The ‘LESSONS’ Project

Understanding the Gaps Between Operational Energy Use and Modeling

Ruth Kerrigan: ruth.kerrigan@iesve.com

The LESSONS Project

"LESSONS is an innovative website, where case studies from previous projects will be stored in a data base. Practitioners will be able to search for 'lessons' from past projects to influence and improve their designs. Practitioners will also be able to upload their own 'Lessons' from projects they have completed"

www.buildinglessons.com

"Low Impact Buildings: Design and Decision Tool"

Technology Strategy Board
Driving Innovation

PICK EVERARD

dmu.ac.uk
DE MONTFORT UNIVERSITY
LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.

Introduction

INTEGRATED ENVIRONMENTAL SOLUTIONS

20 20 20 Targets

- reduce GHG emissions to 20% of 1990 levels,
- 20% of EU energy to come from renewable resources
- 20% reduction in primary energy use compared with baseline projections.

Approximately 80% of a building's total lifecycle energy usage occurs during its operational stage

'As-built' performance of new or refurbished buildings frequently does not achieve the 'as-designed' predicted performance

The EU Energy Efficiency Action Plan 2011 states that the barriers to energy efficiency in buildings need to be overcome in order to meet the targets

Technology Strategy Board
Driving Innovation

PICK EVERARD

dmu.ac.uk
DE MONTFORT UNIVERSITY
LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.

Introduction

Reasons for Inefficiency in Buildings

- The discontinuity between the design and as-built building envelope and systems
- The discontinuity between the design of the building and the operation of the building
- The discontinuity between design stage assumptions and how the control systems are set up and operated
- Most building management systems (BMS) are fixed scheduled and unable to adapt to changing environmental, building envelope, and usage conditions
- Most BMS are using control algorithms several generations behind state-of-the art
- Typical BMS and non-BMS controls systems do not integrate the diverse building systems and equipment well

Technology Strategy Board Driving Innovation
PICK EVERARD
dmu.ac.uk DE MONTFORT UNIVERSITY LEICESTER
VANGUARD HOMES LTD
© Integrated Environmental Solutions Ltd.
Design, Simulate & Innovate with IES <Virtual Environment>

Concept

What is it?

A website to provide dramatically better guidance of design decisions to deliver zero carbon and low impact buildings

Why do it?

The real performance of ‘green’ buildings often falls well below design expectations because designers cease to be involved post occupancy

Technology Strategy Board
Driving Innovation

PICK EVERARD

dmu.ac.uk
DE MONTFORT UNIVERSITY
LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.

Concept

How will it improve design

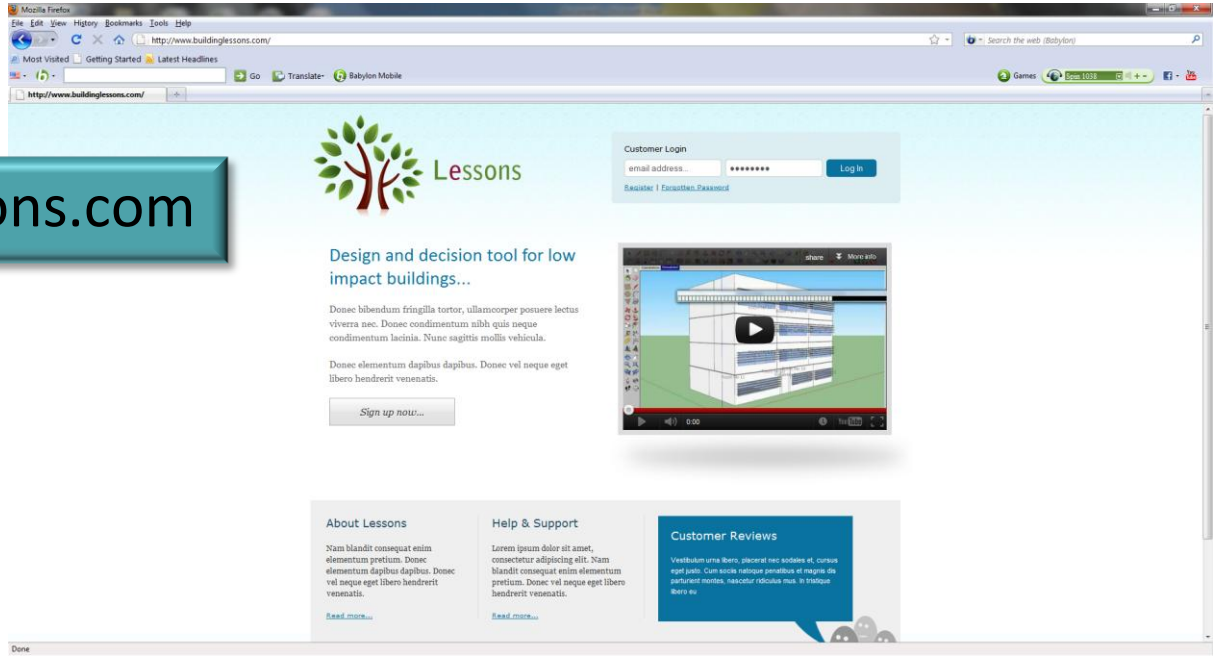
- Creates a tool that allows designers to access previous design cases and insights relevant to their current projects
- Provides comparisons between the expected design performance and the actual operational performance to allow the user to use similar systems or a similar approach
- Allows the modelling providers, such as IES, Energy+, TAS etc to examine where operational data differs from estimated data and understand how to improve their design software
- Provides greater accessibility to design and decision tools for all practising engineers
- Provides access to relevant design information
- Provides tools that help “every stage of the design process

© Integrated Environmental Solutions Ltd.

