D7.2

Demonstration project in UK

Validation through participatory design session – Implementers Community Workshop

Deliverable Report: 7.2 Final version

Streamer - Optimised design methodologies for energy-efficient buildings integrated in the neighbourhood energy systems.
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D7.2 Demonstration project in UK – validation through participatory design session

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Colophon

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Abstract

This is the deliverable arising from the development of a series of Implementers Community (IC) workshops held to explore the ideas behind Project STREAMER and to begin dissemination of the results.

As detailed in the DoW (Description of Work) TRF organised the first Design Workshop involving professionals from the construction industry, architects and building engineers as well as NHS specialists.

This document has been developed by UK partners from TRF and AEC with the latter producing a strategy for the workshop and developing a usable modelling process with the data collected.

An acute hospital is a very complex building/s with a variety of departments and disciplines that have a multitude of differing requirements. Unquestionably, it is not a straightforward "one size fits all" solution, but rather an outcome that can be tailored for different areas which may be transferred to other buildings within the campus and may require slight tweaks and adjustments.

The project that TRF have proposed for Project STREAMER is centred on the upgrade of the Building Management System along with improvements in the building fabric. This will allow us to evaluate proposed changes that can be made to some of the building stock and therefore understand the benefits of such changes in terms of energy savings and Capex versus return on investment (ROI). Through developing the modelling process and then analysing the potential solutions it will be possible to prioritise physical changes to the buildings, fabric and systems. This will provide the building user with the knowledge to make an informed decision as to which retrofitting solution will provide the best outcome in terms of energy reduction and return on investment (ROI).

Improved energy efficiency in the UK NHS will result in massive reductions in carbon emissions and assist in meeting all local, national and international targets. The secondary purpose of STREAMER will be to provide information and evidence that will assist professionals in making key decisions. Well informed energy managers are more likely to get it right by using an aid such as the STREAMER tools when selecting retrofitting solutions.

The initial IC Workshop was intended to run simulations that will present the information for the delegates to make a choice as to which building interventions are the most effective. The intention was to attract around 25 to 30 delegates to participate in the first workshop and invitations were sent out via Hefma (Health Estates and Facilities Management Association) groups and other allied organisations. Although the final head count was below the anticipated level the participation and involvement was very good and interesting feedback was received that would prove useful when planning the second workshop.

It is intended that second workshop will build upon the findings and conclusions of the first workshop with the prospect of running a set of amended building interventions. From discussions among WP7 STREAMER partners it is envisaged that in this instance the team groups will be mixed. In essence, there would be no two colleagues from the same company or discipline (ie architect, engineer, etc) in the same team. This would provide a contrasting thought process and difference of opinion depending upon the particular field of expertise of the delegates involved.

It is envisaged that a multi-disciplinary team will provide a completely different range of concepts as to which building interventions are the most advantageous and cost effective. For example, an architect may have a completely different set of opinions to an engineer, and a person in the construction industry would have a contrasting thought process and mindset to an end user. What may seem the most important aspect of a building intervention to one discipline may not be as relevant to another but all aspects will combine to produce the complete picture. It is expected that this intentional scenario will produce lots of lively discussion and debate which will benefit the whole STREAMER process. Everyone has their part to play and it will be interesting to analyse the results and run simulations in order to establish the optimum solution when a group containing members from all aspects of the building construction industry, maintenance and end users pool their knowledge and experience to decide which building intervention/s are most favoured.

The UK partners felt that, after the first workshop, the process had not yet evolved enough to create the level of interest required to attract new enthusiastic delegates or maintain the level of interest amongst the existing delegates. This was a fundamental factor in postponing the second workshop until May 2017. By this time the whole project will have moved on sufficiently and evolved into something more clear and definite that can be presented to the attendees of the second workshop and provide the desired outcomes.

Publishable executive summary

PROJECT STREAMER - ENERGY EFFICIENT RETROFITTING OF HEALTHCARE BUILDINGS

Rotherham Hospital has now hosted the pilot and the first of two full Implementers Community workshops and is to begin dissemination of the results.
Although the audience was relatively small the concept of Project STREAMER and Energy Efficient Retrofitting in Healthcare Buildings was well received.
The delegates were presented with a brief summary of Project STREAMER, and in particular, the involvement of TRF as the UK partner, with the emphasis being on the retrofitting of existing buildings. In the UK approximately 80% of the healthcare estate is pre 1980s construction so by targeting this area huge reductions will be possible. As energy costs and pass-through charges (non-commodity costs) continue to rise there is an overwhelming case to improve older healthcare premises. It is intended to utilise the STREAMER tools to make informed investment decisions and assess the options available, eg refurbishment versus demolition and new build.

This document details the planning prior to the workshop and gives an overview of the meetings held and decisions arrived at by the partner members. Presentations were delivered by TRF, AEC and Utilitywise to provide the delegates with the information required to understand the basis of the workshop and provide focus for their participation in the simulations. All the material presented at the workshop is highlighted in pale yellow in Section 2 (pages 19-20)
The delegates present engaged well with the facilitators and positive feedback was received during the simulations. Although this was a smaller than envisaged group it appears that the most common option favoured was to implement multiple building interventions rather than employ just the one more far reaching solution.

Fig1 Rotherham Hospital

List of acronyms and abbreviations

- AEC: AEC3
- BIM: Building Information Modeling
- BMS: Building Management System
- BS: British Standard
- EeB: Energy Efficient Building
- ERIC: Estates Return Information Collection
- FM: Facility Management
- GIS: Geographic Information System
- IFC: Industry Foundation Classes
- KPI: Key Performance Indicator
- MEP: Mechanical, electrical and plumbing
- NHS: National Health Service (UK)
- OPD: Out Patients Department
- PoR: Programme of Requirements also known as space programme or brief
- SDMP: Sustainable Development Management Plan
- SoTA: State of the art
- SBEM: Simplified Building Energy Model.(UK National Calculation Method)
- TRF: The Rotherham NHS Foundation Trust
- Uniclass 2015: UK Unified classification tables for the construction industry
- uPVC: unplasticised (rigid) Polyvinyl Chloride.
- VSD: Variable speed drive

Definitions

BMS: is a computer based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, fire systems, security systems and power systems. A BMS consists of hardware and software; the software programme, usually configured in a hierarchical manner, can be proprietary using several different protocols

ERIC: is the main central data collection for Estates & Facilities services from the NHS. Trusts enter data into the system which provides real time performance indicator information allowing organisations to benchmark their performance. Energy consumption and cost are included in this data collection.

IFC: The Industry Foundation Classes (IFC) data model is intended to describe building and construction industry data. It is a platform neutral, open file format specification that is not controlled by a single vendor or group of vendors

SBEM: refers to the computer programme used to assess how energy efficient a commercial property is based upon the building's energy usage and carbon dioxide emissions from month to month. The SBEM assessment provides a set of standards to which a new building /extension should be built in order to comply with energy efficiency regulations.

VSD: describes equipment used to control the speed of machinery. Where applications demand adjustment of flow from a pump or fan, varying the speed of the drive will save energy compared with other techniques for flow control.

Building Information Modelling – is a process involving the generation and management of digital representations of physical and functional characteristics of a building. The resulting BIM provides the tools to support decision making about a building through its design, construction, operational life and demolition.

Geographic Information System – the GIS integrates hardware, software and data for capturing, managing, analysing and displaying all forms of geographically referenced information.

Mechanical, Electrical & Plumbing – MEP is the mechanical, electrical and plumbing improvements that may be carried out in order to improve building energy efficiency.

Contents

1. Output from STREAMER (BIM models, used tools, decisions, etc)

1.1 Models

Information and data relevant to the energy simulation of the hospital campus was patchy: some were available as schedules and lists and some were embedded in written reports. In order to analyse the baseline case of the existing facility and any proposed upgrades it was necessary to consolidate the information in a model. All models and sub-models were developed and used as IFC. This scheme had the expressiveness to represent each of the information sets and the generality to combine these into a single model. Each sub-model and the final model were validated in several steps.

Firstly, the mapping process or export had to complete successfully. In many cases the first representation of the model is IFCXML (ISO10303 part 28). Models held in this format can be checked against the IFC2x3 schema (IFC2x3.xsd) using standard industry tools such as Altova XMLSPY, MS Visual Studio or some XML editors. This stage would detect missing mandatory entities, attributes and relationships.

Then the mapping of IFCXML to IFC was affected using the AEC3 BimServices Transform 1 tool, which uses the RDF IfcEngine DLL. This DLL has been developed over the last 12 years and, unsurprisingly, this mapping tool was found to be fault free.

