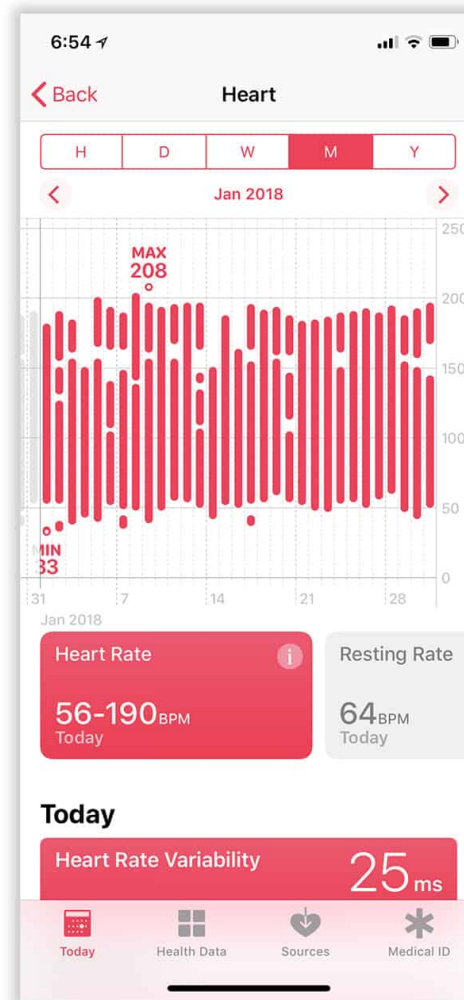
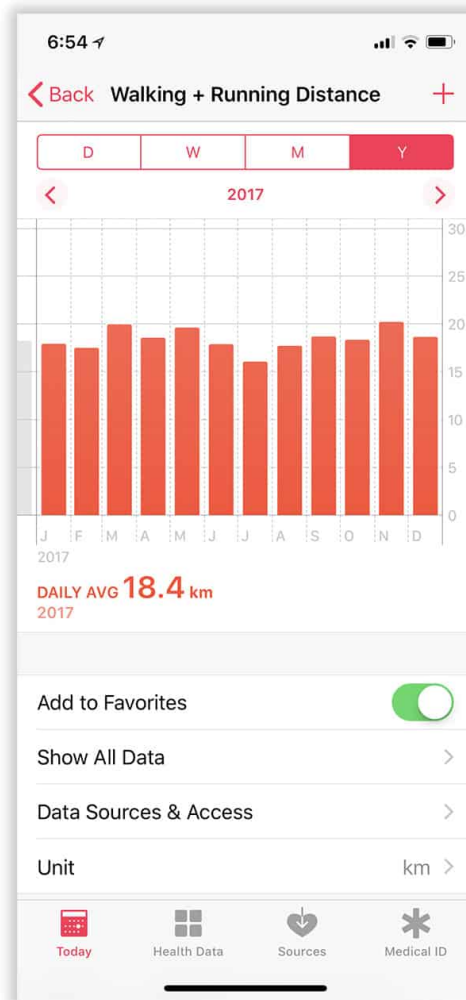
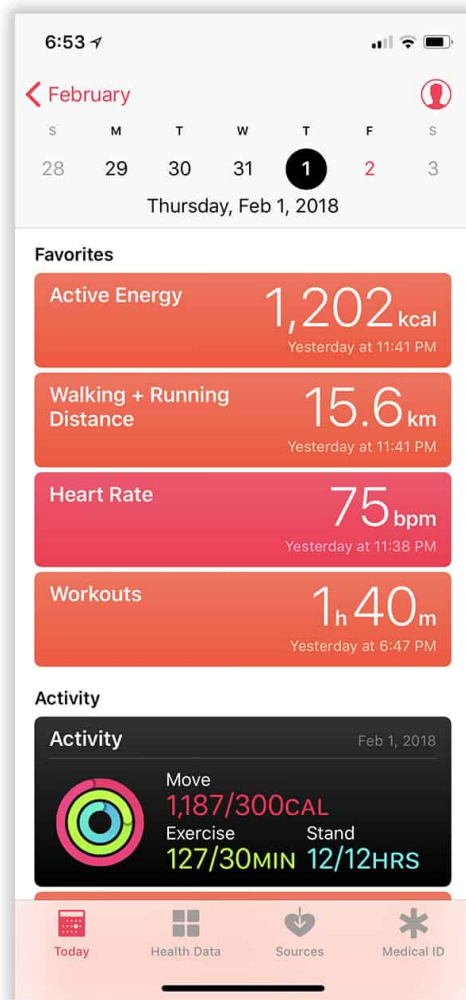