Concept

What does it look like

www.buildinglessons.com

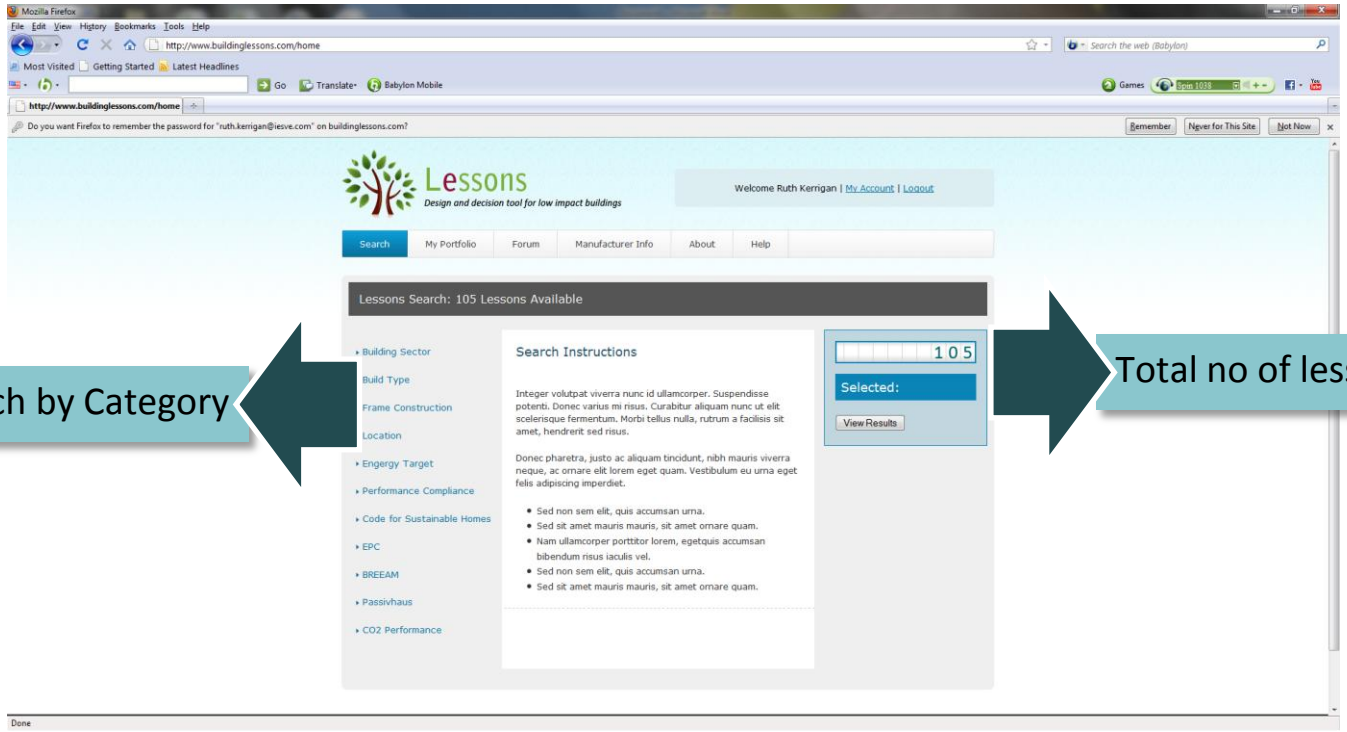


© Integrated Environmental Solutions Ltd.

Functionality

INTEGRATED ENVIRONMENTAL SOLUTIONS

Search



Search by Category

Total no of lessons available

Technology Strategy Board
Driving Innovation

PICK EVERARD

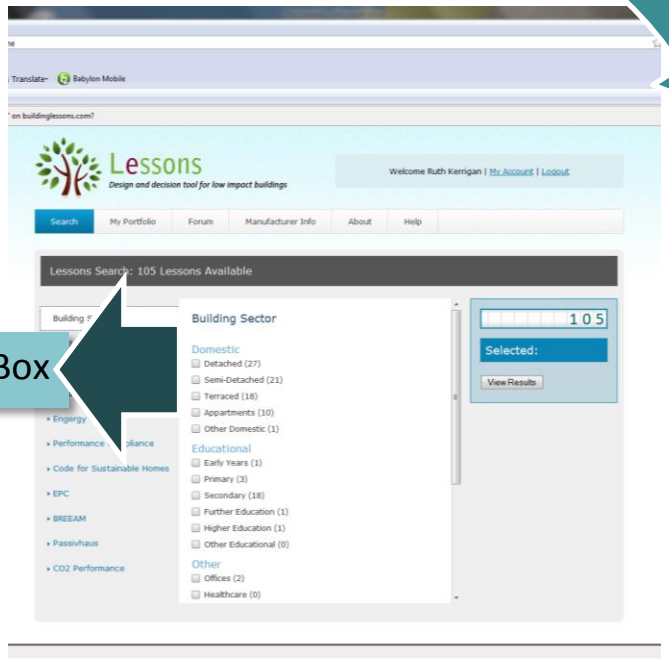
dmu.ac.uk
DE MONTFORT UNIVERSITY LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.