Lastly, the IFC file was viewed in a number of federation and viewing tools such as DDS Viewer, Tekla BimSight and KIT IfcViewer. Whilst some viewers were reluctant to show sub-models without geometry each had a hierarchical tree panel that allowed inspection of the special or specialisation trees embedded in each model. The KIT viewer was particularly useful for examining zones and systems which, as abstract and option collections, other views were less adept at. Each model was also mapped to COBie, a spreadsheet representation of structured asset information for handover for review.

COBie was used for two reasons.

Firstly, it provides a way to reflect back the state of the model for review and discussion. Secondly, it gives a format for introducing additional information; for example when provisional cost rates for the system upgrades were received as a table these were pasted onto the COBie from which the revised IFC was generated.

1.1.1 Intermediate (sub) models

As each information resource was identified it was mapped to become a coherent sub-model. So as to give TRF a physical representation and geo spatial location a simple block model of the campus was created and then exported to IFC. Most of the other information resources were mapped to create IFC sub models by representing the incoming data as a spreadsheet format, such as CSV or Spreadsheet XML 2003. Once represented as XML each could be transformed using rules and methods represented in a second XML file built on a schema called XSLT. The transformation generated IFCXML. Many resources were processed using a common set of rules intended to take any structured spreadsheet having a single worksheet, a single row of header

titles and objects described on subsequent rows. Some resources, such as the electrical sub-circuit meter readings had a less disciplined format and special transformations were created. Lastly, the written description was marked up using AEC3 Require 1 to identify the scope and descriptive definitions. From this mark up a standard transformation mapped the content to IFCXML. Each sub-model was a valid model in IFC terms though some could not be viewed, for example if they contained only non-graphic information.
These processes are illustrated in Fig 2 below.

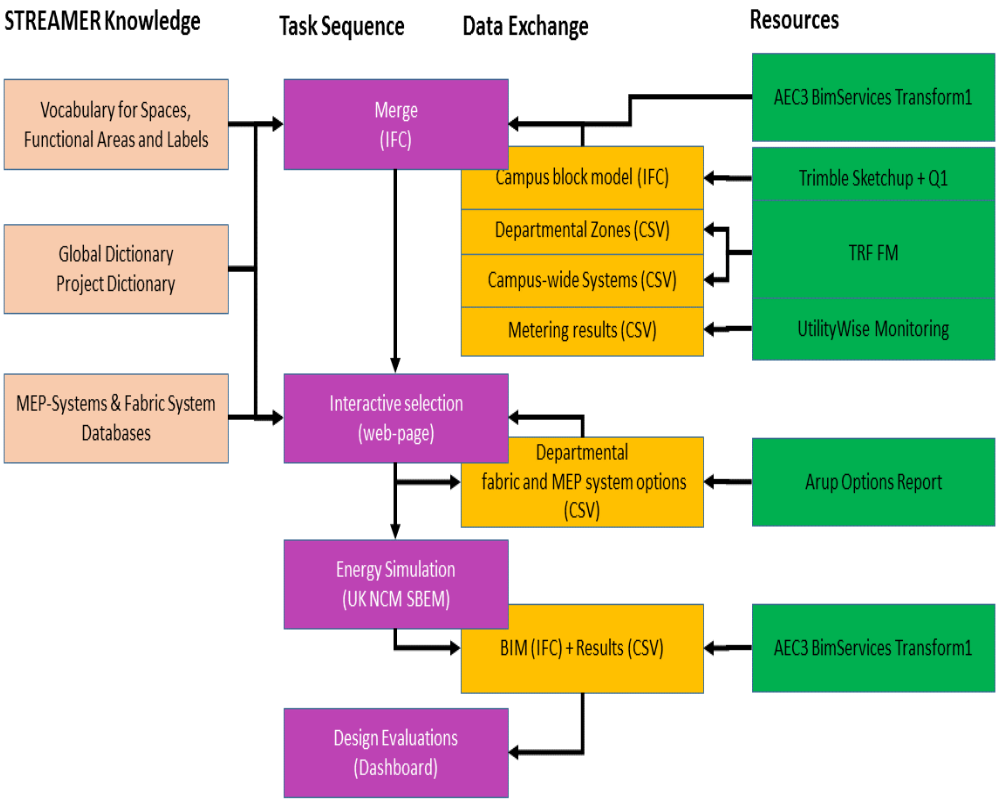


Fig 2

WP7 resources are represented in pink; WP7 processes in purple; WP7 outputs in yellow and WP7 applications in green.

The merge process gave priority to more detailed, longer and more meaningful values and the additional information such as new objects. Whenever a choice was made automatically the "lost" information was logged. In the event there were few issues, essentially because information was sparse. If necessary the process could have been run in pessimistic mode to make a "bad twin" but this was not used.

1.1.2 Master model

A single baseline model was created, representing the current campus, by merging together the sub models derived from the various information resources available. Merging involved taking a starting model and using a transformation to read each supplementary model in turn. Each entity in the supplementary model was compared to see if it was an update to an entity in the starting model or novel. If the entity was novel it was copied in, if it was matched then any attributes were updated, and any references to the supplementary entity replaced with references to the original matched entity. This proved a total generic solution. Attention was focused on what constitutes a match; this may be implicit (there can be only IfcProject in an IFC file) or it may depend on having a common type and name. This process was controlled by a dictionary of synonyms so that, for example, storeys named “Level C”, “C” and “Main” were considered matched. A key feature of the baseline model was that it contained representations of every proposed upgrade. This meant that the baseline model was syntactically correct but semantically implausible where two conflicting system upgrades were described. However, the master model could be validated and all cost calculations inserted by combining quantity information from the zones with rate information from the system upgrades to represent the cost of each option.

1.1.3 Baseline model and option models

During the Implementers Community workshop this baseline model was modified to replace any upgraded systems. The baseline model and each proposal was mapped to the UL NCN SBEM input format. The results were mapped to IFC and treated as an additional sub model to be merged to create final output models. This ensured that the model created for the baseline case and the models and the one created for each Implementer’s proposal were updated with the results prior to sharing with the STREAMER dashboard.

The master model was then filtered to remove all upgrade options. This created a model of the facility as currently existing. In response to user’s proposals for a package of upgrades the master model was filtered to leave only the selected options. Each model was then ready for energy simulation analysis.

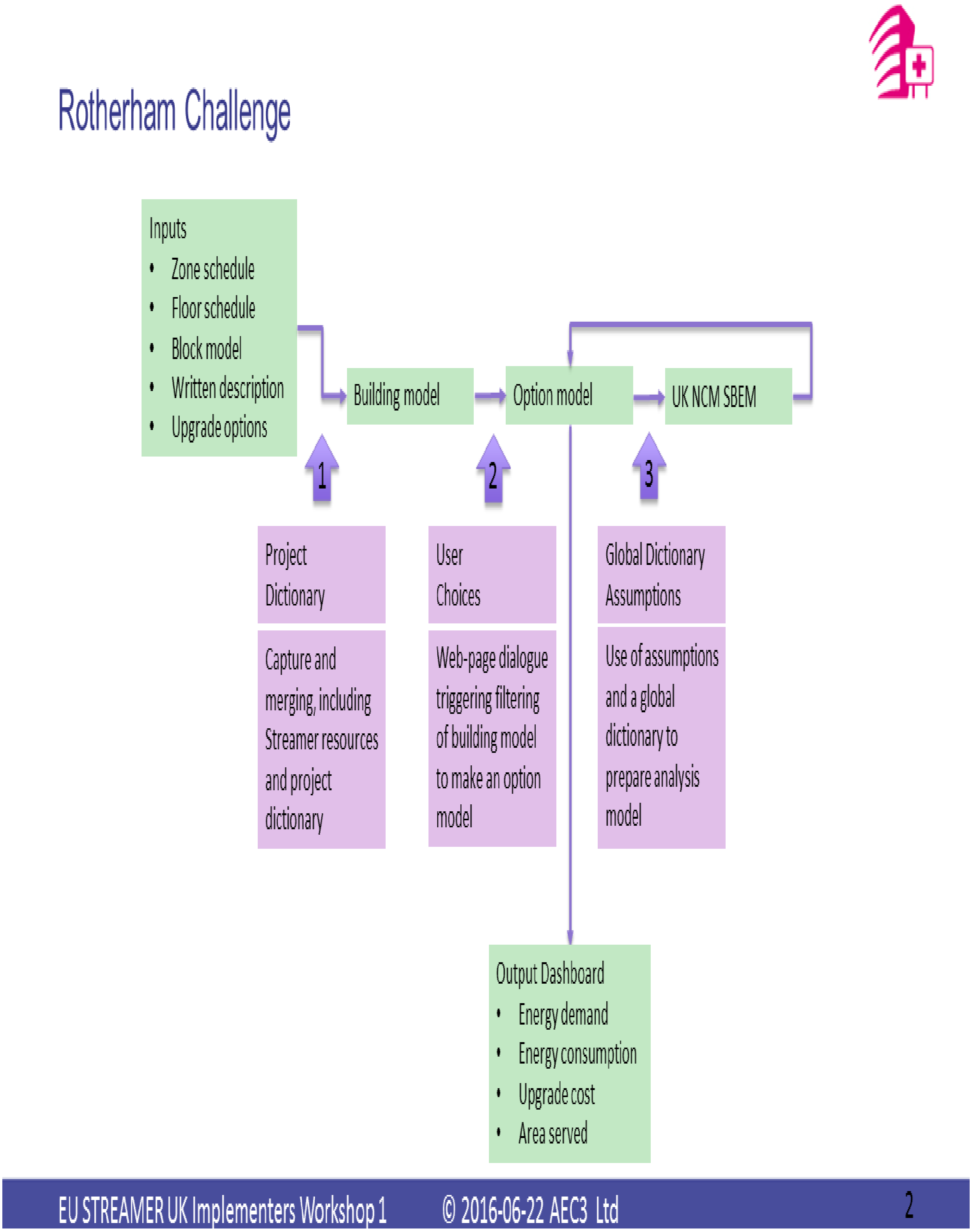


Fig 3

The overall process is illustrated in Fig 3 above.

