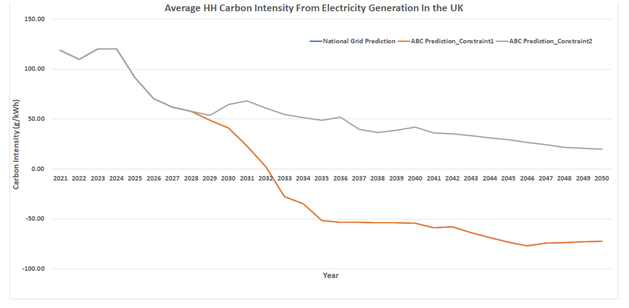


This online controller helps to maintain comfortable indoor temperature while minimising the running cost of the GSHP.

30 Year Half-Hourly Grid Carbon Modelling

XGBoost based prediction of electricity generation and SLSQP optimization of carbon intensity factors to derive a half hourly grid carbon emission profile until 2050.





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