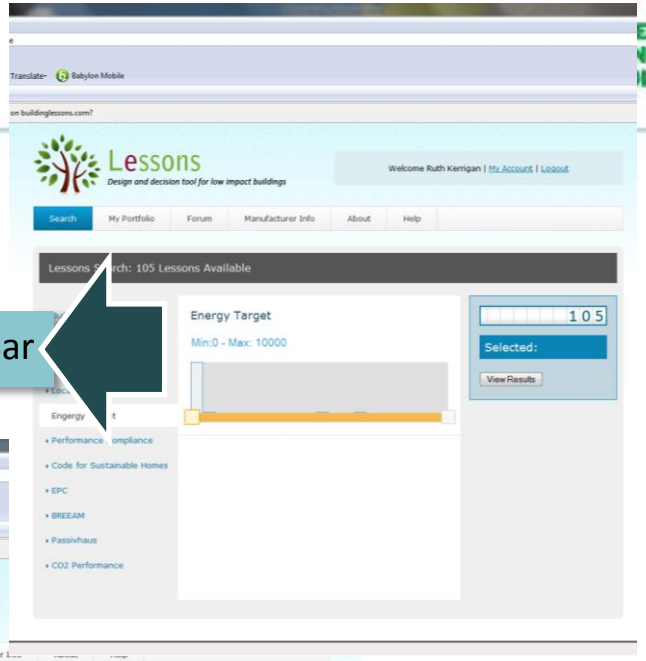
Functionality

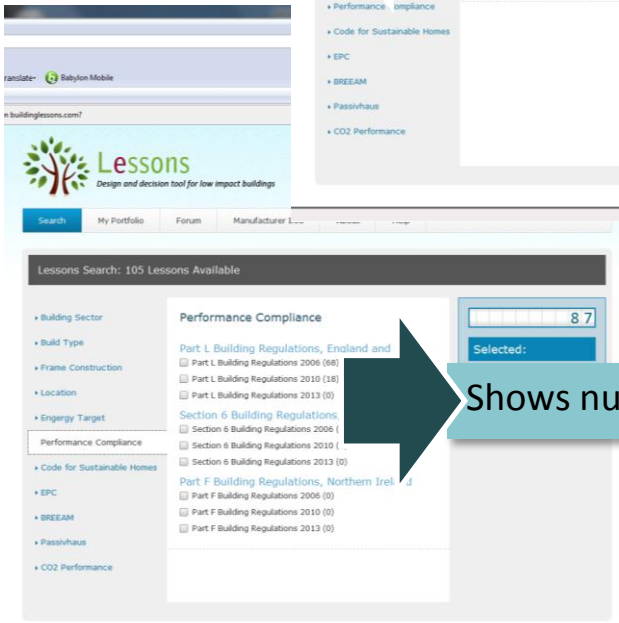
Search



Check Box

Slide Bar





Shows number available

Technology Strategy Board
Driving Innovation

PICK EVERARD

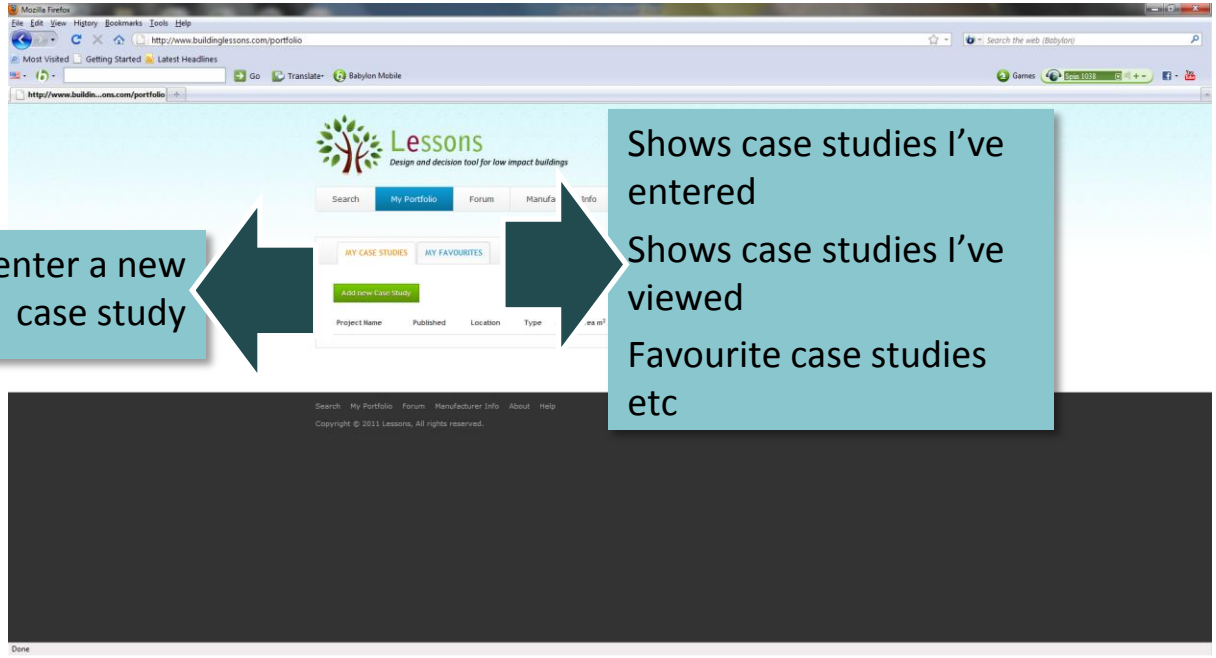
dmu.ac.uk
DE MONTFORT UNIVERSITY
LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.

Functionality

My Portfolio



Allows you to enter a new case study

Shows case studies I've entered

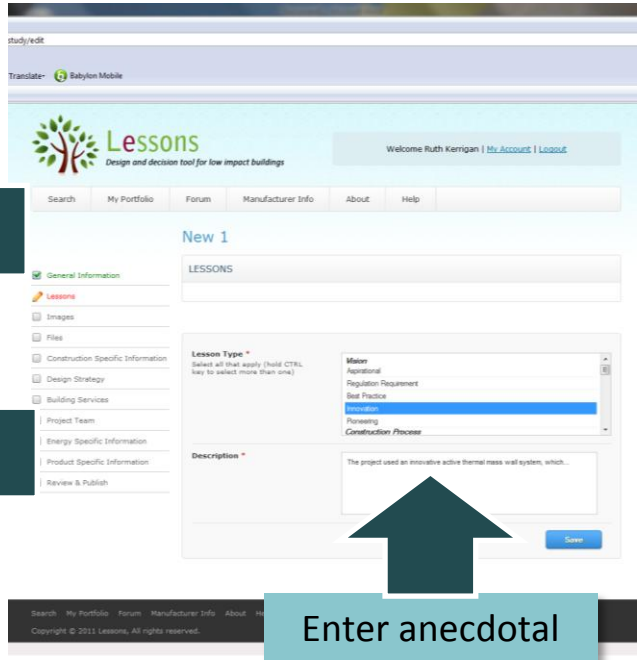
Shows case studies I've viewed

Favourite case studies etc

© Integrated Environmental Solutions Ltd.

