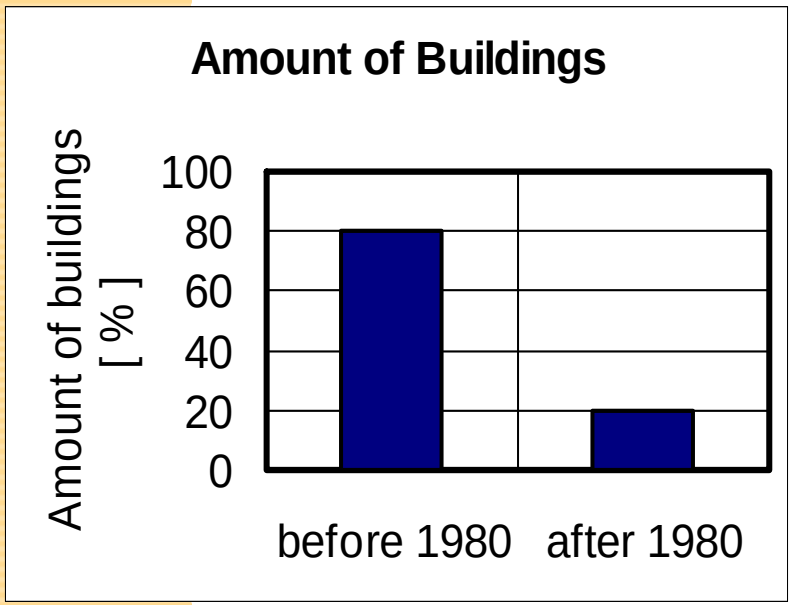
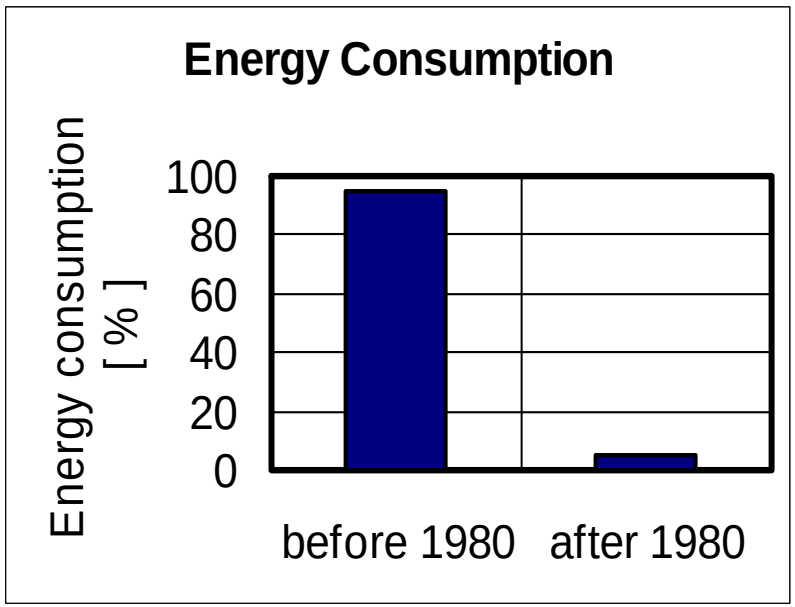
BIT – The BRITA in PuBs Information Tool for Public Decision Makers

Heike Erhorn-Kluttig
Fraunhofer Institute of Building Physics

Background

- Energy consumption of building stock in Europe





Background

- Energy consumption of building stock in Europe
- Concentration on the energy-unefficient building stock
- Significance of energy conservation as set-up goals of (public) decision makers in retrofit projects
- Realised by increasing the knowledge of energy-efficient retrofit technologies and their intelligent application
  - by presenting best practice examples
  - by giving simple-to-use tools at hand that will support them at the first planning phase

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  - by presenting best practice examples
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Background

BRITA in PuBs deliverables \ BRITA in PuBs target groups	technical personnel (planning + manage-ment)	technical mainte-nance staff	technical consultants	politicians	building owners	contractors	building users	general public
financial schemes report	■		□		□			
design guidelines	□		■					
quality control toolbox	□	■				■		
BIT: BRITA in PuBs information tool on innovative retrofit measures	■		□	□	□	■		
demonstration building report	■	□	■		□	■		□
BISHs: BRITA in PuBs blackboard information sheets		■					■	■
BRITA in PuBs e-learning modules		■					□	■
website (www.brita-in-pubs.com)	□	□	□	■	■	□	■	■
electronic newsletter	■			□				
PR-campaign	□			■	□			
articles in journals + magazines	■		□	■	■			□
common eco-buildings symposium + alternative conferences	■		■					

■ specifically targeted to group □ offers valuable information to group

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IEA ECBCS Annex 36: Energy Concept Advisor

33 Case Studies from 10 Countries

Photos	Country	Case Studies
 	Germany	D1: School in Stuttgart-Plieningen D2: Bertolt-Brecht-School, Dresden D3: Paul-Robeson-Schol, Leipzig D4: University Stuttgart D5: University Ulm D6: University Library Bremen D7: Käthe-Kollwitz-School, Aachen D8: Laboratory Building, Jülich
	Den-mark	DK1: Egebjerg School, Ballerup DK2: Enghøj School, Hvidovre DK3: Vridsløselille School, Albertslund
	Finland	SF1: Elementary School Oulujoki, Oulu SF2: Vihasitenkari Day-care Centre
	France	FR1: Louise Labe Secondary School FR2: Gambetta Professional High School
	Greece	GR1: Chemical Engineering Building NTUA, Athens GR2: University of Ionnina GR3: Rural and Surveying Engineering Building NTUA, Athens

Photos	Country	Case Studies
	Italy	I1: University Building Mattatoio, Rome
	Norway	N1: Kampen School N2: Borgen Secondary School
	Poland	PL1: Secondary School Swarzedz PL2: Technical University Poznan
 	United Kingdom	UK1: William Parker Community Secondary School UK2: Hadley Junior School UK3: Thames Valley University, Grove House, Ealing UK4: George Tomlinson School, Bolton, Lancashire UK5: Ketley Town Junior School UK6: Slough Grammar School UK7: Classrooms of the Future, Telford
	USA	US1: Wausau West High School, Sullivan County, Tennessee US2: University New Hampshire US3: University New Hampshire