# Smart Connected Buildings

## Healthy Cities Design 2019

# Today's Consumers: Health Conscious - Environmentally Aware - Design Literate

Ryder



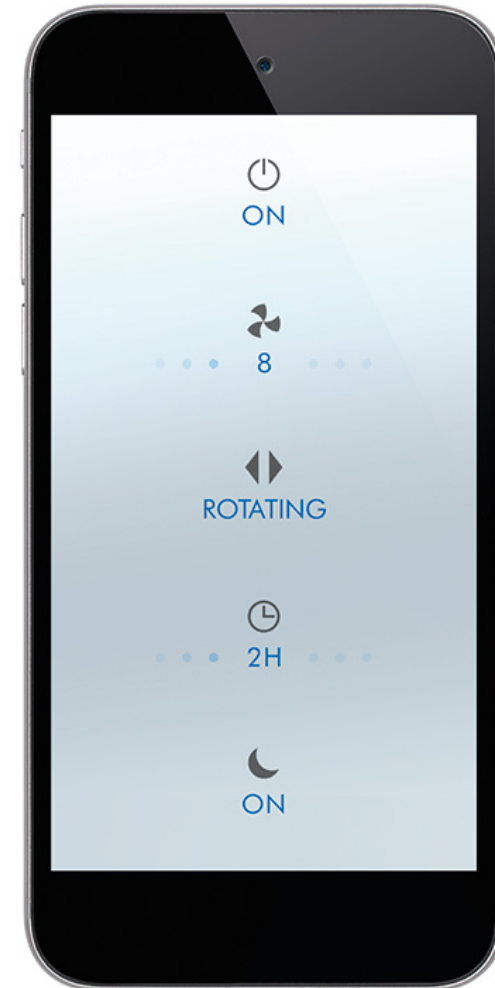
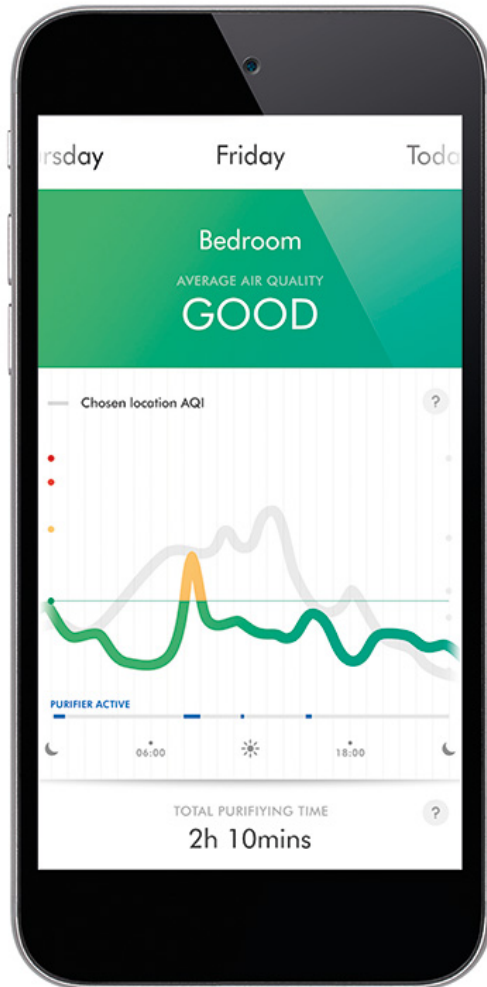
## A Growing focus on External Air Quality