Functionality

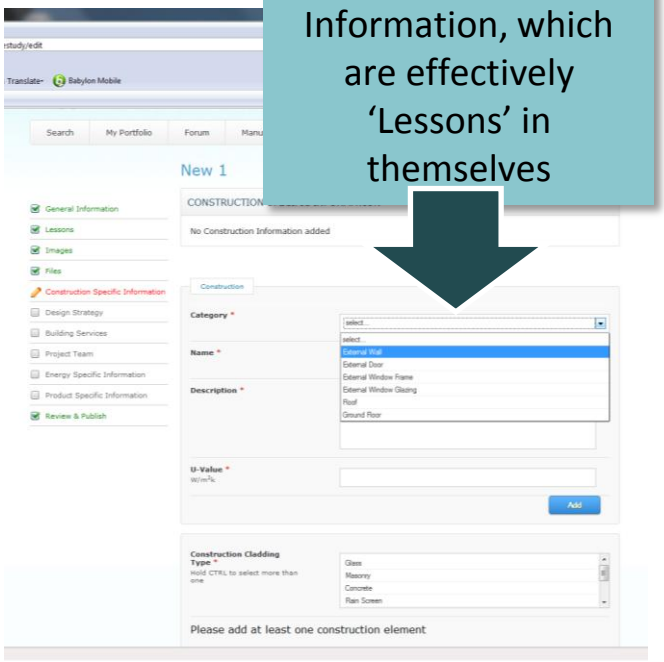
New Case Study



Various levels of information

Post Occupancy Information to compare design against use

Enter anecdotal lessons

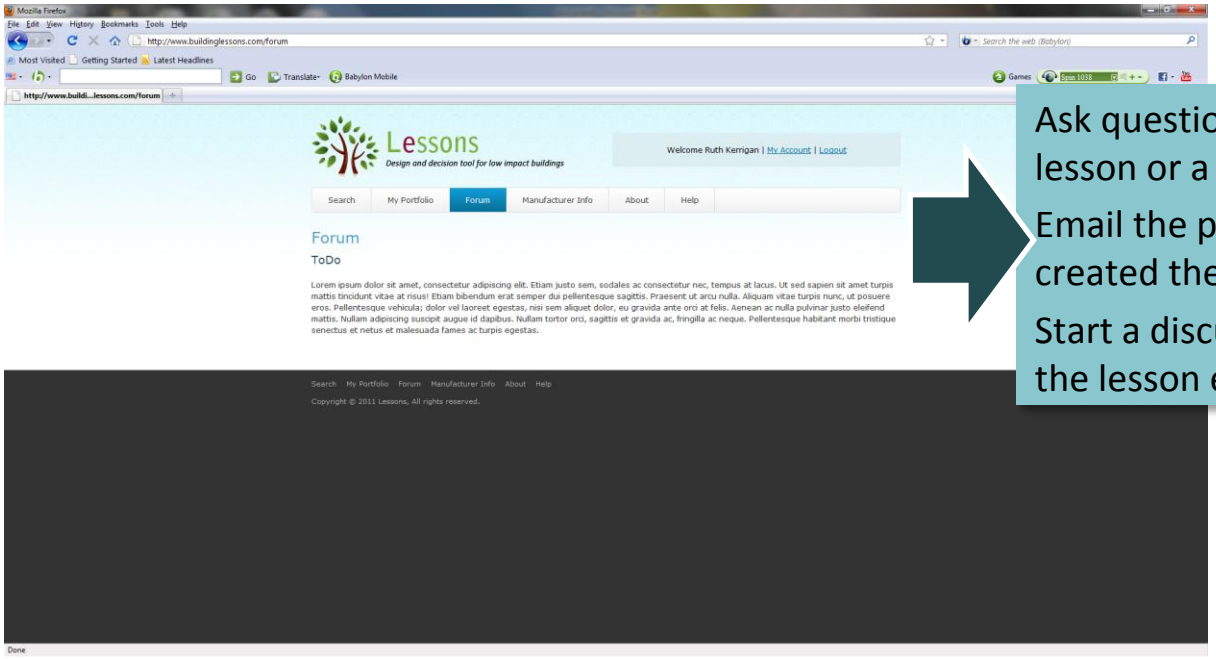


Design and Construction Information, which are effectively 'Lessons' in themselves

© Integrated Environmental Solutions Ltd.

Functionality

Forum

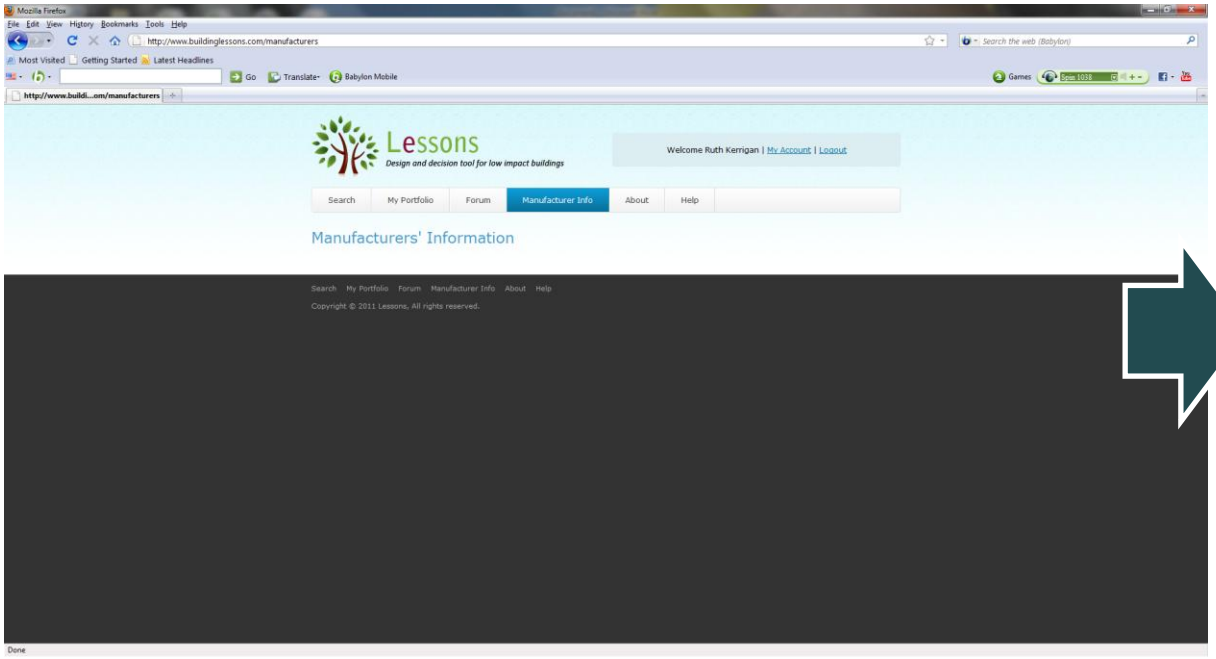


- Ask questions about a lesson or a case study
- Email the person who created the case study
- Start a discussion about the lesson etc

Technology Strategy Board
Driving Innovation
PICK EVERARD
dmu.ac.uk
DE MONTFORT UNIVERSITY
LEICESTER
VANGUARD HOMES LTD
© Integrated Environmental Solutions Ltd.
Design, Simulate & Innovate with IES <Virtual Environment>

Functionality

Manufacturer Info

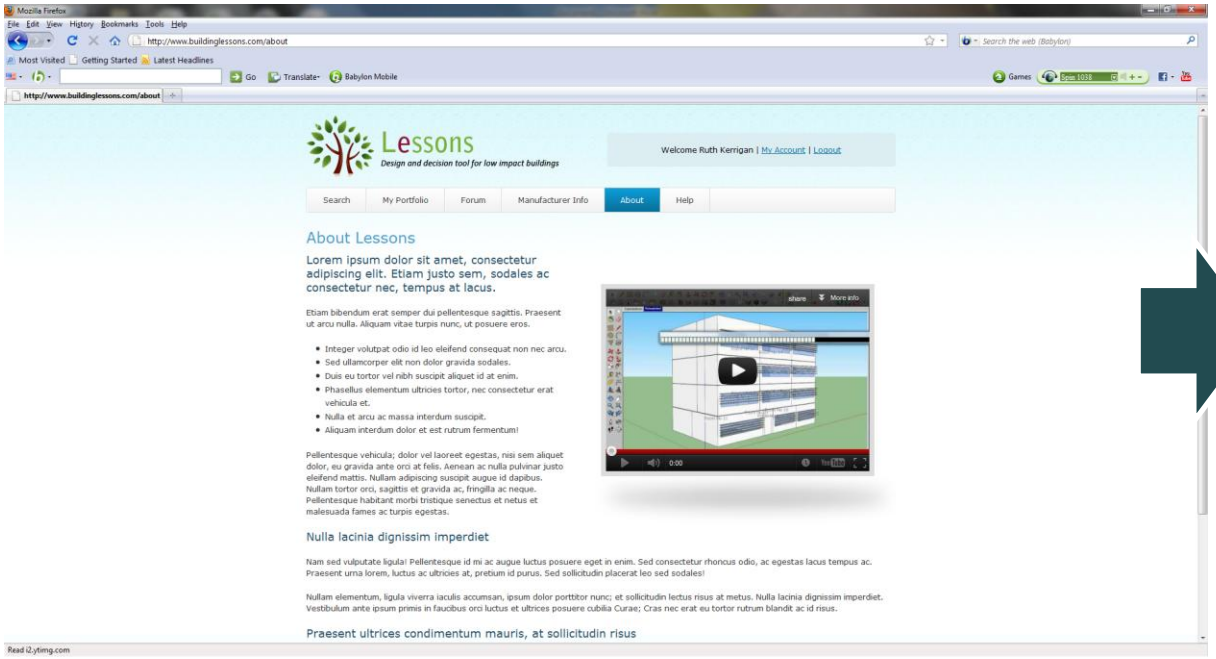


- Choose a manufacturers product to add to your case study
- View where a manufacturers product has been used
- Manufacturers can upload data for use with case studies
- Manufactures can create a 'performance component' of their technology to be linked with IES software and uploaded to a case study for use with a 3D design model