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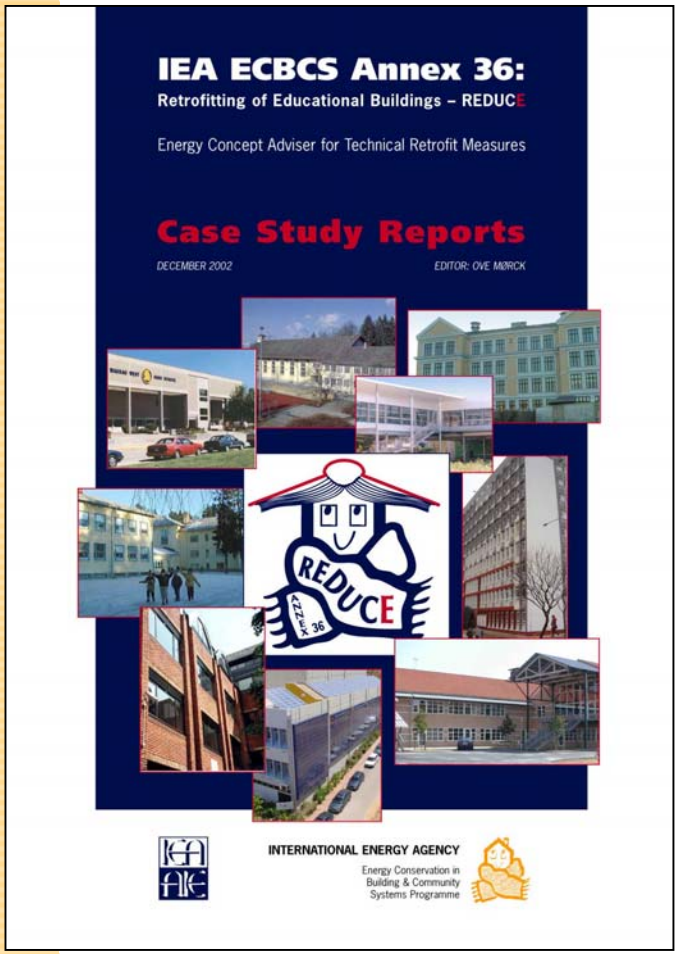
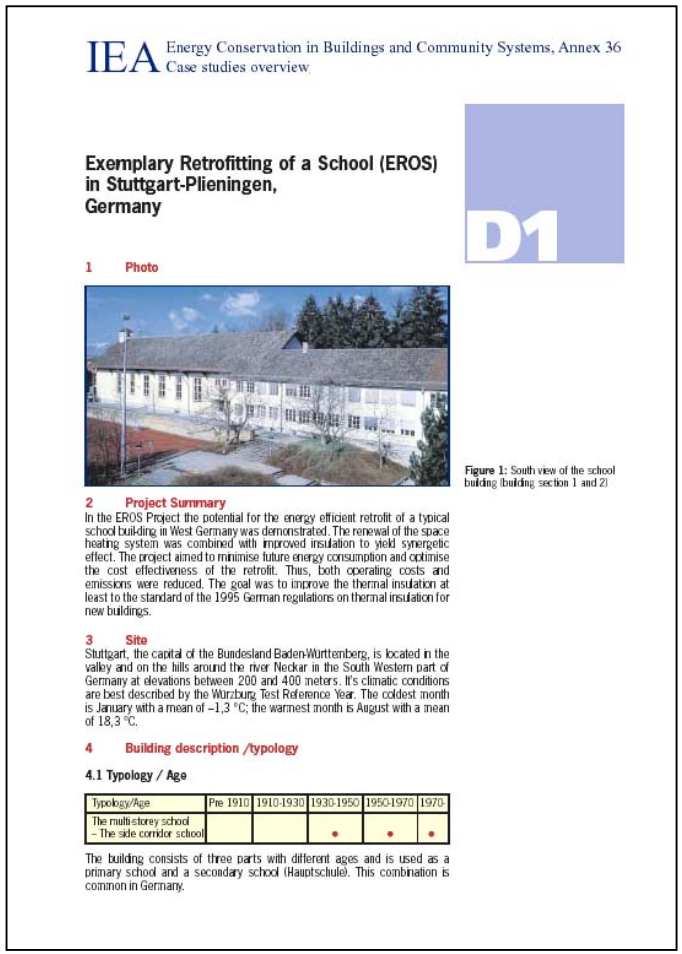
Case Study Report





IEA Energy Conservation in Buildings and Community Systems, Annex 36
Case studies overview

Exemplary Retrofitting of a School (EROS) in Stuttgart-Plieningen, Germany

D1

1 Photo

Figure 1: South view of the school building (building section 1 and 2)

2 Project Summary

In the EROS Project the potential for the energy efficient retrofit of a typical school building in West Germany was demonstrated. The renewal of the space heating system was combined with improved insulation to yield synergetic effect. The project aimed to minimise future energy consumption and optimise the cost effectiveness of the retrofit. Thus, both operating costs and emissions were reduced. The goal was to improve the thermal insulation at least to the standard of the 1995 German regulations on thermal insulation for new buildings.

3 Site

Stuttgart, the capital of the Bundesland Baden-Württemberg, is located in the valley and on the hills around the river Neckar in the South Western part of Germany at elevations between 200 and 400 meters. It's climatic conditions are best described by the Würzburg Test Reference Year. The coldest month is January with a mean of –1,3 °C; the warmest month is August with a mean of 18,3 °C.