Ryder



## Internal Air Quality – Smart Home Appliances

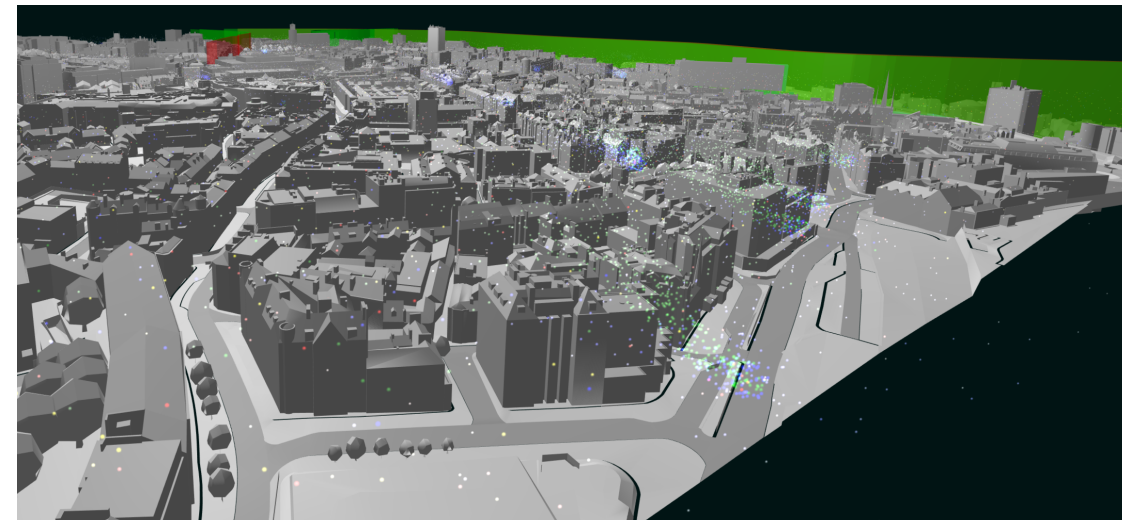
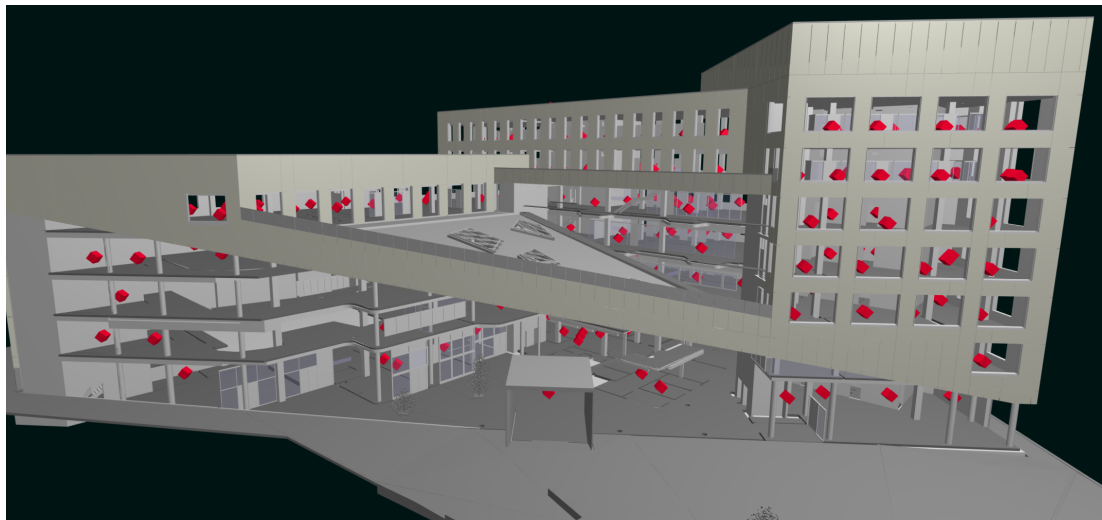
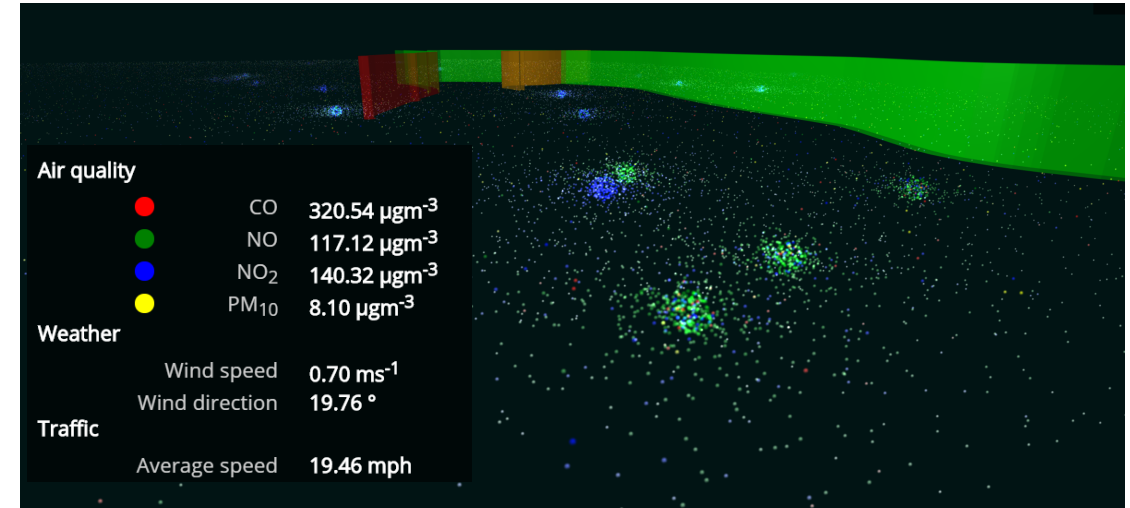