1.1.4 Dashboard results

The calculated results are added back into the main model (see Fig 4 below). The final model was submitted to t STREAMER dashboard. These energy results are visible in the STREAMER dashboard in Fig 5

SBEM_AnnualEnergyDemand_UK - SBEM Delivered energy demand per m2 UK (IfcPropertySet)

Name	Value	Description
HeatingAnnualEnergyDemand	2815.87 MJ	Heating energy demand per m2
CoolingAnnualEnergyDemand	0 MJ	Cooling energy demand per m2
AuxiliaryAnnualEnergyDemand	18.9216 MJ	Auxiliary energy demand per m2
LightingAnnualEnergyDemand	920.142 MJ	Lighting energy demand per m2
HotWaterAnnualEnergyDemand	136.791 MJ	Hot water energy demand per m2
EquipmentAnnualEnergyDemand	1428.98 MJ	Equipment energy demand per m2
CHP_DisplacedAnnualEnergyDemand	0 MJ	Displaced combined heat and power energy demand per m2

SBEM_FuelAnnualEnergyConsumption_UK - SBEM Fuel energy consumption per m2 UK (IfcPropertySet)

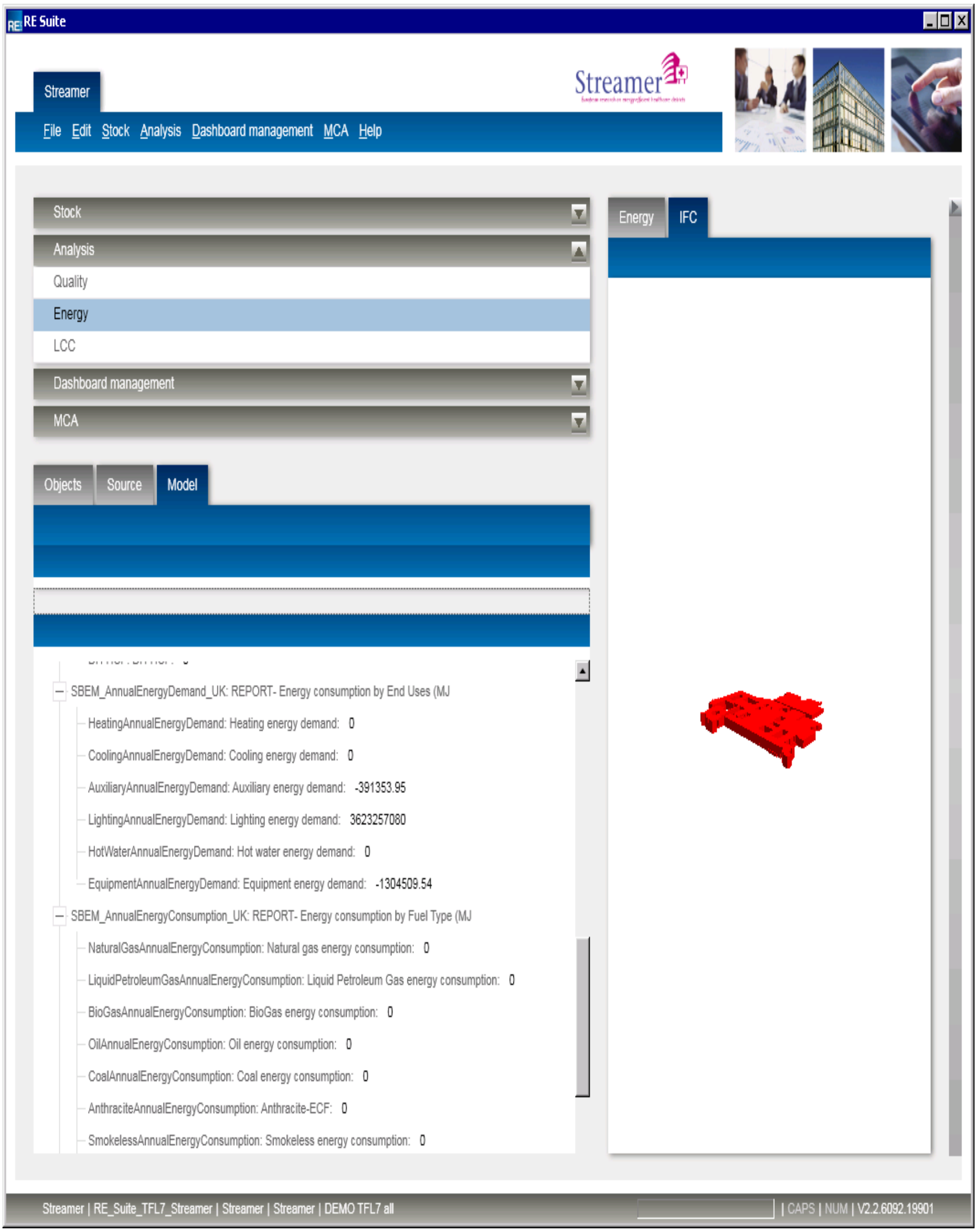
Name	Value	Description
NaturalGasAnnualEnergyConsumption	2952.67 MJ	Natural gas energy consumption per m2
LiquidPetroleumGasAnnualEnergyConsumption	0 MJ	Liquid Petroleum Gas energy consumption per m2
BioGasAnnualEnergyConsumption	0 MJ	BioGas energy consumption per m2
OilAnnualEnergyConsumption	0 MJ	Oil energy consumption per m2
CoalAnnualEnergyConsumption	0 MJ	Coal energy consumption per m2
AnthraciteAnnualEnergyConsumption	0 MJ	Anthracite
SmokelessAnnualEnergyConsumption	0 MJ	Smokeless energy consumption per m2
DualFuelAnnualEnergyConsumption	0 MJ	Dual fuel energy consumption per m2
BiomassAnnualEnergyConsumption	0 MJ	Biomass energy consumption per m2
GridSupplyAnnualEnergyConsumption	939.065 MJ	Grid Supply Electricty energy consumptions per m2
WasteHeatAnnualEnergyConsumption	0 MJ	Waste Heat energy consumption per m2
DistrictHeatingAnnualEnergyConsumption	0 MJ	District heating energy consumption per m2

SBEM_ACTNOT_UK - SBEM Actual and notional kgCO2 equivalent per m2 UK (IfcPropertySet)

Name	Value	Description
AnnualCarbonDioxideEmission	312.542 Kg	Actual kgCO2 equivalent annual emission per m2
NotionalCarbonDioxideEmission	231.267 Kg	Notional (baseline) kgCO2 equivalent annual emission per m2

Fig 4

Fig 5 below depicts the STREAMER dashboard showing UK NCM SBEM results



1.2 Tools

WP7 Application Usage

CALCULATION TOOLS USED BY TRF	Description Description of the other software and tools used for collecting information, making calculations and implementing data to be processed by the STREAMER tools
SKETCHUP with Q1 add-on	Block modelling and geospatial location exported as IFC
AEC3 BimServices Transform1	_from spreadsheet converted spreadsheets to IFC _from Meters converted meter reading tables to IFC _from Utilitywise converted 30 minute sub-circuit measures _merge unified sub-models
AEC3 Implementers Community Web Page	Collected team name, members emails and selected options Prepared and ran the simulation Prepared and merged back and reported the results Notified members and AEC3 of results obtained
AEC3 BimServices Transform1 **UK NCM SBEM** **AEC3 BimServices Transform1**	_as SBEM prepared models for UK NCM SBEM _predicted energy demand and consumption _from SBEM converted results to IFC and prepared report

1.3 Decisions

There was no opportunity to search for detailed building records from several decades past. Experience shows that such records are rarely found and even more rarely complete. Instead the TRF model was developed in such a way so as to respect the limited information available but still produce results that were potentially relevant to the operational team. The two key decisions related to the level of granularity at which modelling would be carried out and to the choice of interactive or automated optioneering.