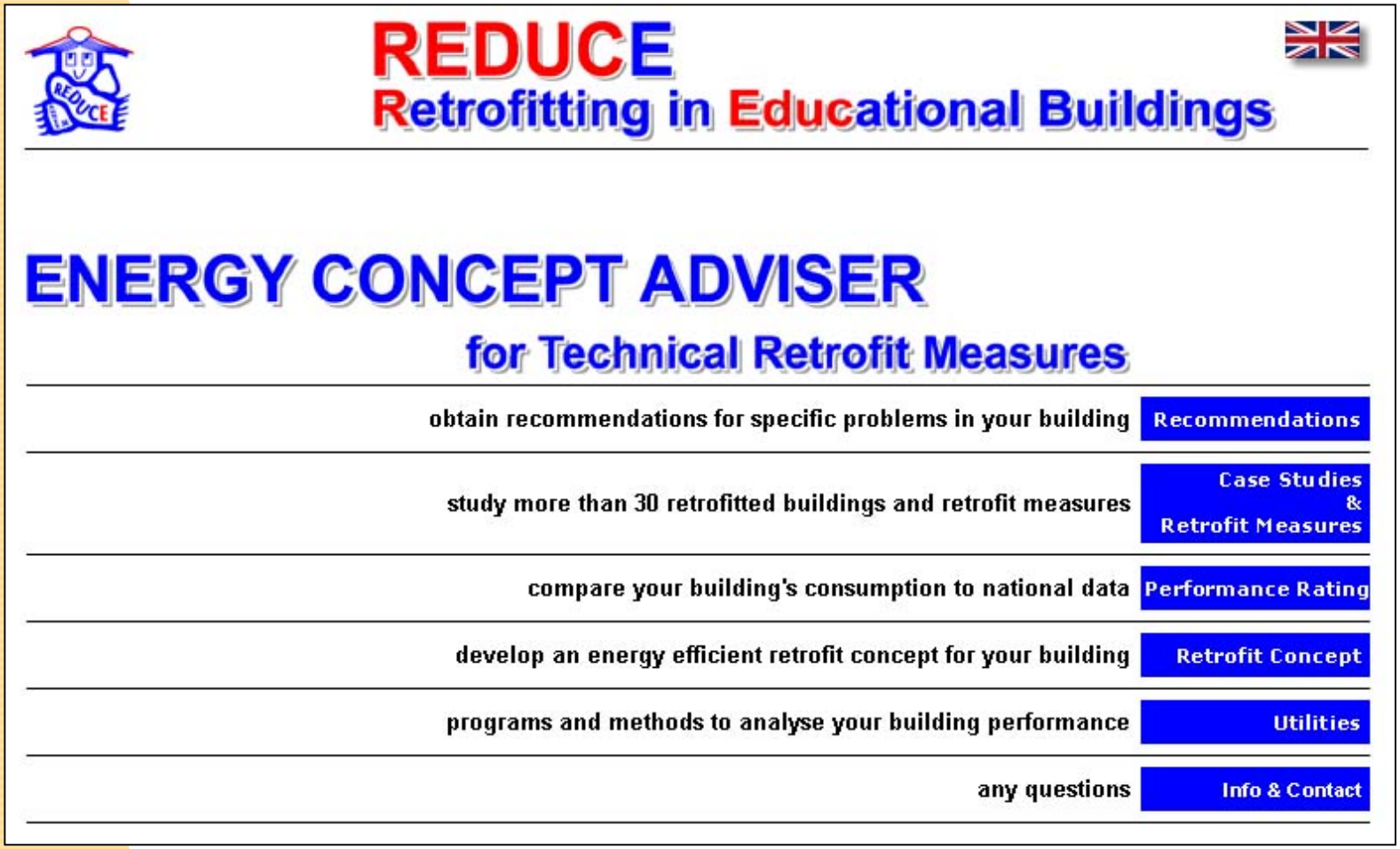
4 Building description /typology

4.1 Typology / Age

Typology/Age	Pre 1910	1910-1930	1930-1950	1950-1970	1970-
The multi-storey school – The side corridor school			•	•	•

The building consists of three parts with different ages and is used as a primary school and a secondary school (Hauptschule). This combination is common in Germany.

Navigator


REDUCE
Retrofitting in Educational Buildings
ENERGY CONCEPT ADVISER
for Technical Retrofit Measures
obtain recommendations for specific problems in your building
Recommendations
study more than 30 retrofitted buildings and retrofit measures
Case Studies & Retrofit Measures
compare your building's consumption to national data
Performance Rating
develop an energy efficient retrofit concept for your building
Retrofit Concept
programs and methods to analyse your building performance
Utilities
any questions
Info & Contact

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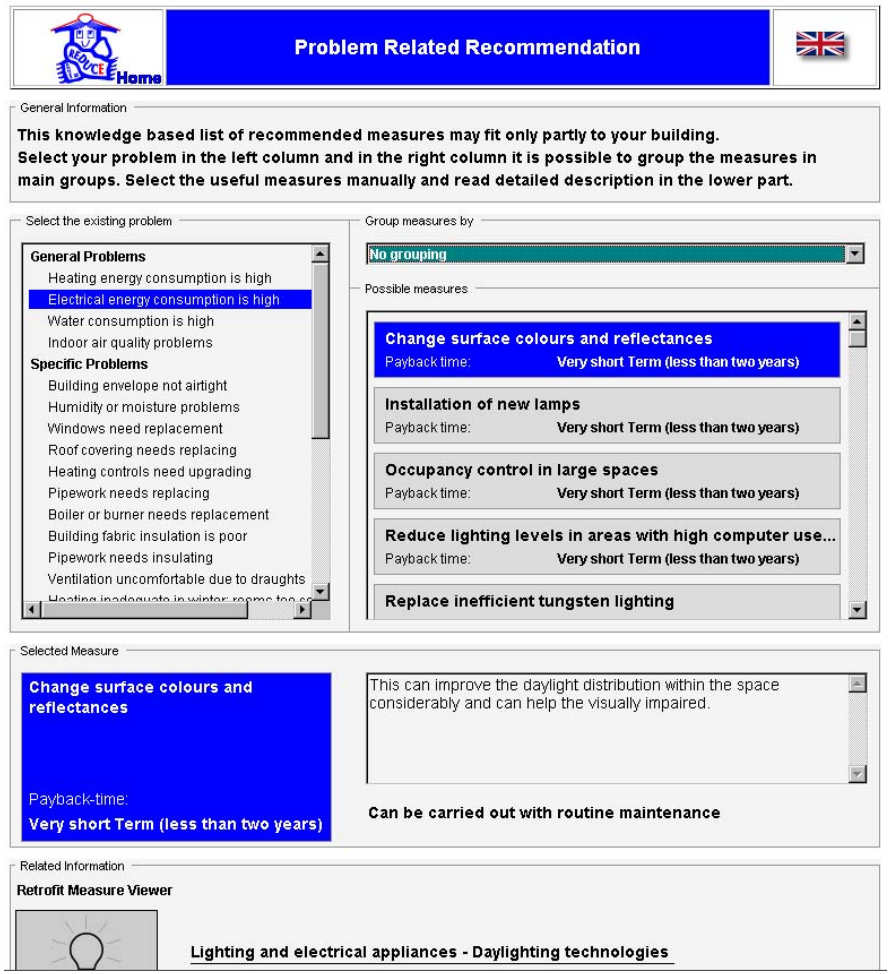
Problem Related Recommendations



Home

Problem Related Recommendation

General Information

This knowledge based list of recommended measures may fit only partly to your building.
Select your problem in the left column and in the right column it is possible to group the measures in main groups. Select the useful measures manually and read detailed description in the lower part.