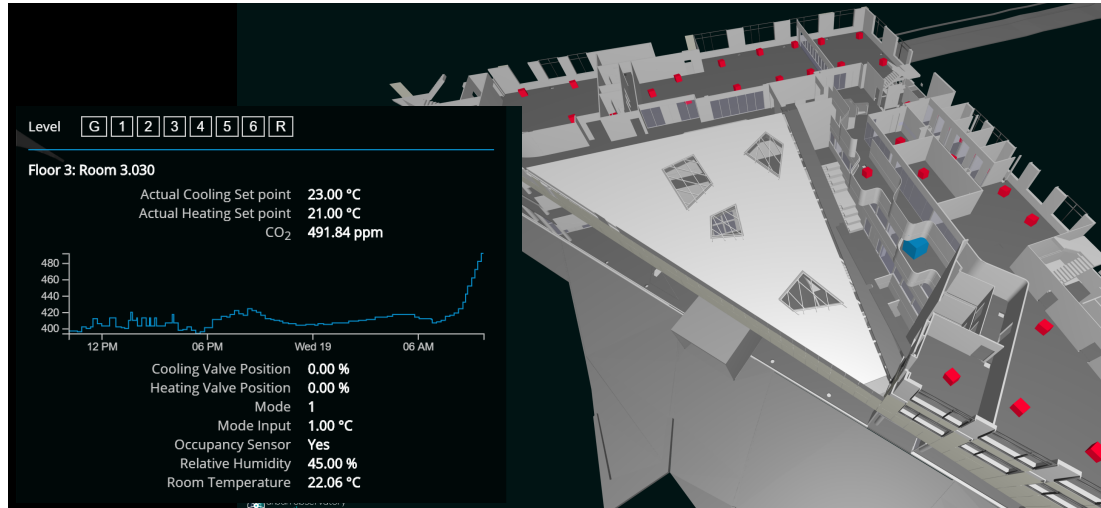
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# Urban Observatory: The Living Lab = Building as a Lab | City as a Lab