1.3.1 Strategy – zones and systems

TRF and AEC discussed and agreed to focus on the department descriptions as the tactical decisions relating to the possible upgrade of the fabric and MEP systems would be taken at that level. This proved to be in contrast to the new-build projects where the modelling was taken down to space and component level. Modelling at the zone (departmental) level meant that detailed room layouts and equipment lists would not be needed. The operational cycles (daily, weekly, monthly, yearly) would be applied across all the spaces in that department. Similarly, modelling at the system (fabric, structure or MEP) level meant that detailed service runs, fabric details or, in most cases, emitters would not be needed. The system entity would quantify the demand, often as a floor area of the zone, and the capacity in energy terms. Fabric "systems" were quantified as physical areas (wall, floor, ceiling) serving a zone. This allowed high level cost information to be applied.

1.3.2 Gaming v Optimisation

Initially it was envisaged that the range of options would be driven through an optimisation engine such as the Swiss "Optimum" open source toolkit. The options were named in a rigorous and structured way so as to support this approach. However, it was decided that in order to obtain active engagement at the Implementers Community workshops the STREAMER options would be presented as a semi-competitive game. Attendees were invited to form small teams. This allowed the researchers to engage with the discussions and to note the drivers and skill sets to be deployed.

1.4 Lessons learned

Conclusions / recommendations

We concluded that the two strategic decisions had been justified in that simple direct results were obtained that related directly to the named departments and upgrades, and that good engagement had been achieved.

We therefore recommend that more attention should be given to development and use of strategic, campus-level design and simulation tools. It may be possible to develop a hybrid approach and tools where a design in various stages of development, at various stages in its life cycle, is analysed much more frequently.

The majority of energy analysis tools are predicated on detailed descriptions of building spaces and components. Linking in information from BIM authoring tools is sometimes possible. In some cases using tools such as SBEM it is possible to use the tools with a higher level description, focusing on zones and systems. STREAMER has created a link from this higher level BIM.
The process of identifying appropriate comparisons has been started but it is important to recognize that UK NCM SBEM is not a complete simulation; its main purpose is to allow relative (not absolute) comparisons, for example between 1990 standard buildings and current proposals.

The use of high level systems and zones ensured that the choices put to the workshop delegates were clear and well defined. Using "gamification" meant that the conversations and approaches of industry professionals (see section 2) are being captured. A consequence is that the Rotherham example is of increasing interest across the UK.

Rotherham has used the STREAMER encoding for its Departmental zones, and the set of STREAMER activity, fabric and system specifications. Their application has enabled the use of standard tools to high (campus / estate) level energy predication. A key stage in the use of these resources is to match them against known entities in the Rotherham Hospital model. This was aided by the use of UK Uniclass 2015 classification of Systems (Table Ss) , supplemented with a some human interpretation. Their systematic use in future applications would be enhanced with the adoption other UK UNiclass 2015 tables (or a pan-European classification structure based on ISO 12006-part 2) on all the STREAMER information resources.

The process of identifying appropriate comparisons has been started, but it is important to recognise that UK NCM SBEM is not a complete simulation: its main purpose is to allow relative (not absolute) comparisons, for example between 1990 standard buildings and current proposals. Information about the known energy consumption will be compared against the refined energy predictions which will be used in workshop 2.

2 Planning & Outcome of the Workshop

2.1 Purposes and structures

With the emergence of the first results of the technical development, it was agreed that the theme of the workshops should be to involve the participants in developing strategies for TRF.
A Preliminary workshop meeting was held at Rotherham Hospital on 26th February 2016. A record of the minutes is reproduced below.

Pre-Workshop Attendees

Attendee	Organisation
John Cartwright	TRF
Martin Aizlewood	TRF
Nick Nisbet	AEC
Bob Wakelam	AEC
Gillian Smith	Utilitywise

1) It was confirmed that IC Workshop 1 would take place at Rotherham Hospital on Wednesday 8th June 2016 and that IC Workshop 2 would take place at Rotherham Hospital on Friday 7th October 2016.
2) Delegates will be drawn from specialist fields in the construction, design and engineering fields as well as professional bodies within the healthcare sector
3) **IC Workshop 1** – it was agreed that separate powerpoint presentations should be prepared by each partner of approximately 15 minutes duration, content as detailed below, and that 10 minutes should then be set aside after each presentation for a Q & A session
   a) *Presentation 1 – TRF*
      An overview of Project Streamer shall be presented with the milestones achieved so far and those yet to be reached clearly identified.
      The departments selected as the Case Study areas (OPD & Ward B6) will be introduced along with all the work to date; eg building information, electrical data and thermal data.
      An explanation of the format and content of the workshop, and the anticipated outcomes, will introduce presentation 2
   b) *Presentation 2 – AEC*

Building information of the 2 study areas will be presented detailing the work to date and the next steps, including conclusions and findings from the two IC Workshops

c) *Presentation 3 – Utilitywise*
Electrical data collection being used for this project will be explained and demonstrated, with the interaction of the monitoring and modelling being the focus

4) After the presentations and questions the workshop activity will commence.
Delegates will be split into groups and audience tick box menus will be distributed detailing certain building improvements. Groups will have to decide which improvements will be most effective in whichever way they see fit.
When the groups have completed their respective “building improvements” AEC will arrange for simulations to be run to find the best outcomes and there will be a competition winner
5) On line forms will be set up after Workshop 1 for delegates to select improvements in readiness for Workshop 2
6) A questionnaire will be produced prior to Workshop 1 which will allow for delegates who are unable to travel to the venue to submit their selections. There will also be a feedback form which will provide useful information for the planning of Workshop 2
7) *Presentation 4 – Utilitywise*
Utilitywise will present information related to building improvements costing details for a variety of interventions. This will assist in populating forms for Workshop 2
8) **IC Workshop 2** – it is proposed to review all the activity from Workshop 1 and revisit the building improvements, building on the lessons learned. However, this time the groups will be mixed and will not contain more than 1 member from the same organisation. AEC will again run simulations and the group will be asked for their summations and conclusions. They will also be asked what else they would like to see included, if anything
9) It was agreed that TRF, AEC and Utilitywise should have a catch up meeting in early May to ensure all is on track and that any problems are ironed out well before the first workshop
10) It was also agreed that Joram Nauta should be invited to the second workshop and deliver the closing address as this would provide formal direction and participation from TNO

For the Pilot workshop, the proposed presentations and interactive workshop were discussed and the key points arising were rehearsed.
It was agreed that the participants should be able to choose upgrade strategies from the menu prepared at the start of the project by the MEP consultants. This had the specific aim of creating a conversation between team members, encouraging the raising of issues and queries, and ultimately exploring whether architects, MEP consultants, energy consultants or FM managers were most effective at developing a strategy based on minimal specification and simulation information. Once their proposals were in and analysed, displaying the results would lead to a second round of discussions and the presentation of prizes and thanks to participants.

A Mock workshop meeting was then held at Rotherham Hospital on 18th May 2016 and a record of the minutes is reproduced below

Workshop 1 Speakers

Attendee	Organisation
John Cartwright	TRF
Martin Aizlewood	TRF
Nick Nisbet	AEC
Bob Wakelam	AEC
Gillian Smith	Utilitywise
Conor McMahon	Utilitywise

1) The agenda was confirmed for IC Workshop 1

Workshop 1 Programme

1	All	Registration and refreshments	9.30 onwards
2	JC	Welcome and Introductions	10.00 - 10.10
3	JC	Introducing the EU Streamer Project: Can better design and management save energy?	10.10. – 10.30
4	MA	Rotherham Hospital FM and energy: How does an acute hospital manage its energy bills?	10.30 – 11.00
5	JC	U.K. Case study: Rotherham's involvement with EU STREAMER	11.00 – 11.30
6	NN	The technical response: How can simulation help energy strategy for existing buildings?	11.30 – 12.00
7	NN	Open workshop discussion: Choosing an upgrade strategy	12.00 – 12.30
8	All	Lunch	12.30 – 13.30
9	GS	Energy monitoring and strategy: How Utilitywise is contributing	13.30 – 14.00
10	NN	Evaluation of attendee's strategies: Have we found a good strategy?	14.00 – 14.30
11	JC	Summary and next steps: Has the workshop worked for you and who should be invited to the next workshop?	14.30 – 14.45
12	Panel	Final Q&A and Workshop close	14.45 – 15.00