Select the existing problem

- **General Problems**
  - Heating energy consumption is high
  - Electrical energy consumption is high
  - Water consumption is high
  - Indoor air quality problems
- **Specific Problems**
  - Building envelope not airtight
  - Humidity or moisture problems
  - Windows need replacement
  - Roof covering needs replacing
  - Heating controls need upgrading
  - Pipework needs replacing
  - Boiler or burner needs replacement
  - Building fabric insulation is poor
  - Pipework needs insulating
  - Ventilation uncomfortable due to draughts
  - Heating inadequate in winter: rooms too co

Group measures by: No grouping

Possible measures

Change surface colours and reflectances
Payback time: **Very short Term (less than two years)**

Installation of new lamps
Payback time: **Very short Term (less than two years)**

Occupancy control in large spaces
Payback time: **Very short Term (less than two years)**

Reduce lighting levels in areas with high computer use...
Payback time: **Very short Term (less than two years)**

Replace inefficient tungsten lighting

Selected Measure

Change surface colours and reflectances

Payback-time:
Very short Term (less than two years)

This can improve the daylight distribution within the space considerably and can help the visually impaired.

Can be carried out with routine maintenance

Related Information

Retrofit Measure Viewer

Lighting and electrical appliances - Daylighting technologies

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Matrix of Case Studies and Retrofit Measures

Home

Case Studies & Retrofit Measures

Sorting of:

Case Studies by country

Retrofit Measures by Energy technologies

Country	Retrofit Measures / Case Studies						
		✓	✓	✓			
		✓		✓		✓	✓
				✓			
				✓			
		✓	✓	✓	✓	✓	✓
		✓	✓		✓	✓	✓
		✓	✓		✓	✓	✓
		✓		✓	✓	✓	✓

Case Study Viewer

Home | Case Study Viewer | Exemplary Retrofitting of a School (EROS) in Stuttgart, Germany | Download of REPORT as PDF

- General Data
- Site, Typology
- Before Retrofit
- Retrofit Concept
- Energy Savings
- User Evaluation
- Renovation Costs
- Lessons Learned
- Additional Information

General Data

Address of project	Grund- und Hauptschule Plieningen Paracelsusstr. 4 70599 Stuttgart Germany
Year of construction	1936/1957/1970
Year of renovation	1996-1997
Total floor area	5260 m^2
Number of pupils	
Numer of classrooms	25 + 3 practical rooms
Typical classroom	60 m^2 20-25 pupils

South view of the school building

Project Summary

In the EROS Project the potential for the energy efficient retrofit of a typical school building in West Germany was demonstrated. The renewal of the space heating system was combined with improved insulation to yield synergetic effect. The project aimed to minimise future energy consumption and optimise the cost effectiveness of the retrofit.Thus, both operating costs and emissions were reduced. The goal was to improve the thermal insulation at least to the standard of the 1995 German regulations on thermal insulation for new buildings.

Retrofit features

- composite thermal insulation system, internal insulation
- low-E-coated glazings
- roof insulation with styrofoam done by teachers and students themselves
- replacement of the lighting system, daylight dependent artificial lighting control
- new gas boilers (condensing/low temperature boilers), new radiators

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				✓			
				✓			
		✓	✓	✓	✓	✓	✓
		✓	✓		✓	✓	✓
		✓	✓		✓	✓	✓
		✓		✓	✓	✓	✓

Retrofit Measure Viewer

Home | Retrofit Measure Viewer | Management | Download of REPORT as PDF

- Introduction
- Energy auditing
- Commissioning
- Education & training
- Non-investment

Energy auditing techniques

An audit is defined as a "systematic examination". For a school (or indeed any type of building) there are three levels of auditing that could be carried out:

Level 1: Comparison with other schools

Compare energy (or resources) use with other similar schools. This is often known as benchmarking.

Advantages

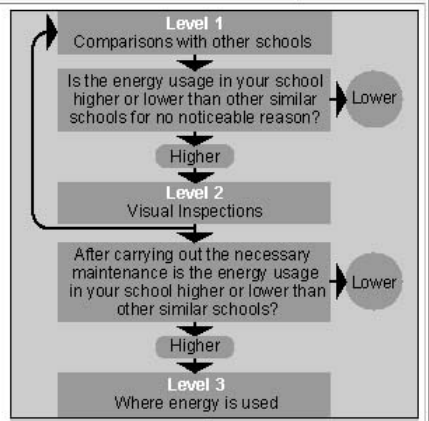
- Quick, cheap and easy to carry out

Disadvantages

- Not comparing like with like and gives little encouragement for good schools to improve

Level 2: Visual Inspections

Carry out a visual inspection of the rooms and facilities in a school for deterioration of fixtures and fittings, to check whether equipment is operating correctly and where energy (or resources) is being wasted.



Flow diagram of possible auditing techniques

Advantages

- Can be used as part of the maintenance programme and to investigate whether on-going work is requiredDisadvantages
- Unable to quantify how much energy is being used or where its being used.

Level 3. Where energy is used

To estimate, calculate or measure where and when the energy is being used (or wasted) to achieve the optimum in energy conservation.