Ryder



Healthier Buildings, New Technologies and Data

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Farmer Report - Hackitt Review

Procuring for Value - CLC

Reinvention: Leadership Collaboration Skills and Technology.

Focus on:

Health + Wellbeing

Social Health – Resilient communities

Environment Health – Zero Waste

The Living Lab - Building as a Lab / City as a Lab



## Understanding the performance gap

Understanding the deficiencies in design, construction and commissioning processes that result in the difference between expected and realised building performance is critical.

Ongoing project to investigate the feasibility of a platform for performance measurement in buildings (in this case tenanted properties) by linking in-use environment data with information about the design specification, material construction and property assets.

The research team integrate building information models (BIM) with occupant data and real-time in-use data captured through environmental sensors.

## Technology Environments and Behaviour: Smart Connected Buildings

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Open and scalable platform that is hardware and software agnostic.

Innovate UK funded social housing pilot study.

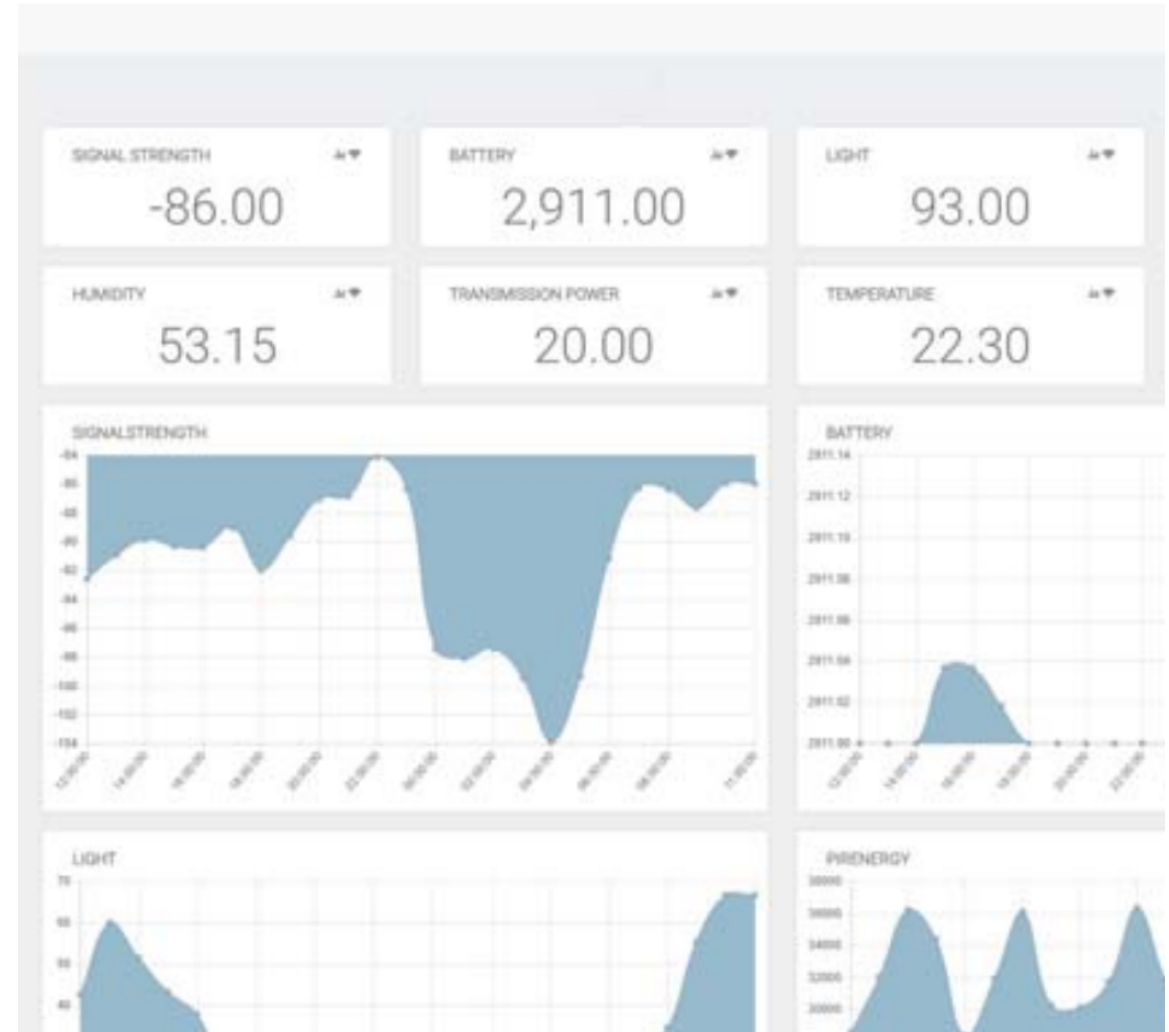
Residential wellbeing metrics.

ERDF funded research to provide actionable health and wellbeing advice to occupants.

Implications of Hackitt Review and high rise building application.