2) Agenda item 3 was presented by TRF with comment and feedback received from the group
3) Agenda item 4 was presented by TRF with comment and feedback received from the group
4) Agenda item 5 was presented by TRF with comment and feedback received from the group
5) Agenda item 6 was presented by AEC with comment and feedback received from the group
6) Agenda item 7 was presented by AEC with comment and feedback received from the group

7) Agenda item 9 was presented by Utilitywise with comment and feedback received from the group
8) Agenda item 10 was presented by AEC with comment and feedback received from the group
9) It was agreed that the content of all presentations should be increased to ensure that there would be enough material to fulfil the running time allotted
10) TRF would include more information on Project Streamer and in particular the other 3 demonstration cases. TRF would also expand upon the projects and initiatives that have brought about a >30% reduction in carbon emissions since 2009
11) AEC would include more information about the modelling process, in particular BIM and SBEM
12) Utilitywise would expand upon the monitoring being carried out at Rotherham Hospital for Project Streamer and in particular the technical information regarding how the circuit data is captured and reported

Implementers Community Workshop 1

As soon as the technology was proved, invitations were issued to a cross section of the AEC / FM community with interests in existing buildings, and hospitals in particular. A flyer was sent out electronically along with a copy of the agenda, and a personal invite was delivered to members of the Northern & Yorkshire Energy and Environmental Group at its March meeting.
Details of the flyer and accompanying information were advertised as below:

The Rotherham NHS
NHS Foundation Trust

AEC3

Implementers Community Workshop 1

Project STREAMER
UK Case Study
The Rotherham NHS Foundation Trust
Date - Wednesday 8th June, 2016 at 10.00 – 3pm
Venue - Rotherham Hospital
Lecture Theatre
PGME Department
Moorgate Road
Rotherham
S60 2UD
For further details please contact Martin Aizlewood on 01709 424133 or
martin.aizlewood@rothgen.nhs.uk or visit our websites

Project STREAMER

Project STREAMER is an industry driven collaborative research project on Energy Efficient Buildings (EeB) in the healthcare district, funded by the European Union. It is a European initiative with a 4 year duration commencing in September 2013, and is aimed at reducing the energy use and carbon emissions of both new and retrofitted in healthcare districts of the EU by 50% in the next 10 years.

There are 19 partners (5 large companies, 6 small/medium enterprises, 4 research institutes, 3 public hospitals and 1 private hospital) from 9 countries across the EU.
All manner of mixed building types will be analysed; ie, acute hospitals, clinics, offices, laboratories, kitchens, laundries and educational buildings.

The Rotherham NHS Foundation Trust (TRFT) is the UK participant alongside partners from France, the Netherlands and Italy. AEC3 is working alongside TRFT in providing detailed information via advanced design tools such as BIM (Building Information Modelling) and GIS (Geographic Information System) which will result in a mechanism that will allow an informed decision to be made as to which MEP (Mechanical, Electrical & Plumbing) interventions are implemented in order to maximise energy and carbon reductions.

AEC3 are using COBie software (Construction Operations Building Information Exchange) which is a data format for the publication of a subset of building modelling information focused on delivering building information, not geometric modelling.
These tools will investigate the building / area selected under various categorisations such as typological, spatial, functional, fabric and medical equipment.

The 4 hospitals (France, the Netherlands, UK and Italy) are each involved in case studies to verify the expected results.
There are around 470 NHS Trusts in the UK and over 75% of building stock was constructed before 1975. Therefore for the purpose of the UK Demonstration Case the focus has to be on energy efficient retrofitting rather than new build.

If Project STREAMER delivers the desired outcome there is enormous potential for significant energy reduction across the healthcare estate not only in the UK but all across Europe.

The UK Implementers Community workshop 1 was held on 8th June and 18 people attended as shown below:

Workshop 1 Attendees

Attendee	Organisation	Role
John Cartwright	TRFT	Director of Facilities
Martin Aizlewood	TRFT	Energy Manager
Nick Nisbet	AEC3	Director
Bob Wakelam	AEC3	R & D Manager
Craig Wilson	BTHFT	Energy Manager
Andy Clarkson	Kier	Senior Project Manager
Scott Dickinson	TRFT	Head of Estates
Neil Orpwood	HLM Architects	Healthcare Director
Ian Higgins	RDaSH	Environmental Manager
Steve Gibbons	RDaSH	Estates Operational Officer
Ian Scholey	W. Wright	Electrical Design Engineer
Barry Frith	W. Wright	Electrical Design Engineer
Matt Birkett	W. Wright	Site Engineer
Nick Wright	TRFT	Estates Projects
Gillian Smith	Utilitywise	Energy Services
Kevin Atchison	Utilitywise	Business Development Manager
Conor McMahon	Utilitywise	Business Development Manager
Richard Tandy	Utilitywise	Head of Energy Services
Apologies were received from:		
Mohammad Sajard	BFT	Sustainability Manager
Dale Wilcock	1st Call Technologies	Director
Matt Drabble	1st Call Technologies	Controls Specialist
Paul Tundall	HLM Healthcare	
Dr. Sam Zulu	Leeds Beckett University	
Paul McCabe	NTWFT	Head of Estates
Sarah Neil	NTWFT	Sustainability Manager

Although the group was smaller than anticipated there was a healthy level of enthusiasm and interest.

2.2 Participants and Teams

The audience was drawn from members of the construction industry, M & E engineering professionals, architects and designers, and colleagues from neighbouring NHS Trusts.

Whilst the final number was somewhat lower than had been hoped there was a good deal of enthusiasm from the members present.

Everyone engaged with the concept and there was some lively discussion and debate as the day progressed, especially during the interactive session.

Nick Nisbet of AEC3 explaining how the building interventions interactive exercise would work and delegates gathering information in readiness for the team competition

Nick presented all the interactive options regarding building improvements and the delegates then made their selections on line. The existing MEP and building fabric status were presented alongside a raft of improvements and the teams were then asked to select their preferred options.

The images below illustrate some of the options available to them and the forms that the teams submitted.

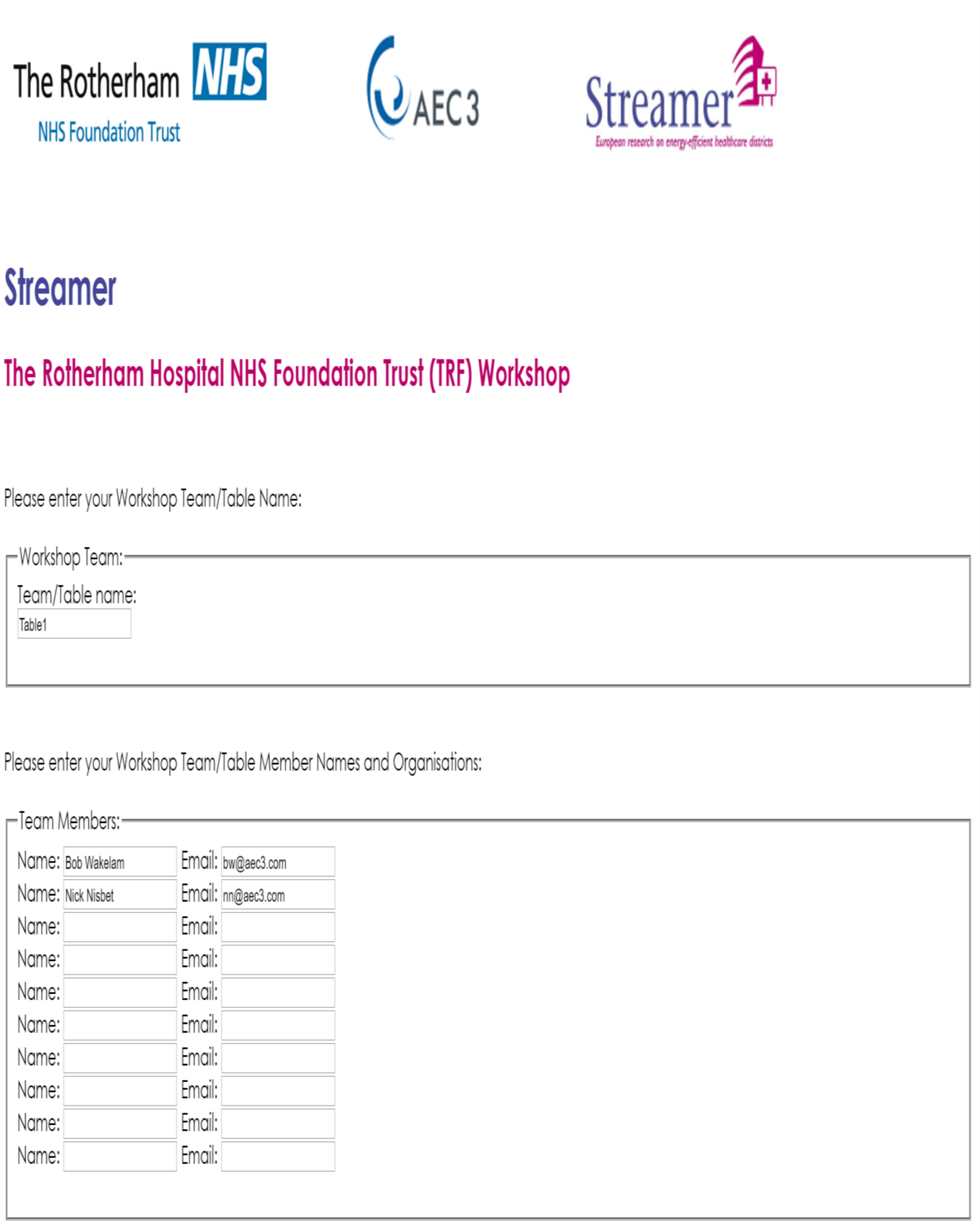
COBie schedule of potential system upgrades