Advantages

- Show where energy is being used/wasted and justify additional funding for improvements

Disadvantages

- Complicated and may need a consultant for assistance

Usefuk websites for auditing and benchmarking techniques

http://www.schools.audit-commission.gov.uk/
http://www.dfes.gov.uk/amps
http://www.energybenchmarking.co.uk/schools/
http://www.fuel4thought.co.uk/assess/index.html
http://www.actionenergy.gov.uk

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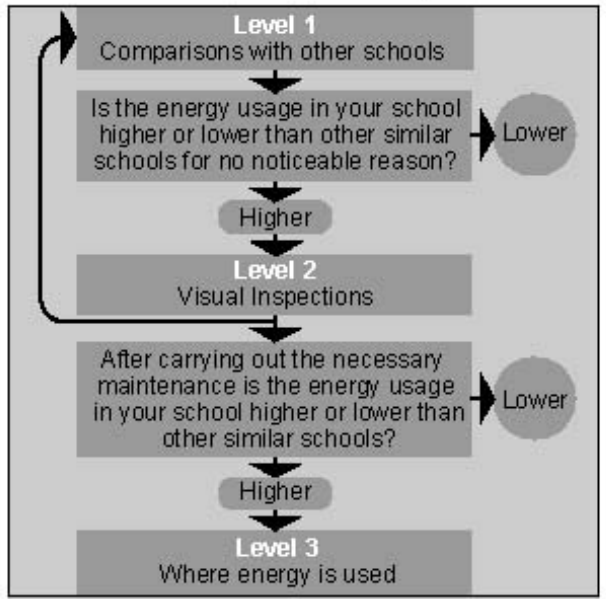

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Usefuk websites for auditing and benchmarking techniques

http://www.schools.audit-commission.gov.uk/
http://www.dfes.gov.uk/amps
http://www.energybenchmarking.co.uk/schools/
http://www.fuel4thought.co.uk/assess/index.html
http://www.actionenergy.gov.uk

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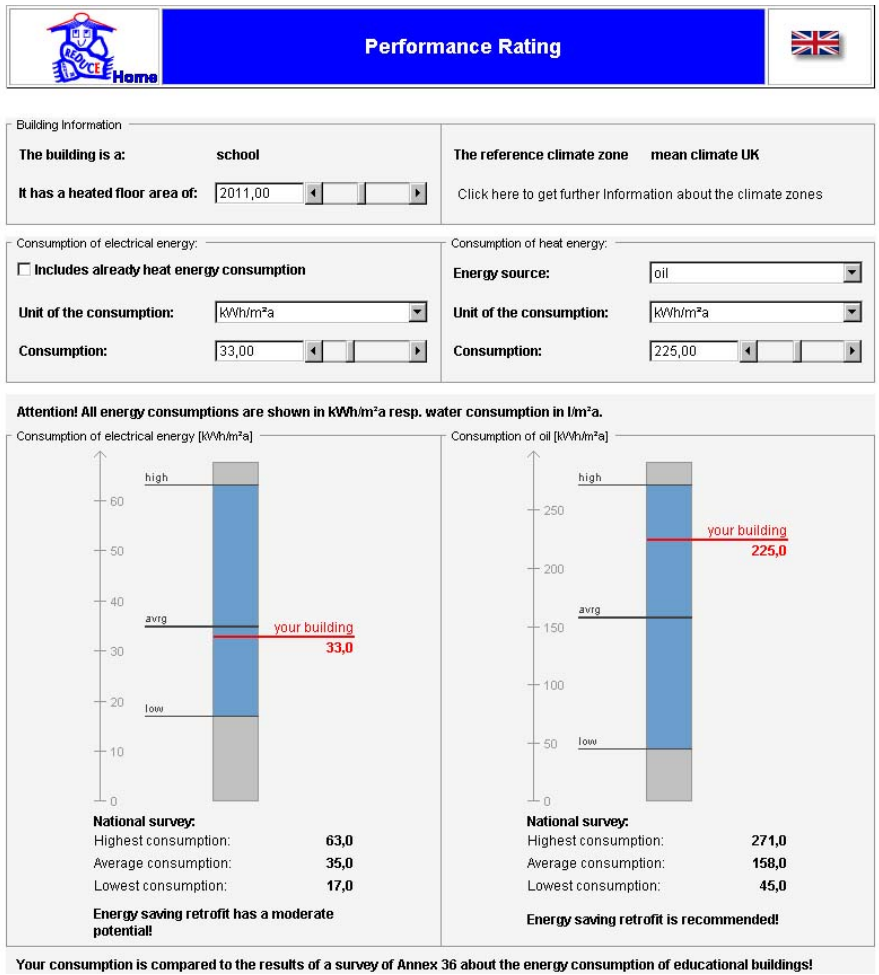
Performance Rating



Performance Rating

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Building Information

The building is a: school

It has a heated floor area of: 2011,00

The reference climate zone mean climate UK

Click here to get further Information about the climate zones

Consumption of electrical energy:

☐ **Includes already heat energy consumption**

Unit of the consumption: kWh/m²a

Consumption: 33,00

Consumption of heat energy:

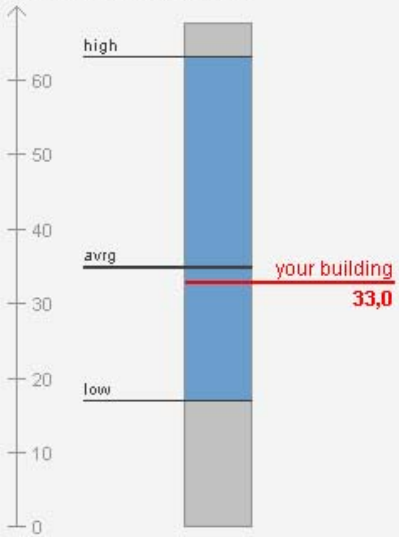
Energy source: oil

Unit of the consumption: kWh/m²a

Consumption: 225,00

Attention! All energy consumptions are shown in kWh/m²a resp. water consumption in l/m²a.

Consumption of electrical energy [kWh/m²a]

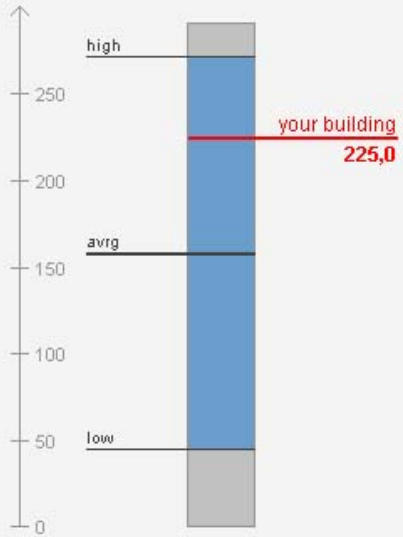


National survey:

Highest consumption:	**63,0**
Average consumption:	**35,0**
Lowest consumption:	**17,0**

Energy saving retrofit has a moderate potential!