Continued development with Housing Associations in England, Scotland, Canada, New Zealand and Australia.

Applications in other residential and workplace projects.



## Methodology

Qualitative interviews with stakeholders at the social housing partner organisation to understand current maintenance regimes. Thematically analysed to determine a set of prioritised stakeholder information needs.

Use case scenarios based on the information needs, building design & performance and industry standards were developed and tested within the project.

A sensor infrastructure for in-use monitoring was defined

A total of 68 sensors were deployed across seven apartments within a single apartment block, and on average data were captured for six months from each apartment.

A sensor agnostic platform was developed that allowed data of any type ( for example real-time temperature data or static occupant data) to be linked to the spatial data of the building model. Data visualisation techniques were used to display the real-time building performance data in the context of the spatial building model.



## Sensors and Platform

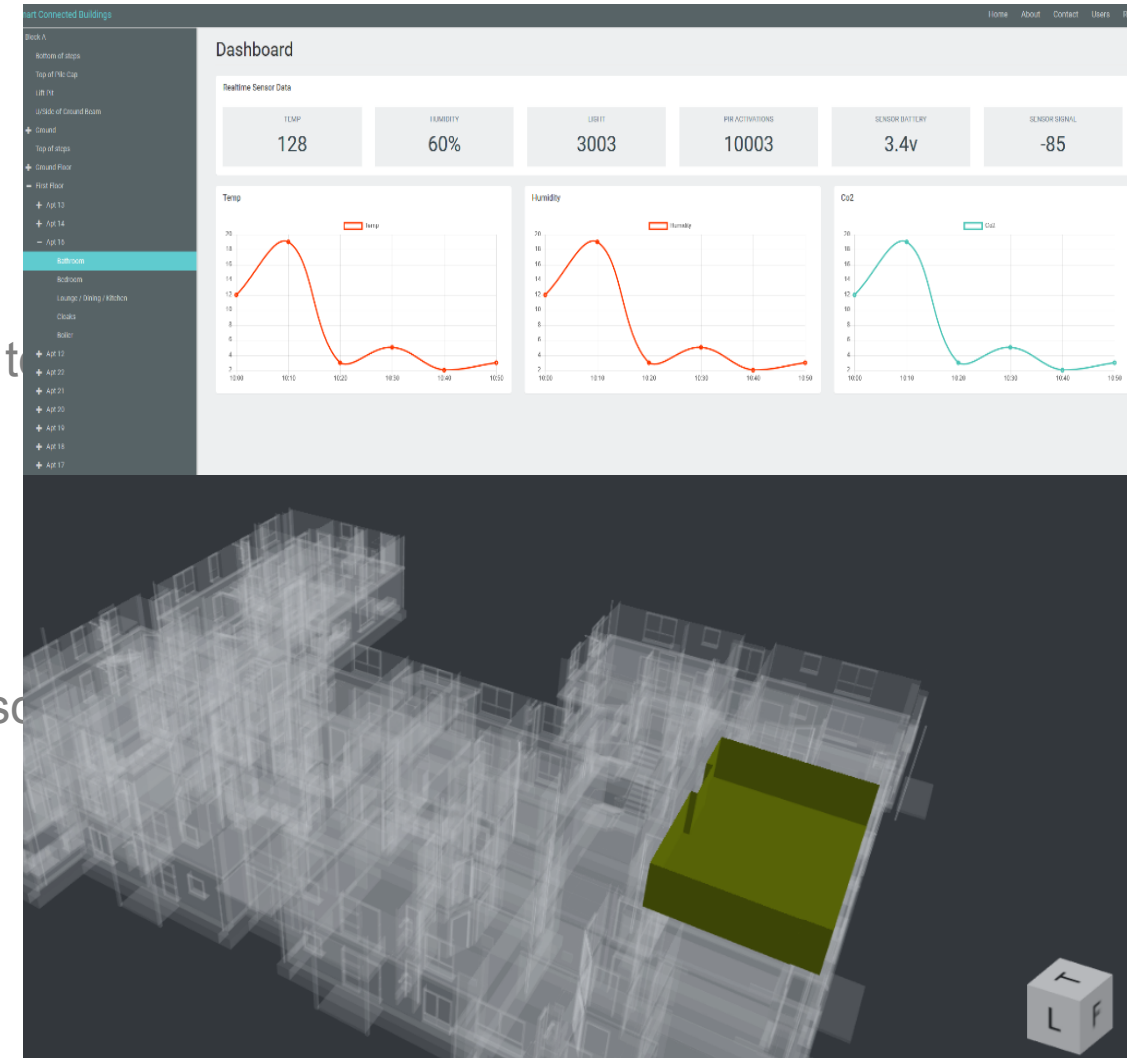
Sensor monitored temperature, ambient light and humidity.