	A	B	C	D	E	F	G	H	I
1	Name	Created By	Created On	Category	Component Names	External System	External Object	External Identifier	Description
2	B6 Ceiling Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_30_25_	B6 Ceiling Option 0	General Spreadsheet to IFC Converter	IFC System	Osys0000	Suspended ceiling with fibre board tiles with slatted to so
3	B6 External Glazing Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_25_60_	B6 External Glazing Option 0	General Spreadsheet to IFC Converter	IFC System	Osys0001	Full height wooden framed single glazed, bottom two pa
4	B6 External Glazing Option 1	nn@aec3.com	2015-02-17T10:10:41	Ss_25_60_	B6 External Glazing Option 1	General Spreadsheet to IFC Converter	IFC System	Osys0002	Triple glazed units with greater natural light
5	B6 External Glazing Option 2	nn@aec3.com	2015-02-17T10:10:41	Ss_25_60_	B6 External Glazing Option 2	General Spreadsheet to IFC Converter	IFC System	Osys0003	Solar tinted glass or film
6	B6 External Glazing Option 3	nn@aec3.com	2015-02-17T10:10:41	Ss_25_50_	B6 External Glazing Option 3	General Spreadsheet to IFC Converter	IFC System	Osys0004	Solar shading
7	B6 external Wall Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_25_13_	B6 external Wall Option 0	General Spreadsheet to IFC Converter	IFC System	Osys0005	Traditional masonry brick and block construction
8	B6 Floors Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_30_12_	B6 Floors Option 0	General Spreadsheet to IFC Converter	IFC System	Osys0006	Concrete, screed and lino with stramit boards installed b
9	B6 Heating Circuits Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_60_40_	B6 Heating Circuits Option 0	General Spreadsheet to IFC Converter	IFC System	Osys0007	One heating circuit, PR3(W) via zone valve 12
10	B6 Heating Controls Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_75_70_	B6 Heating Controls Option 0	General Spreadsheet to IFC Converter	IFC System	Osys0008	Single temperature sensor heating control for whole zon
11	B6 Heating Controls Option 1	nn@aec3.com	2015-02-17T10:10:41	Ss_75_70_	B6 Heating Controls Option 1	General Spreadsheet to IFC Converter	IFC System	Osys0009	Individual room/area wireless temperature sensor heatin
12	B6 Heating Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_60_40_	B6 Heating Option 0	General Spreadsheet to IFC Converter	IFC System	Osys0010	Frenger heated ceilings with a small proportion of wet he
13	B6 Heating Option 1	nn@aec3.com	2015-02-17T10:10:41	Ss_60_40_	B6 Heating Option 1	General Spreadsheet to IFC Converter	IFC System	Osys0011	Underfloor heating system
14	B6 Insulation Option 0	nn@aec3.com	2015-02-17T10:10:41	n/a	B6 Insulation Option 0	General Spreadsheet to IFC Converter	IFC System	Osys0012	25-50mm thick fibre glass insulation to ceilings and min
15	B6 Insulation Option 1	nn@aec3.com	2015-02-17T10:10:41	n/a	B6 Insulation Option 1	General Spreadsheet to IFC Converter	IFC System	Osys0013	100mm thick insualtion to ceilings and additional cavity in
16	B6 Insulation Option 2	nn@aec3.com	2015-02-17T10:10:41	Ss_25_20_	B6 Insulation Option 2	General Spreadsheet to IFC Converter	IFC System	Osys0014	Clad external walls with EWIS (external wall insulation sys
17	B6 Internal Partitions Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_25_10_	B6 Internal Partitions Option (	General Spreadsheet to IFC Converter	IFC System	Osys0015	Plasterboard internal walls
18	B6 Lighting, Automatic Controls Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_70_80_	B6 Lighting, Automatic Contr	General Spreadsheet to IFC Converter	IFC System	Osys0016	No controls
19	B6 Lighting, Automatic Controls Option 1	nn@aec3.com	2015-02-17T10:10:41	Ss_70_80_	B6 Lighting, Automatic Contr	General Spreadsheet to IFC Converter	IFC System	Osys0017	Occupancy sensor and dimmable options
20	B6 Lighting Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_70_80_	B6 Lighting Option 0	General Spreadsheet to IFC Converter	IFC System	Osys0018	5 foot, 65W , T12 fluorescent, two rooms have 4x18W mo
21	B6 Lighting Option 1	nn@aec3.com	2015-02-17T10:10:41	Ss_70_80_	B6 Lighting Option 1	General Spreadsheet to IFC Converter	IFC System	Osys0019	LED 600x600, 40W tile panel lighting and/or HF T5 fluore
22	B6 Mechanical Ventilation Option 0	nn@aec3.com	2015-02-17T10:10:41	Ss_65_Ve_	B6 Mechanical Ventilation Op	General Spreadsheet to IFC Converter	IFC System	Osys0020	Some mechanical ventilation but supply only with no ener

Facility / Floor / Space / Zone / Type / Component / System / Assembley / Connection / Spare / Resource / Job / Impact / Document / Attribute

Below is an example of the level of reporting for circuit monitoring of all the electrical distribution boards of the selected areas *(Fig 6)*. The screen shot shows a report of the electrical consumption of the distribution boards. Circuit level reporting (*Fig 7)*, for both power and lighting, is available for each distribution board to provide the granular information required to assist in the modelling process.

Application Emailed Detailed Results To Participants



The Rotherham NHS
NHS Foundation Trust

AEC3

Streamer
European research on energy-efficient healthcare districts

Streamer

The Rotherham Hospital NHS Foundation Trust (TRF) Workshop

Please enter your Workshop Team/Table Name:

Workshop Team:

Team/Table name: Table1

Please enter your Workshop Team/Table Member Names and Organisations:

Team Members:

Name:	Bob Wakelam	Email:	bw@aec3.com
Name:	Nick Nisbet	Email:	nn@aec3.com
Name:		Email:	
Name:		Email:	
Name:		Email:	
Name:		Email:	
Name:		Email:	
Name:		Email:	
Name:		Email:	
Name:		Email:	