Consumption of oil [kWh/m²a]



National survey:

Highest consumption:	**271,0**
Average consumption:	**158,0**
Lowest consumption:	**45,0**

Energy saving retrofit is recommended!

Your consumption is compared to the results of a survey of Annex 36 about the energy consumption of educational buildings!

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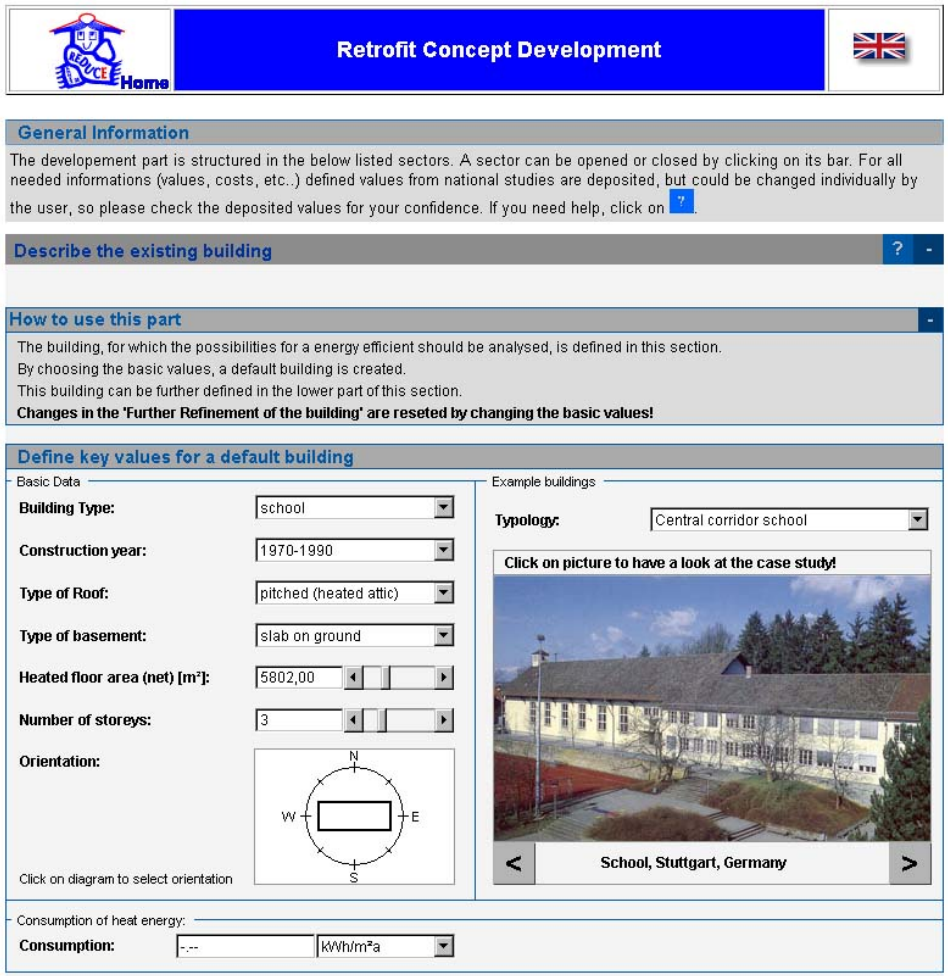
Retrofit Concept Development



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Retrofit Concept Development

General Information

The developement part is structured in the below listed sectors. A sector can be opened or closed by clicking on its bar. For all needed informations (values, costs, etc..) defined values from national studies are deposited, but could be changed individually by the user, so please check the deposited values for your confidence. If you need help, click on ?.

Describe the existing building

? -

How to use this part

-

The building, for which the possibilities for a energy efficient should be analysed, is defined in this section.
By choosing the basic values, a default building is created.
This building can be further defined in the lower part of this section.
Changes in the 'Further Refinement of the building' are reseted by changing the basic values!

Define key values for a default building

Basic Data

Building Type: school

Construction year: 1970-1990

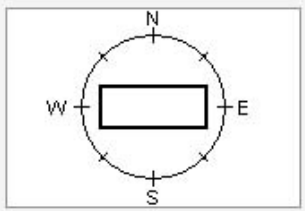
Type of Roof: pitched (heated attic)

Type of basement: slab on ground

Heated floor area (net) [m²]: 5802,00

Number of storeys: 3

Orientation:



Click on diagram to select orientation

Example buildings

Typology: Central corridor school

Click on picture to have a look at the case study!

< School, Stuttgart, Germany >

Consumption of heat energy:

Consumption: -.-- kWh/m²a

Further Refinement of the building

Location

Geometry and Elements of Building Envelope

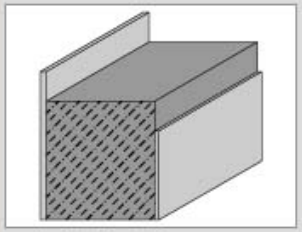
Heated volume (gross) [m³]:	26986	Heated floor area [m²]:	5802
Ratio A/V [m²/m³]:	0,39	Area of thermal envelope [m²]:	10391

Switch through the different envelope elements:

|<< | << | external wall | pitched roof | ground plate | window north | window east | window south | window west | >> | >|

Add element | Copy this element | Delete this element

external wall



Name: external wall

Area[m²]: 3510,21 Maintenance Costs: 8,00 €/m²a

Structure: concrete sandwich construction

concrete sandwich construction: interrior plaster, 20 cm concrete, 4 cm insulation, 11,5 cm concrete

Existing U-Value: 0,8 W/m²K

☐ This component have to be retrofitted anyway.