CO2 sensors were used to detect if people were in the properties and if ventilation was adequate.

Heating activity was monitored through clamps on the boiler to give insight into how the heating system was used.

Additionally, power consumption was monitored to highlight activity such as cooking, which may generate humidity.

A web-based prototype was developed linking real-time sensor data to a BIM model to provide the navigational structure for navigating the information.



## Outcomes

A total of 68 sensors were retrofitted across seven apartments within a single apartment block, on average data were captured for six months from each apartment.

15 use case were identified from initial interviews:

4 related to energy cost savings, 8 to occupancy comfort and health primarily around overheating, under heating, damp and respiratory issues and 3 related to building performance.

Measures of humidity featured most significant as it has a direct relationship to wellbeing and maintenance. Followed by over and under heating of properties and light levels.

A sensor infrastructure for in-use monitoring was defined.

A sensor agnostic platform was developed that allowed data of any type ( for example real-time temperature data or static occupant data) to be linked to the spatial data of the building information model.

Data visualisation techniques were used to display the real-time building performance data in the context of the spatial building model to provide actionable advice.

## Conclusion

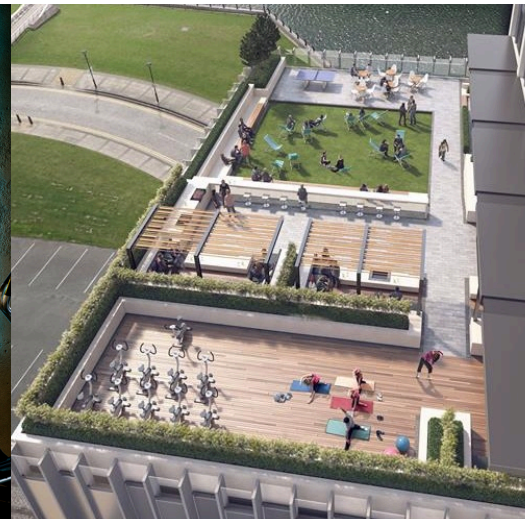
The user-centred approach to understanding current performance issues in domestic housing presents a methodology for capturing a set of use cases that provide an informed set of information requirements. Further analysis of these requirements highlighted ten key data sources for understanding in-use building performance data. These include:

1. tenant applications
2. BIM model
3. design documents
4. building energy performance forecast data
5. installation checks
6. post occupancy evaluation
7. practical compliance checks
8. standard building regulations (reference documents)
9. surveys; and (10) sensors.

Rogage, K., Clear, A., Alwan, Z., Lawrence, T., & Kelly, G. (2019). Assessing building performance in residential buildings using BIM and sensor data. *International Journal of Building Pathology and Adaptation*.