Fig 6

Electrical Sub Circuit Monitoring Interface

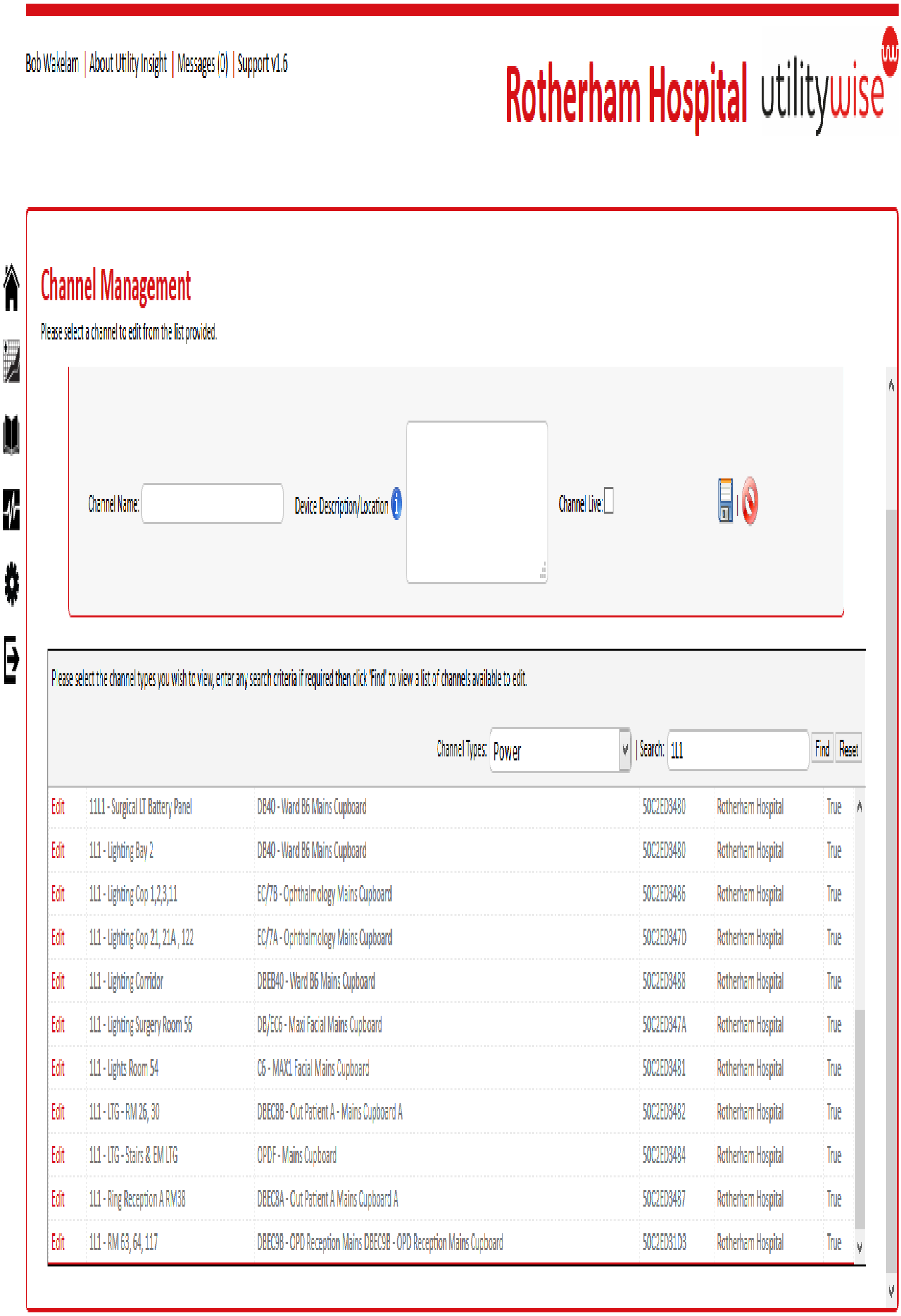


Fig 7

Predicted Energy Consumption (MJ/year) - y axis

Against Investment (£) for example upgrade options - x axis

Proposal	Investment	Energy
BaseLine	0	567000
OPDEG3-WB6EG1	20000	476000
OPDEG3	17000	500000
WB6EG1	6000	520000

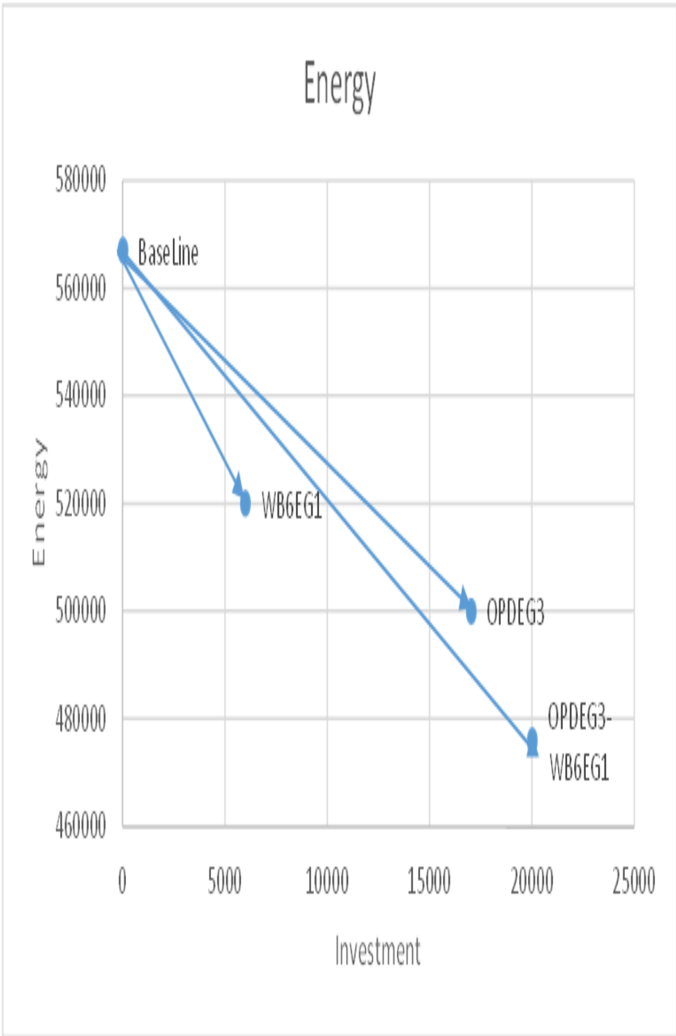


Fig 8

After all the building improvements were selected by the teams, Nick Nisbet and Bob Wakelam (of AEC) carried out simulations *(Fig 8)* which showed the optimum solutions.

2.3 Feedback

Discussion points, participants, collected feedback, competition results)

The W. Wright team were the eventual winners and as promised the winning team were awarded with a “cup”.

But this was no ordinary cup ……………………..

……………………………………………………… It was a “money can’t buy” Project STREAMER winning team mug.

And only 5 of these are in existence.

John Cartwright (TRF) carried out the presentation of the prizes.

Workshop 1 Prizes

Winners “W. Wright”

Other prizes included LED torches and plug-in LED holographic night lights

Discussion points

During the course of the workshop several critical discussions took placed and are summarised here:

- The unit cost of natural gas, currently about £0.03 per kWh, is expected to rise over the next three years because of the imposition of the EU-wide energy and carbon levies. In some circumstances the effective cost could, for large energy users, become as high as £0.20 per kWh. It should be noted that because TRF has invested in a CHP system they do not expect to be subject to this penalty rate, but it will affect a neighbouring health district. The unit cost of electricity, whilst the commodity price is actually falling, will increase due to the pass through charges of the suppliers and generating companies. Also, Climate Change Levy (CCL), which is a taxable commodity will rise by 45% for electricity and by 67% for gas by the year 2019

- During the interactive session the participants organised themselves into 4 groups (teams)
    - RDaSH – wanted to apply their knowledge of Rotherham Hospital to refine the options listed, and indeed to add their own, even though they recognised that the exercise was intended not to burden the participants with facts and figures but rather to respond to their intuitions. They felt that there would be beneficial packages and synergies

    - W. Wright – who were effectively the Rotherham "Home Team" and emphasised their knowledge of the heating and lighting aspects. They were also able to dismiss some options upon their knowledge of the main hospital structure. They were confident that underfloor heating was not an option even though it had been listed by the MEP consultant and so appeared on the options list

    - FTReal – thought the options list was too short and that other hospital wide strategies could have been included alongside the Department (zone) specific options. The architect present echoed the principle shown on a presentation earlier that the cheapest unit of energy is the one that is not used, by advocating "fabric first" the idea that money should be allocated to the fixed structure in preference to any mechanical or electrical systems within the department

    - Project Team – was populated by the Director of Facilities at the hospital

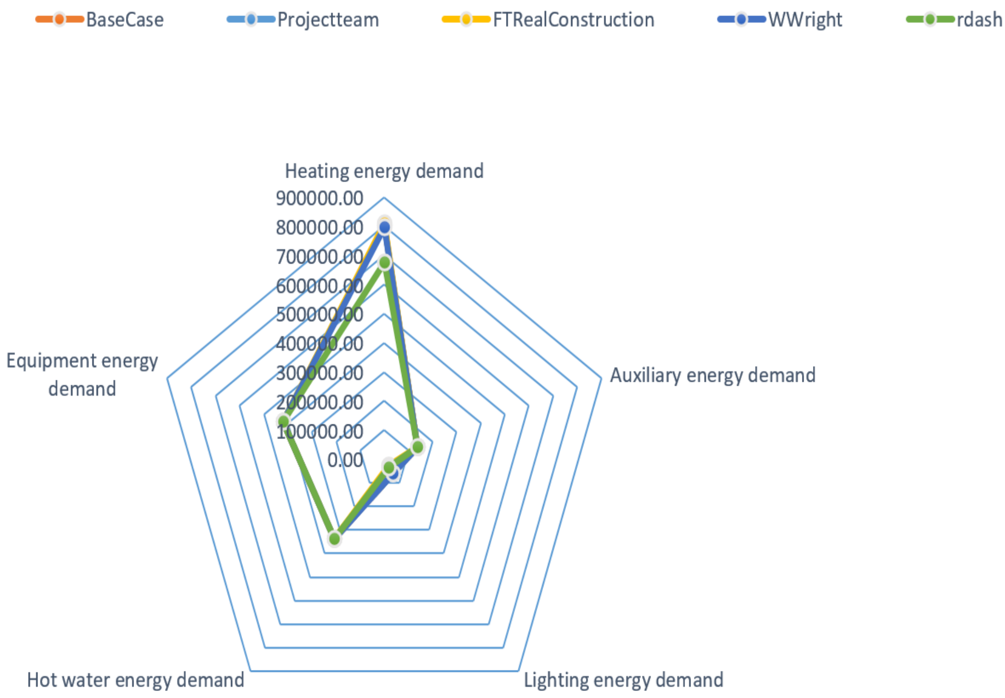
- During the presentation of the results:
    - It was conceded that one of the options for additional heating controls was not supported by the UK SBEM application. Information on these was gathered but only so that recommendations for their addition could be appended to an optional EPC / DEC report, one of the additional outputs alongside the energy simulation results

