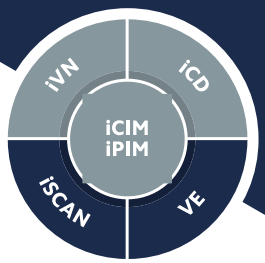
Barts Health NHS
Alex Wing

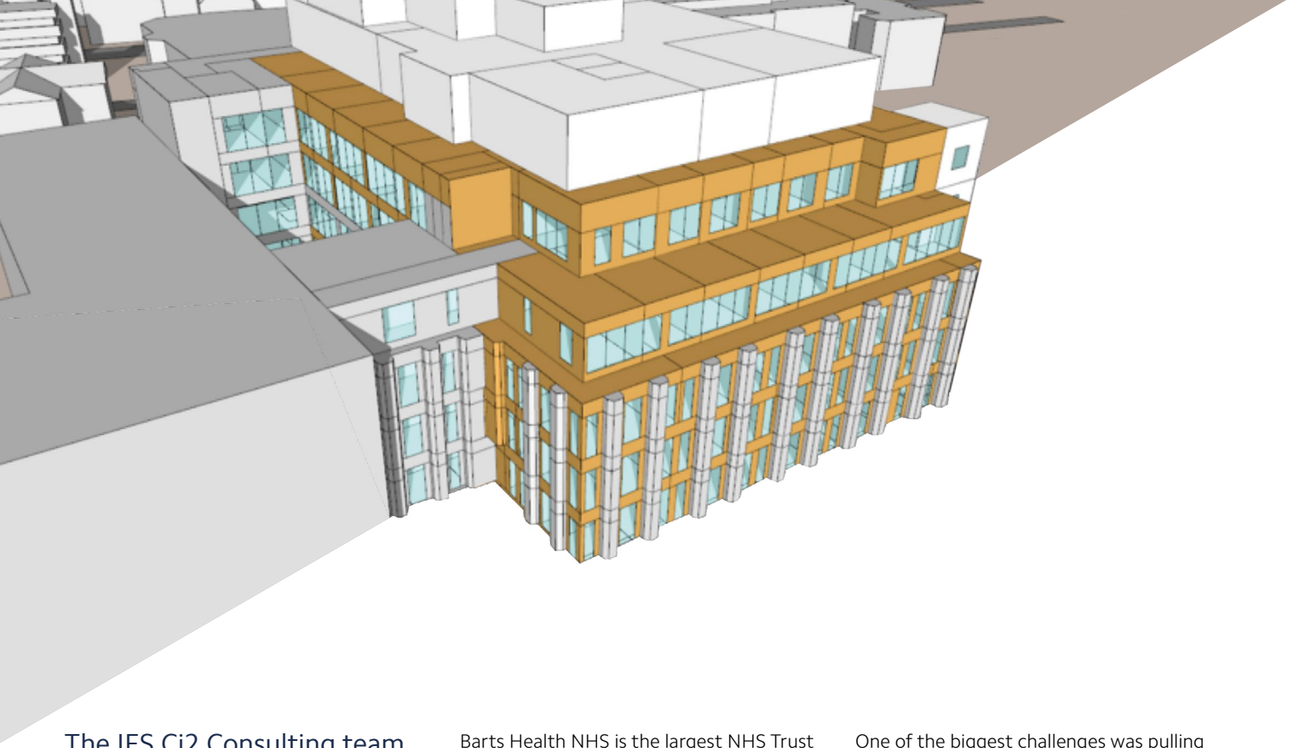
The Trust turned to IES to deliver a virtual benchmark of the building, accurate to within a small percentage, in order to identify operational issues and assess potential Energy Improvement Strategies. Possible energy demand reductions of 22.5% for Gas and 30% for Electricity were demonstrated.



BARTS HEALTH NHS
ALEX WING

SECTOR: IES ICL
DATE: November 2016
COUNTRY: UK

www.iesve.com/icl



The IES Ci2 Consulting team, by utilising existing building performance data via the web portal, produced a calibrated model of the Alex Wing building in the VE. This allowed the success of energy conservation strategies to be measured, whilst also allowing potential future measures to be evaluated.

Barts Health NHS is the largest NHS Trust in the UK. The Trust's ambition is to be the most sustainable in the UK by 2020; leading the way in the NHS as an exemplar of best practice, knowledge sharing and innovation.

During 2016, Barts Health NHS Trust undertook an innovative project with IES to undertake enhanced Energy Modelling and Building Management System (BMS) Data Analysis services for the Alex Wing – Dental Teaching Hospital within The Royal London Hospital.

The programme which was delivered in conjunction with Skanska, aimed to take advantage of the existing Building Management System (BMS) and extensive sub-metering infrastructure, in order to utilise the latest advances in building performance modelling to deliver innovation in how the Trust approaches assessment of proposed Energy Conservation Measures (ECMs).

Using a combination of building data and advanced computer modelling, IES has been able to create a virtual benchmark of the building which comfortably meets the calibration thresholds for ASHRAE Guideline 14. IES were able to calibrate the model to hourly precision for electricity. Monthly calibration was achieved for gas, with modelled gas consumption accurate to a daily duration.