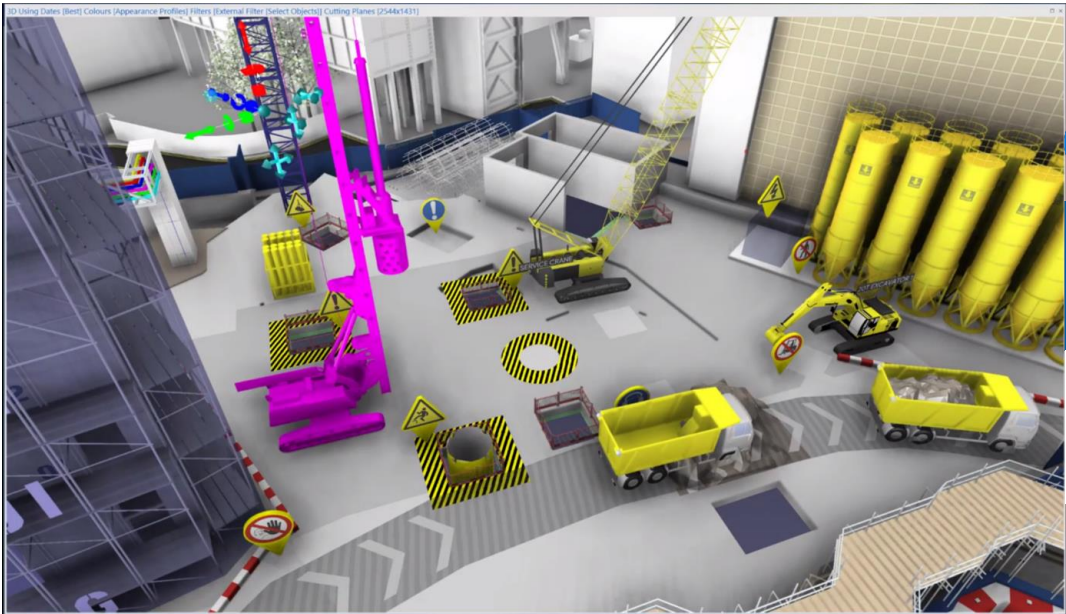
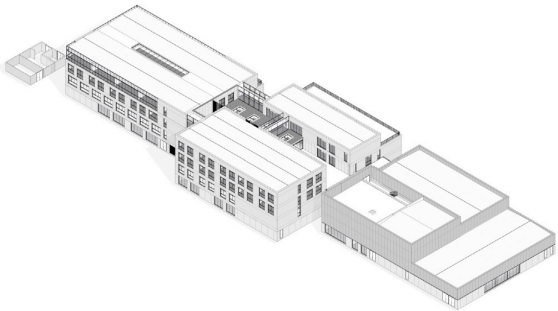
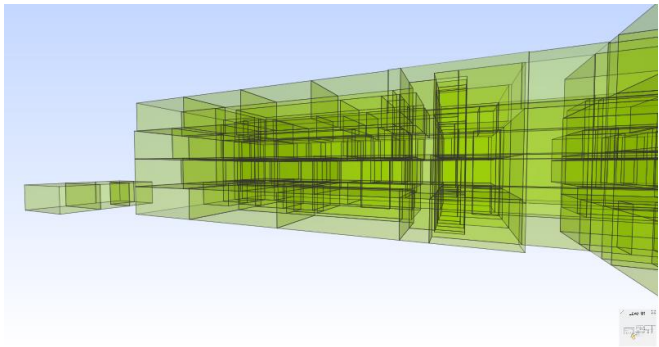
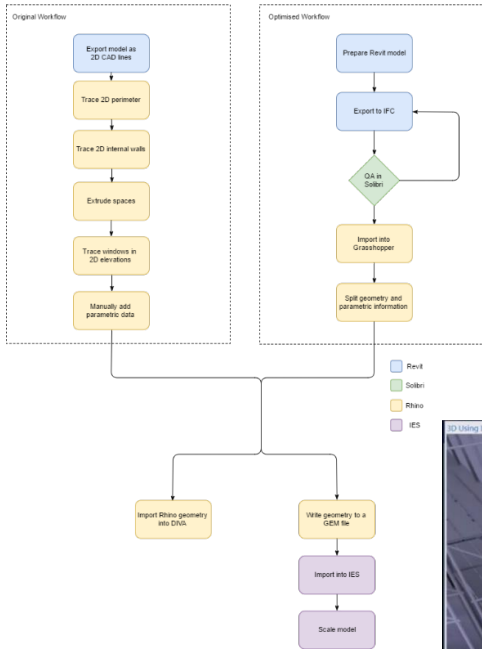
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# Environmental Health and Net Zero Carbon Futures – Scottish Government

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## Moving forward

Lead and increase collaboration

Lower costs to the NHS and a healthier population.

Better educational attainment and workplace productivity.

Reduced emissions, lower energy bills and a lower carbon footprint.

Improved building performance and analysis.

Improved health, wellbeing and comfort.

Greater life chances, independent living and care.

Greater community resilience and cohesion.

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Please get in touch to collaborate!

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