Technology Strategy Board
Driving Innovation
PICK EVERARD
dmu.ac.uk
DE MONTFORT UNIVERSITY LEICESTER
VANGUARD HOMES LTD
© Integrated Environmental Solutions Ltd.
Design, Simulate & Innovate with IES <Virtual Environment>

Functionality

About

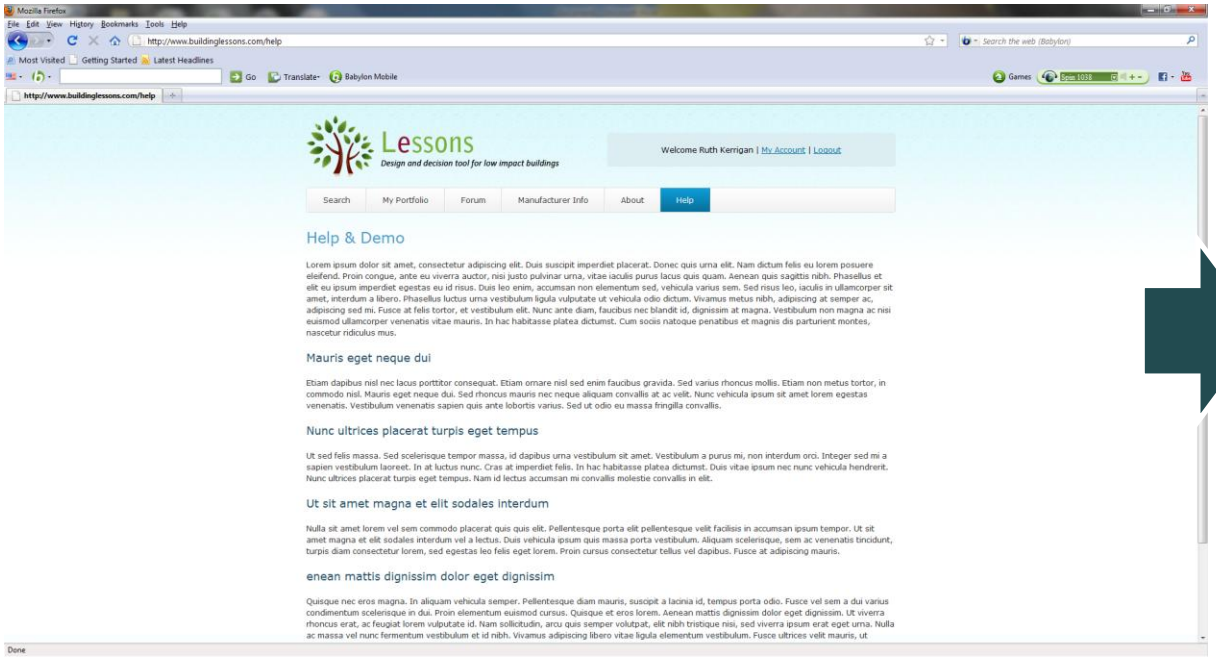


Information about the website

© Integrated Environmental Solutions Ltd.

Functionality

Help



Help files, manuals and youtube demos to show the user how to enter, search and use the website

© Integrated Environmental Solutions Ltd.

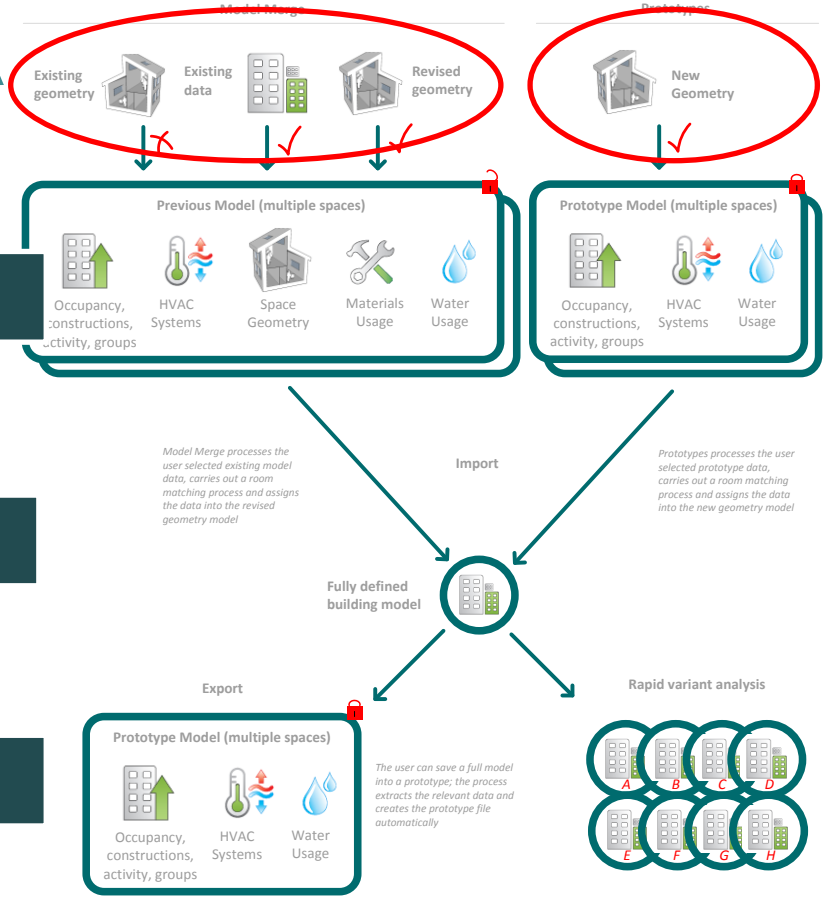
Functionality

Upload/Download

imports and exports user chosen data, namely: templates, constructions, profiles, systems, openings and room group definitions