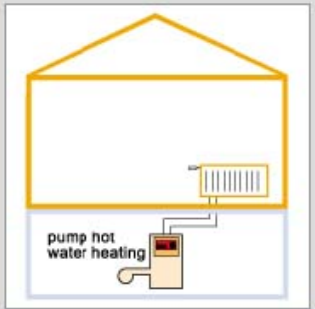
Heating and Ventilation system

Choose the existing plant

The heat energy is generated by: pump hot water heating 90/70 °C

The type of ventilation is: natural ventilation

Details of selected plant



Detailed description of the choosen plant:

pump hot water heating 90/70 °C, high temperature boiler, thermostatic room regulation, natural ventilation

Maintenance Costs 10,00 €/m²a

Adjusted setback modes: no setback

Used energy source Oil

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Describe the existing building ? +

Select one retrofit measure for each building element ? -

How to use this part -

This part is for the selection of retrofit measures for each building element, which are going to be retrofitted. The measure with the best cost benefit value is automatically selected. This selection can be changed.

Select a Component: Choose a component and an element, which are going to be retrofitted.

Select a Retrofit Measure: Shows all retrofit measures. Change the chosen measure here by clicking on the checkbox 'Select this measure'.

Overview: Shows the results of the retrofit measures for this element. Each of the measures are calculated related to the unretrofitted building

Select a component -

Main Group Building envelope **Element** external wall

Existing Structure concrete sandwich construction

Existing U-Value: 0,81 W/m²K

Select a retrofit measure -

1 internal insulation with 6 cm polystyrene, vapour barrier and gypsum board

improved U-Value: 0,36 W/m²K

Investment costs: 50,00 €/m²

Maintenance costs: 6,00 €/m²a

◉ Select this measure as choosen retrofit measure for this element

2 external insulation with 12 cm mineral wool and plaster

improved U-Value: 0,24 W/m²K

Investment costs: 80,00 €/m²

Maintenance costs: 4,00 €/m²a

○ Select this measure as choosen retrofit measure for this element

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Describe the existing building ? +

Select one retrofit measure for each building element ? -

How to use this part +

Select a component -

Main Group Building envelope **Element** external wall

Existing Structure concrete sandwich construction

Existing U-Value: 0,81 W/m²K

Select a retrofit measure +

Overview -

	Retrofit Measures:	Heat Energy demand:	Capital Expenditure:	Cost Benefit Value:
	Existing Building	412,0 kWh/m²a		
1	internal insulation with 6 cm polystyrene, vapour barrier and	372,0 kWh/m²a	175000 €	0,70 €/(kWh/a)
2	external insulation with 12 cm mineral wool and plaster	362,0 kWh/m²a	280000 €	0,90 €/(kWh/a)
3	external insulation with 20 cm mineral wool and plaster	355,0 kWh/m²a	351000 €	1,00 €/(kWh/a)
4	external insulation with 12 cm polystyrene foam and plaster	362,0 kWh/m²a	245000 €	0,80 €/(kWh/a)
5	external insulation with 20 cm polystyrene foam and plaster	355,0 kWh/m²a	298000 €	0,90 €/(kWh/a)

How to use this part

This part is for the creation and comparison of different concepts for an energy efficient retrofitting. There are possibilities for creating five different concepts. After having selected elements for a concept, the different concepts can be compared in the lower part 'Overview'.

Select elements for the different concepts Choose here, which elements shall be retrofitted within a concept

Overview: Look at the results of the different concepts. Different energy and economic values can b

Select elements for the different concepts

Element: / Choosen retrofit measure:	Concept 1	2	3	4	5
ground plate 4 cm mineral wool, screedfloor	☑	☑	☑	☑	☐
pump hot water heating 90/70 °C Condensing Boiler 35/28- Add ventilation system (80% recovery)	☑	☐	☑	☐	☑
lighting source Compact Fluorescent	☑	☑	☑	☑	☑
external wall internal insulation with 6 cm polystyrene, vapour barrier and gypsum boar	☐	☑	☑	☐	☑
lighting control Occupancy sensor	☐	☑	☐	☑	☐
window north	☐	☐	☐	☐	☑

The measures are sorted by benefit-cost-value

Overview

Show: Energy values

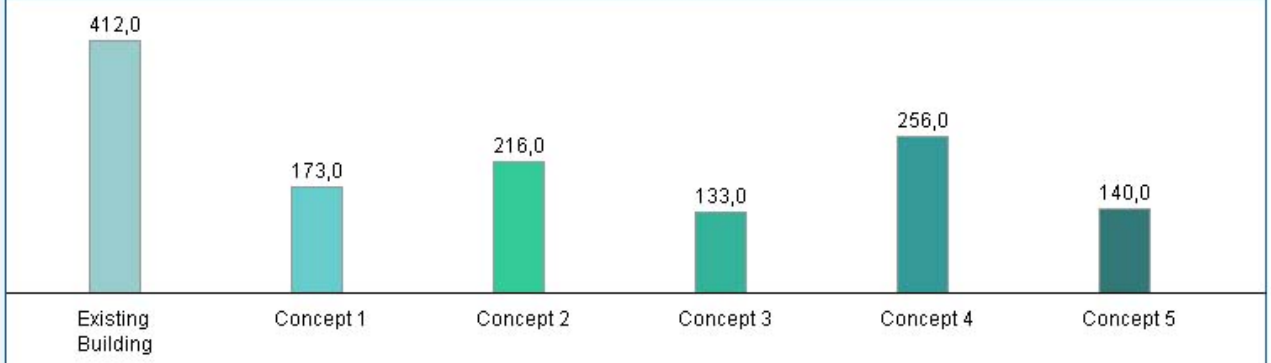
Show: Primary Energy

Show Results related to floor area

Show consumptions | Show savings

Primary Energy

All Values are shown in kWh/m²a!