One of the biggest challenges was pulling together data from a number of on- and off-line sources to build the initial simulation model of the building, enhance it and finally calibrate it by matching simulation data against real data for a benchmark period of April-Dec 2015. Design, post-build and operational data needed to be pulled together, all of which were in different formats, resolutions and time-steps. Information came from; geometry data in naviswork files, building log books, pdfs documenting thermal properties, BMS, AMR data, manual reads, and much more.

IES was able to provide unique visibility of existing building performance time-series data consolidating AMR, BMS and Condition data using the iSCAN web portal. This included a range of data such as energy, plant operation, and indoor environmental conditions. Hourly weather data to support Heating & Cooling Degree Day calculations and building energy simulations, was also sourced by IES.

The extensive sub-metering available at the Alex Wing and the data enhancement undertaken by IES facilitated in-depth analysis of energy use breakdown at the site. By utilising real year historical weather data in the simulation it was possible to provide a better match of model predicted energy use against historical energy use. However, even with such extensive data, calibration is challenging due to uncertainty caused by malfunctioning meters, data loss and the inherent difficulty of extrapolating energy use from pulsed meter readings.

Energy Conservation Measures reviewed	Energy Demand changes
1) **Changes to controls strategies**	29% reduction in Gas Energy Demand 6% reduction in Electricity Energy Demand
2) **Changes to plant operation schedules and the addition of AHU inverters**	19% reduction in Gas Energy Demand 3.5% reduction in Electricity Energy Demand
3) **Installation of Solar PV and CHP**	35% increase in Gas Energy Demand 23% reduction in Electricity Energy Demand 13% reduction in Energy Costs 9% reduction in CO^2 Emissions
4) **If all above measures were implemented/installed**	22.5% reduction in Gas Energy Demand 30% reduction in Electricity Energy Demand 28% reduction in Energy Spend 27% reduction in CO^2 Emissions

The final calibrated benchmark model IES created has been able to successfully identify both operational issues, act as independent validation of the energy savings impacts being achieved through a separate ongoing commissioning project, and virtually evaluate the effectiveness of proposed Energy Conservation Measures (ECMs).

A series of measures were reviewed by IES in the calibrated benchmark model in four different stages. The data analysis and modelling presented a number of ECMs, which if all were implemented, showed that a 22.5% reduction in Gas Energy Demand and a 30% reduction in Electricity Energy Demand is possible. This equates to a 28% reduction in Energy Spend and 27% reduction in CO^2 Emissions.

The measures reviewed were 1) changes to controls strategies 2) changes to plant operation schedules and the addition of AHU inverters 3) installation of Solar PV and CHP and 4) if all above measures were implemented/installed. The figures produced enabled Barts to see the effect of different groups of measures in isolation and in accumulation.

"Energy costs Barts Health £14 million a year, forecast to increase to £24 million by 2018. We have already achieved a lot towards our 2020 target and are on track to meet our legal targets to reduce energy by 80 percent. Now that many of the 'quick win' and short payback measures have been implemented, the organization now needs to work hard to achieve the 2020 target and seek transformational change in order to achieve the 2050 target."

Fiona Daly
Associate Director of Sustainability and Patient Transport

KEY FACTS

- 22.5% reduction in Gas and 30% reduction in Electricity Energy Demand modelled
- 28% reduction in Energy Spend and 27% reduction in CO^2 Emissions modelled
- Strategic review of existing and ongoing Energy Management and data acquisition activities
- Enhanced calibrated model created using real building data
- Calibration comfortably met thresholds for ASHRAE Guideline 14

Final Model Calibration Results:

End Use	CVRMSE (Coefficient of Variance Root Mean Square Error)	NMBE (Net Mean Bias Error)
Electricity (Monthly)	2.8	-0.4
Electricity (Hourly)	14.3	-0.8
Gas (Monthly)	8.6	0.4
HVAC (Monthly)	6.1	-3.4
Small Power (Monthly)	2.5	2.2

The measures in 1) have already been implemented within the Alex Wing by Barts Health NHS, through a separate commissioning project. The savings predicted by IES are in line with the savings the on-site commissioning team are tracking in real life.

One of the key advantages of the IES Ci2 Service is that by looking at measures in isolation and in combination you gain different perspectives on the relative impact of measures and are able to better make business-led decisions.

For example, when the CHP system was introduced an increase in Gas Energy Demand was observed against a significant reduction in Electricity Energy Demand. However, IES was able to put this into context by also looking at the associated reductions in Energy Spend and CO^2 emissions this change would give; both in isolation and in combination with other measures.

To complete the project IES has now handed the calibrated model of the building to Skanska so that they can use this valuable digital asset in future work. Training has also been undertaken to enable their staff to utilise the model in evaluation of future proposed Energy Conservation Measures, changes in use, refurbishment, and in continuous commissioning of the building.

The main advantage of this approach is that measures can be considered in combination rather than separately; taking into account interactions and knock on effects which might occur, and enabling quick virtual testing of different combinations. Other advantages include the ability to evaluate measures from a 'Business Case' perspective; predicting improvements in cost, energy and environmental conditions which can be linked to payback periods and other metrics in order to make strategic decisions.

PLEASE CONTACT
E-mail enquiries@iesve.com
Call 0141 945 8500

www.iesve.com/icl

EUROPE | NORTH AMERICA
ASIA | AUSTRALIA