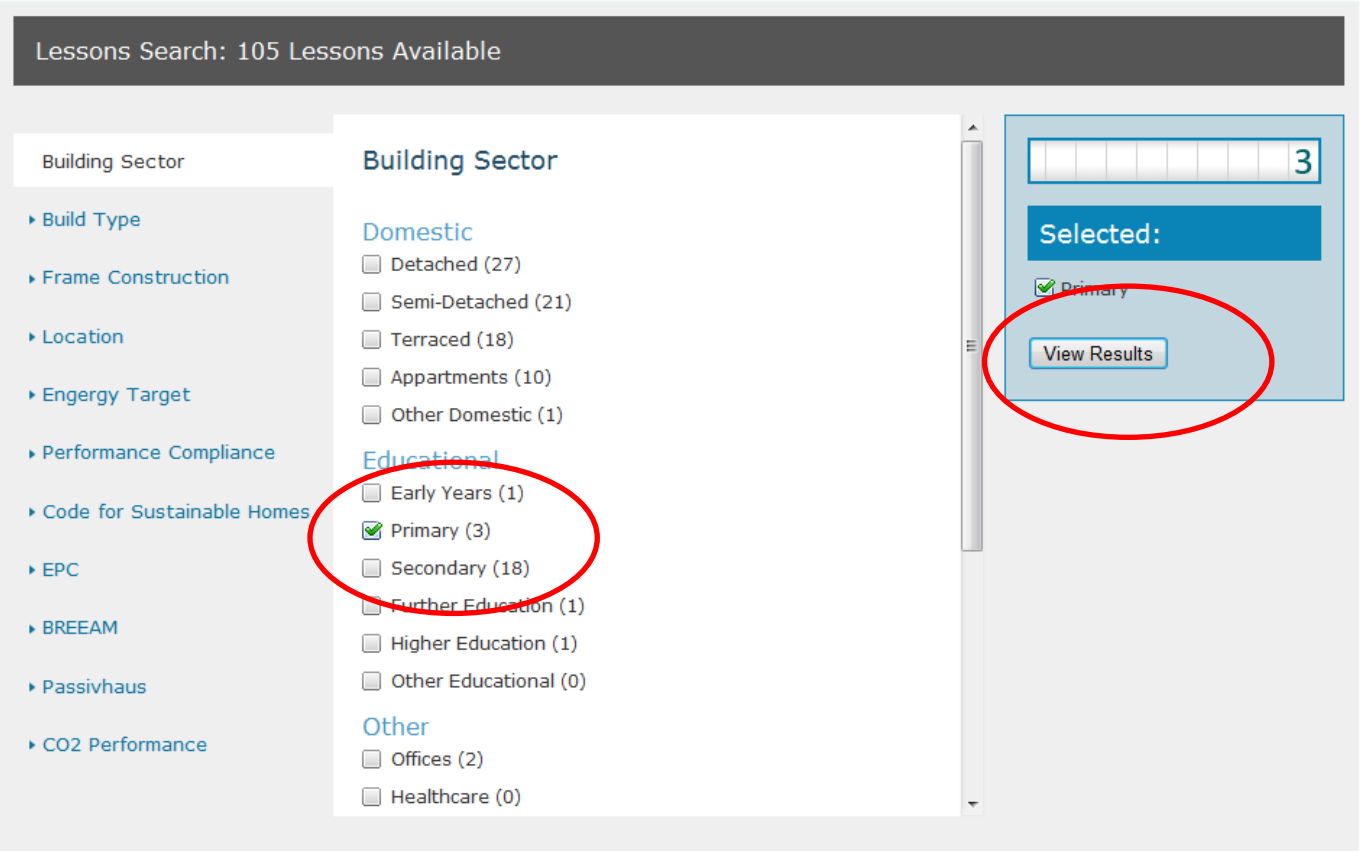
The user can control what data is imported / exported and how the imported data is applied to a model

The function can match rooms by room name and replace existing data or just import the data to model databases for manual assignment



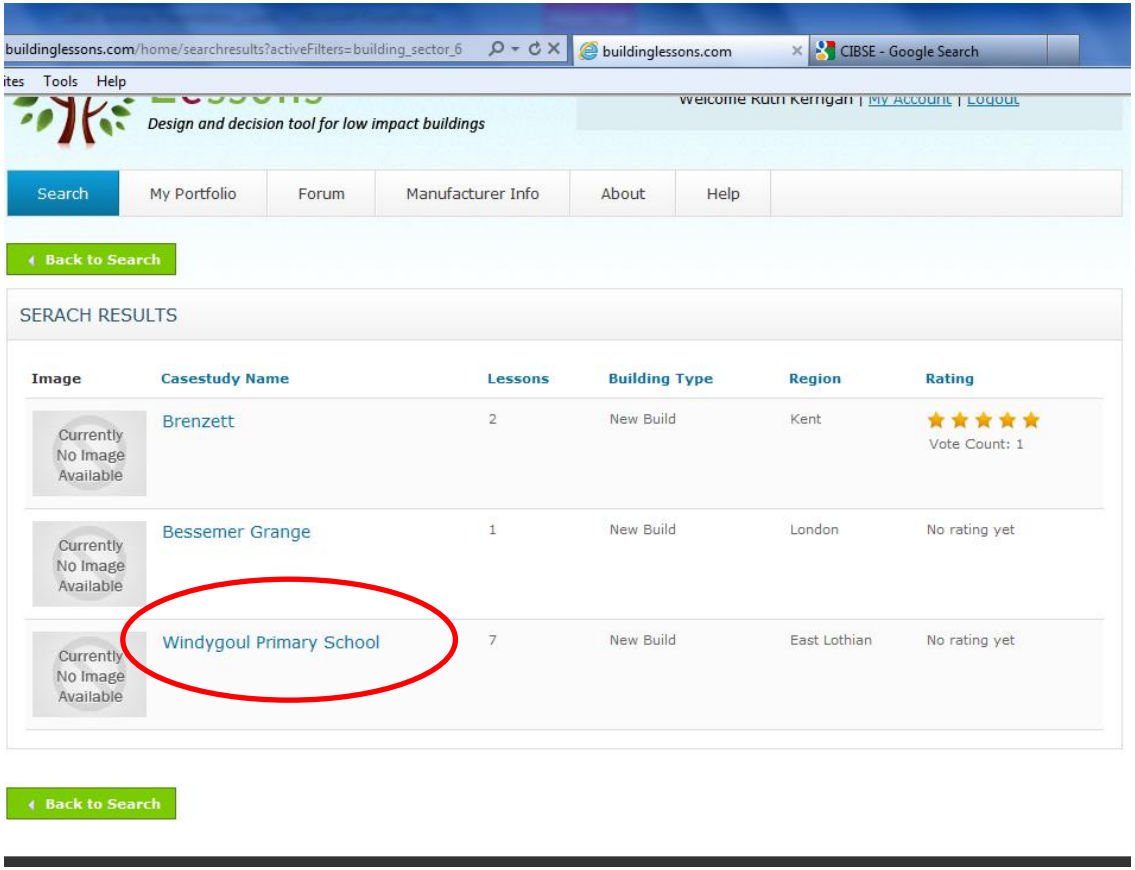
Technology Strategy Board
Driving Innovation
PICK EVERARD
dmu.ac.uk
DE MONTFORT UNIVERSITY LEICESTER
VANGUARD HOMES LTD
© Integrated Environmental Solutions Ltd.
Design, Simulate & Innovate with IES <Virtual Environment>