    - The guidance to choose the most cost effective options was disregarded by all the teams who chose multiple upgrade options. It is thought that the optimal strategy would be a single upgrade, though interactive benefits between options might make a combination more effective than a single upgrade. In the event, all teams chose 8-11 options

Selected strategies

During a break in the workshop the simulation results were collated and published on screen.

Energy Demand Breakdown (MJ/year) by Workshop 1 Teams



Energy Demand Breakdown for Upgrade Options

Upgrades Selected By Workshop 1 Teams

Code	RDash	FTReal	Wwright	ProjectTeam
OPCEG1	Yes			
OPCEG2		Yes	Yes	
OPCEG3				Yes
OPCHC1		Yes	Yes	Yes
OPCIN1	Yes		Yes	Yes
OPCIN2		Yes		
OPCLC1		Yes	Yes	Yes

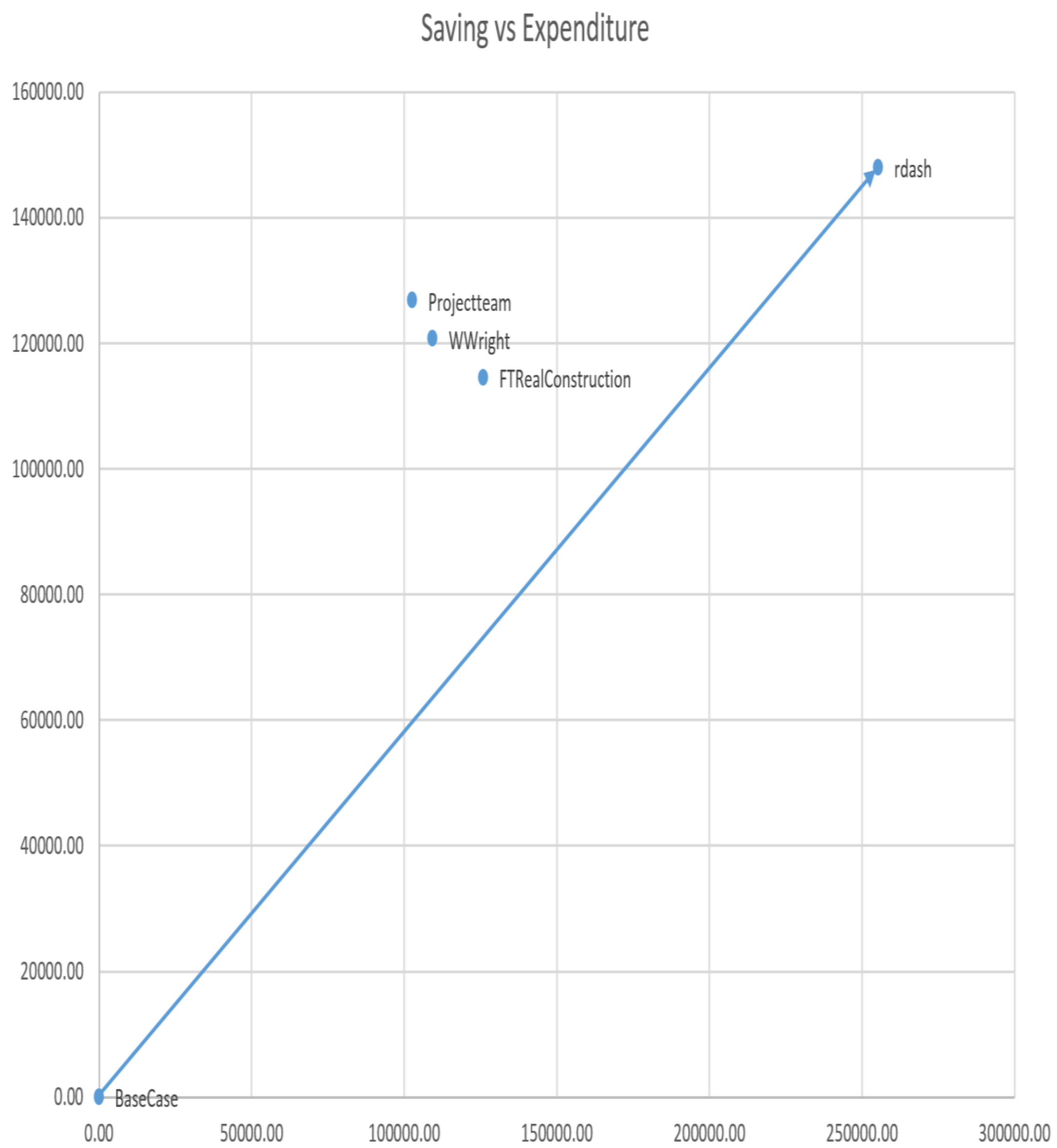
Code	RDash	FTReal	Wwright	ProjectTeam
OPCLT1	Yes	Yes	Yes	Yes
WB6EG1	Yes	Yes	Yes	Yes
WB6HC1	Yes	Yes	Yes	Yes
WB6HC1			Yes	
WB6HT1	Yes			
WB6IN1	Yes		Yes	Yes
WB6IN2		Yes		
WB6LC1			Yes	Yes
WB6LT1	Yes	Yes	Yes	Yes
Number of options	8	9	11	10
Energy savings MJ	255431	125997	109395	102731
Cost of options (£)	£147,954.75	£120,664.75	£120,664.75	£126,736.75
Benefit/Cost (8p per MJ)	0.1381	0.0835	0.0725	0.0648
Payback years	7	12	14	15

Notes:

- RDaSH saved on both heating and lighting energy demand
- Auxiliary, hot water and equipment energy demand was unaffected
- The team that chose the fewest options, but spent the most, made double the energy savings of the others and achieved the best payback
- At 1p per MWh all the proposals had a payback of over 50 overs, whereas at 8p per MWh the payback range was 7-15 years

Proposed Expenditure (£) By Workshop 1 Teams - y axis

Versus Savings (MJ/year) - x axis



- RDaSH achieved the best benefit / cost ratio and the best savings from the biggest expenditure
- On the graph above, savings appear on the X axis and expenditure on the Y axis, so the shallowest line represents the best value

2.4 Lessons learned

Conclusions / recommendations

During the course of the workshop several critical discussions took place and are summarised below:

- It became apparent that mobilising interest with targeted professionals would be very difficult, and that travelling to Rotherham was not an option for some

- A group of approximately 24-28 participants was initially envisaged but late withdrawals due to business commitments reduced the attendance to just 18 (including STREAMER members)

- Whilst the turnout was a little disappointing the reduced numbers did actually serve to better focus the activity and discussion of the group

- TRF has concerns about the ability to maintain interest , and indeed, generate fresh interest amongst group members for the follow up workshop which was originally scheduled for October 2016

- With this in mind TRF has decided to postpone the second workshop, planned for October 2016, until there is something really tangible to present from STREAMER that may attract a bigger and more focussed audience

- To this end, the second Implementers Community workshop has been re-arranged for 3rd May 2017

- It is intended that the second Implementers Community Workshop should involve a broad cross section of individuals with expertise in all aspects of building design, construction and operation. These delegates will be gathered into mixed groups to provide differing (and in some cases opposing) views as to which would be the preferred interventions. The logic being that a consensus will be reached and the results analysed to provide a unique insight into providing a common means of energy saving and carbon reduction

- From lessons learned with Workshop 1 a fuller presentation of the STREAMER workshop will be delivered, along with an improved briefing of the participants. There will be more systematic documentation of the discussions by instructing each team to appoint a reporter to document their discussions and selections, resulting in improved analysis including consideration of better heating controls