Example



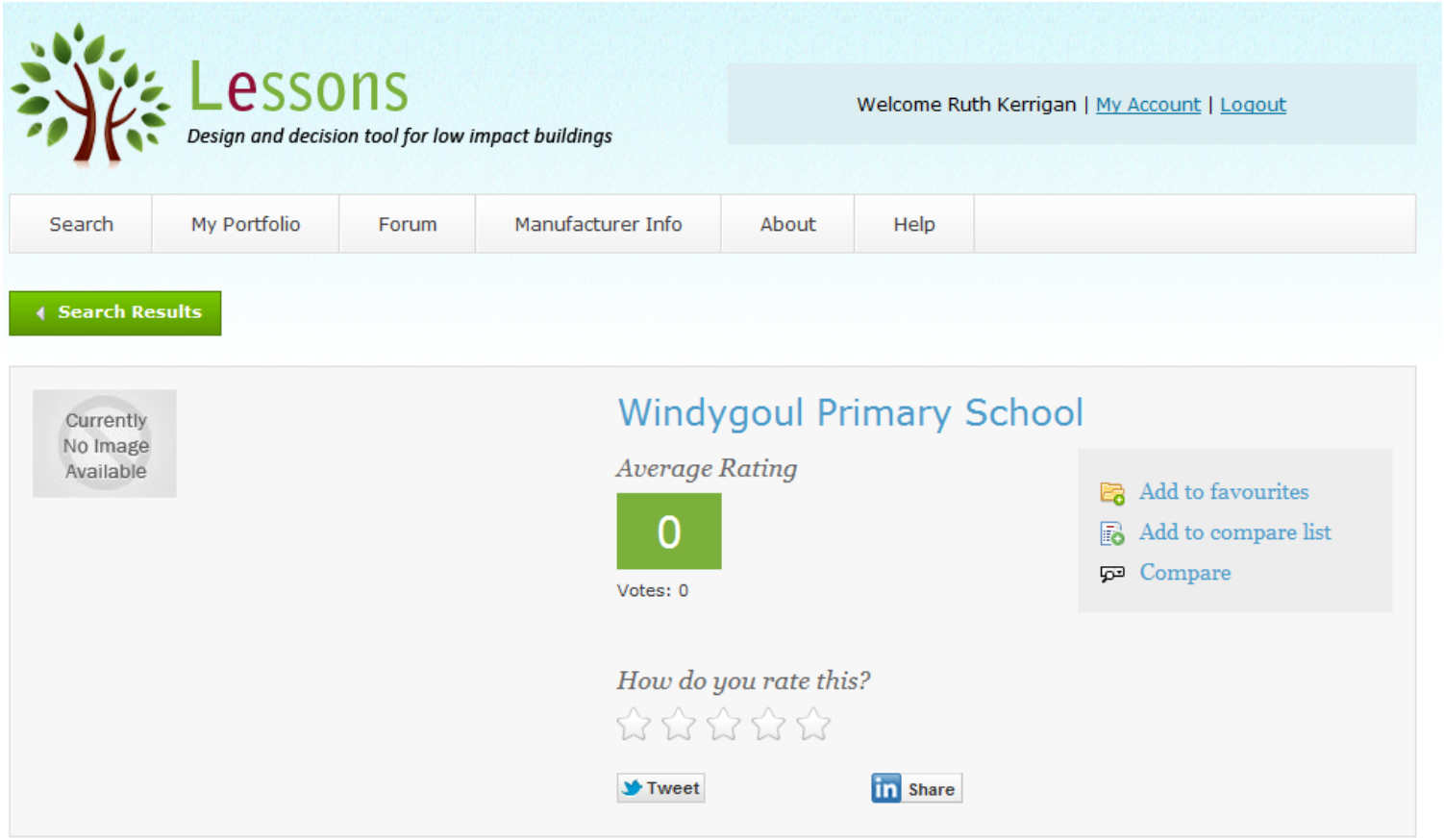
Technology Strategy Board
Driving Innovation
PICK EVERARD
dmu.ac.uk
DE MONTFORT UNIVERSITY
LEICESTER
VANGUARD HOMES LTD
© Integrated Environmental Solutions Ltd.
Design, Simulate & Innovate with IES <Virtual Environment>

Example



Technology Strategy Board
Driving Innovation
PICK EVERARD
dmu.ac.uk
DE MONTFORT UNIVERSITY LEICESTER
VANGUARD HOMES LTD
© Integrated Environmental Solutions Ltd.
Design, Simulate & Innovate with IES <Virtual Environment>

Example

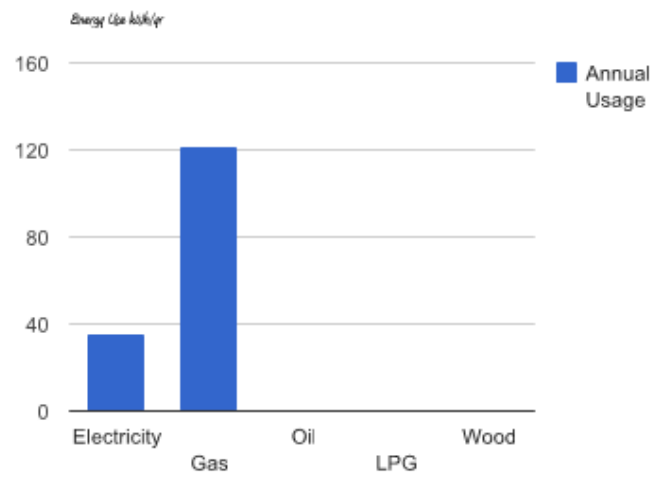


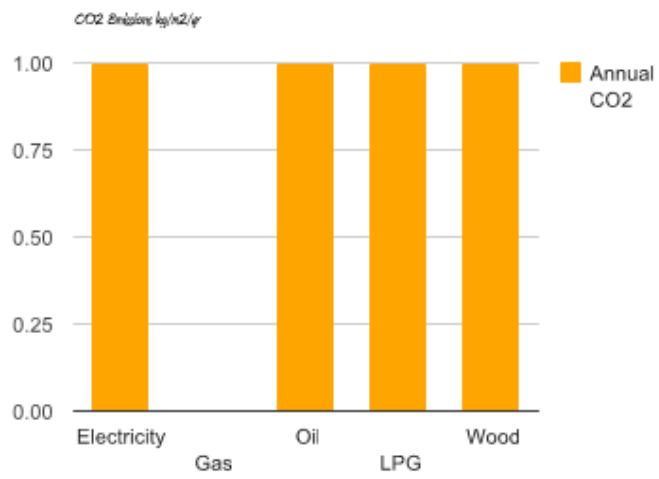
© Integrated Environmental Solutions Ltd.

Example

INTEGRATED ENVIRONMENTAL SOLUTIONS

CHARTS





Technology Strategy Board
Driving Innovation

PICK EVERARD

dmu.ac.uk
DE MONTFORT UNIVERSITY
LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.

Example

INTEGRATED ENVIRONMENTAL SOLUTIONS

GENERAL

Property	Value
Source of Information	P19 - Carbon Trust
Building Phase	Completed
Project Type	New Build
Building Sector	Primary
Construction Type	Offset MMC
Year of Completion	2007 Quarter 2
Building Area m²	3462
Town/City	Windygoul
County or Region	East Lothian
Postcode	
Country	
Performance Compliance	Part L Building Regulations 2006
Code for Sustainable Homes	Not Applicable
EPC	Not Applicable
BREEAM	Not Applicable
Passivhaus	Not Applicable
Energy Performance (predicted) kWh/m²/yr	1

Technology Strategy Board
Driving Innovation

PICK EVERARD

dmu.ac.uk
DE MONTFORT UNIVERSITY LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.

Example

INTEGRATED ENVIRONMENTAL SOLUTIONS

LESSONS

Category	Sub-Category	Lesson
Construction Process	Design	The walls of the building are constructed from pre-fabricated timber frame panels which contain insulation manufactured from recycled newspaper. In addition to offering insulation in excess of the levels required under current legislation, the panels fit neatly together with air-tight joints and so reduce uncomfortable and energy wasting draughts. These prefabricated panels accelerated the build process and reduced the generation of on-site waste during construction.
Construction Process	Manufacture	
Construction Process	Construction	
Technology Types	Insulation	
Construction Process	Design	An underfloor heating system has been installed in most areas of the building. Underfloor heating is an efficient means of providing warmth evenly across a whole room and improves comfort levels by avoiding the creation of hot and cold spots. The heating system is supplied by highly efficient gas condensing boilers.
Construction Process	Design	The school was designed to maximise the availability and use of natural lighting. The classrooms have sloped ceilings and are glazed at occupant level on both outer facing walls. On the opposing walls, which face into the courtyard, windows are mounted at a higher level. The classrooms are thus provided with ample daylight. Glazing on the Northern elevation of the building is minimised to prevent heat loss. Inevitably, however, some artificial lighting was required in the school. To provide this without excessive energy consumption, the design team opted for highly efficient fluorescent lighting with automatic controls. These controls, which monitor both occupancy and level of natural light in the room, minimise energy use by ensuring that lights are only switched on when the room is occupied and by automatically dimming the lights in relation to the amount of daylight available.
Technology Types	Glazing	
Construction Process	Design	Control Lighting to Save Energy No matter how efficient the light, it will waste energy if left on whilst the room is empty. Also, using natural light will only save energy when electric lights are controlled in relation to the amount of daylight available (i.e. dimming or switching off when there is sufficient daylight to support the activity being undertaken in the room). For new buildings, or refurbishment of lighting systems in existing buildings, select automatic lighting controls which take account of room occupancy and natural light levels.
Wider Professions	Management	
Construction Process	Design	By installing opening windows on opposing walls in the classrooms, the designers created a passive ventilation system that supplies fresh air and cooling without the need for power hungry air conditioning systems. The windows are opened and closed under manual control, with the higher level windows using small motors controlled by the room's occupants. As the air in the room warms up, it rises to the higher part of the ceiling and escapes via the high level windows. In doing so, cooler fresh air is drawn into the room through the outer facade windows. The lower windows have a higher hopper so that fresh air does not blow across occupants and cause discomfort in winter. Modelling of the building carried out by consultants during the design process indicated that, by using this passive ventilation strategy, with solar shading on the outside, excessive temperatures would not be a problem. The experience of the occupants of the school is that comfort levels are good and that
Technology Types	Natural Ventilation	
Technology	Glazing	

Technology Strategy Board
Driving Innovation

PICK EVERARD

dmu.ac.uk
DE MONTFORT UNIVERSITY
LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.

Example

INTEGRATED ENVIRONMENTAL SOLUTIONS

CONSTRUCTION

Category
External Wall

Back to top

BUILDING SERVICES

Category
Other Renewables
Other Renewables

Back to top

DESIGN

Strategy	Priority	Description
daylighting	High	The school was designed to maximise the availability and use of natural lighting. The classrooms have sloped ceilings and are glazed at occupant level on both outer facing walls. On the opposing walls, which face into the courtyard, windows are mounted
ventillation	High	By installing opening windows on opposing walls in the classrooms, the designers created a passive ventilation system that supplies fresh air and cooling without the need for power hungry air conditioning systems.

TEAM

Name	Role	Company
East Lothian Council	Client	East Lothian Council

Back to top

ENERGY

Property	DESIGN	ESTIMATED
Energy Use: Electric kWhr/yr		36
Energy Use: Gas kWhr/yr		122
Energy Use: Oil kWhr/yr		1
Energy Use: LPG kWhr/yr		1
Energy Use: Wood kWhr/yr		1
CO_2 Emissions: Electric kg CO_2/yr		1
CO_2 Emissions: Gas kg CO_2/yr		0
CO_2 Emissions: Oil kg CO_2/yr		1
CO_2 Emissions: LPG kg CO_2/yr		1
CO_2 Emissions: Wood kg CO_2/yr		1

Technology Strategy Board
Driving Innovation

PICK EVERARD

dmu.ac.uk
DE MONTFORT UNIVERSITY LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.

Impact

Benefits with respect to operation versus model

- Design is based on lessons from existing buildings, therefore comparison of how the design performed versus how the building operated can be taken into account
- Lessons with respect to design strategy, systems used, constructions used etc can be examined and learnt from
- Models of exemplar buildings with respect to ‘as designed’ performance against ‘as built’ performance can be downloaded and used with your own design model
- Technologies used can be examined with respect to their advantages and disadvantages and informed decisions with respect to whether or not to use them can be made

© Integrated Environmental Solutions Ltd.

Impact

Wider Impacts

- Improved design, quality and productivity
- Better design at early stage
- 40-50% lower energy use and carbon emissions
- Drive towards zero carbon buildings
- Informed information for the retrofit market
- …

Technology Strategy Board
Driving Innovation

PICK EVERARD

dmu.ac.uk
DE MONTFORT UNIVERSITY
LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.

INTEGRATED ENVIRONMENTAL SOLUTIONS

Thank you
Q&A

Technology Strategy Board
Driving Innovation

PICK EVERARD

dmu.ac.uk
DE MONTFORT UNIVERSITY
LEICESTER

VANGUARD HOMES LTD

© Integrated Environmental Solutions Ltd.