Report of Concept 1

General Data:

Building Type:	school	Construction year:	1970-1990
Number of storeys:	3	Climatic zone	UK North

Building Data:

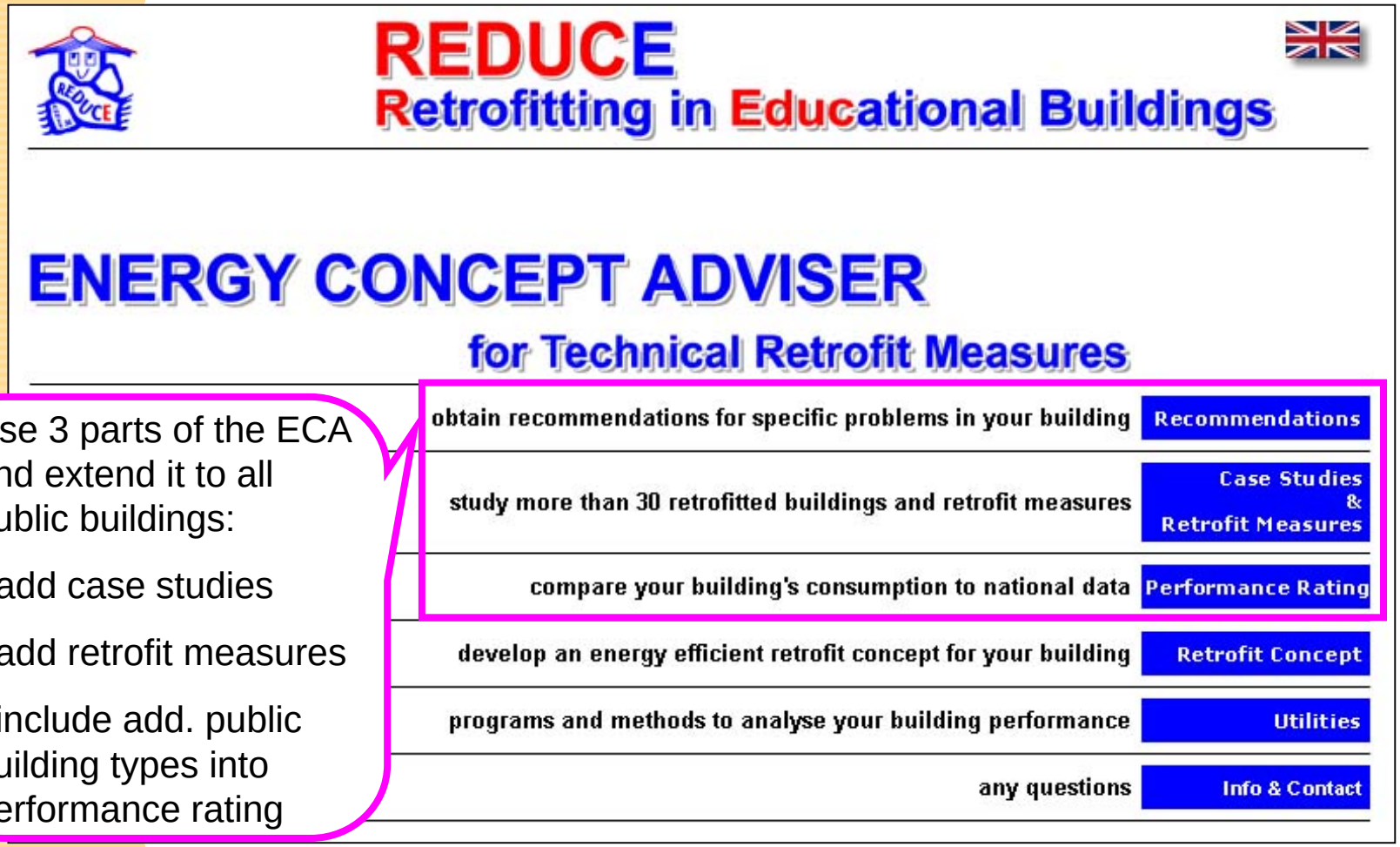
Heated volume (gross) [m³]:	26900 m³	Heated floor area [m²]:	5800 m²
Ratio A/V [m²/m³]:	0,30 1/m	Area of thermal envelope [m²]:	10300 m²

Building Envelope:

Name	external wall		
Structure	concrete sandwich construction		
Area	3510,00 m²	U-Value	0,80 W/m²K
Name	pitched roof		
Structure	18 cm rafter, insulation between the rafters, lattice, tiles		
Area	2760,00 m²	U-Value	0,60 W/m²K
Name	ground plate		
Structure	20 cm of concrete, screedfloor		
Selected Retrofit Measure	4 cm mineral wool, screedfloor		
Area	2560,00 m²	U-Value	0,70 W/m²K
Name	window north		
Structure	double glazing, wooden or plastic frame, with sealing		
Area	542,00 m²	U-Value	2,40 W/m²K

Java Applet Window

Work in BRITA in PuBs



Use 3 parts of the ECA and extend it to all public buildings:

- add case studies
- add retrofit measures
- include add. public building types into performance rating

Work in BRITA in PuBs: Case Studies

Denmark: Copenhagen

Cultural Centre Proeve-hallen

Great Britain: Plymouth

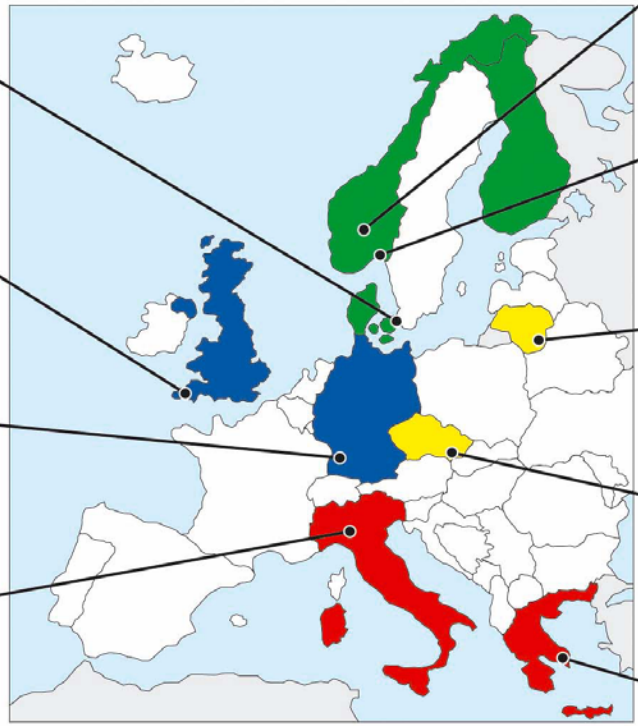
Plymouth College of Further Education

Germany: Stuttgart

Nursery Home Filderhof

Italy: Milano

Student Hostel Daniel's



Norway: Hol

Church Hol Commune

Norway: Asker

Borgen Community Centre

Lithuania: Vilnius

Main Building Vilnius Gediminas University

Czech Republic: Brno

Students Social and Cultural Centre "Brewery"

Greece: Athens

Evonymos Ecological Library

Work in BRITA in PuBs: Retrofit Measures

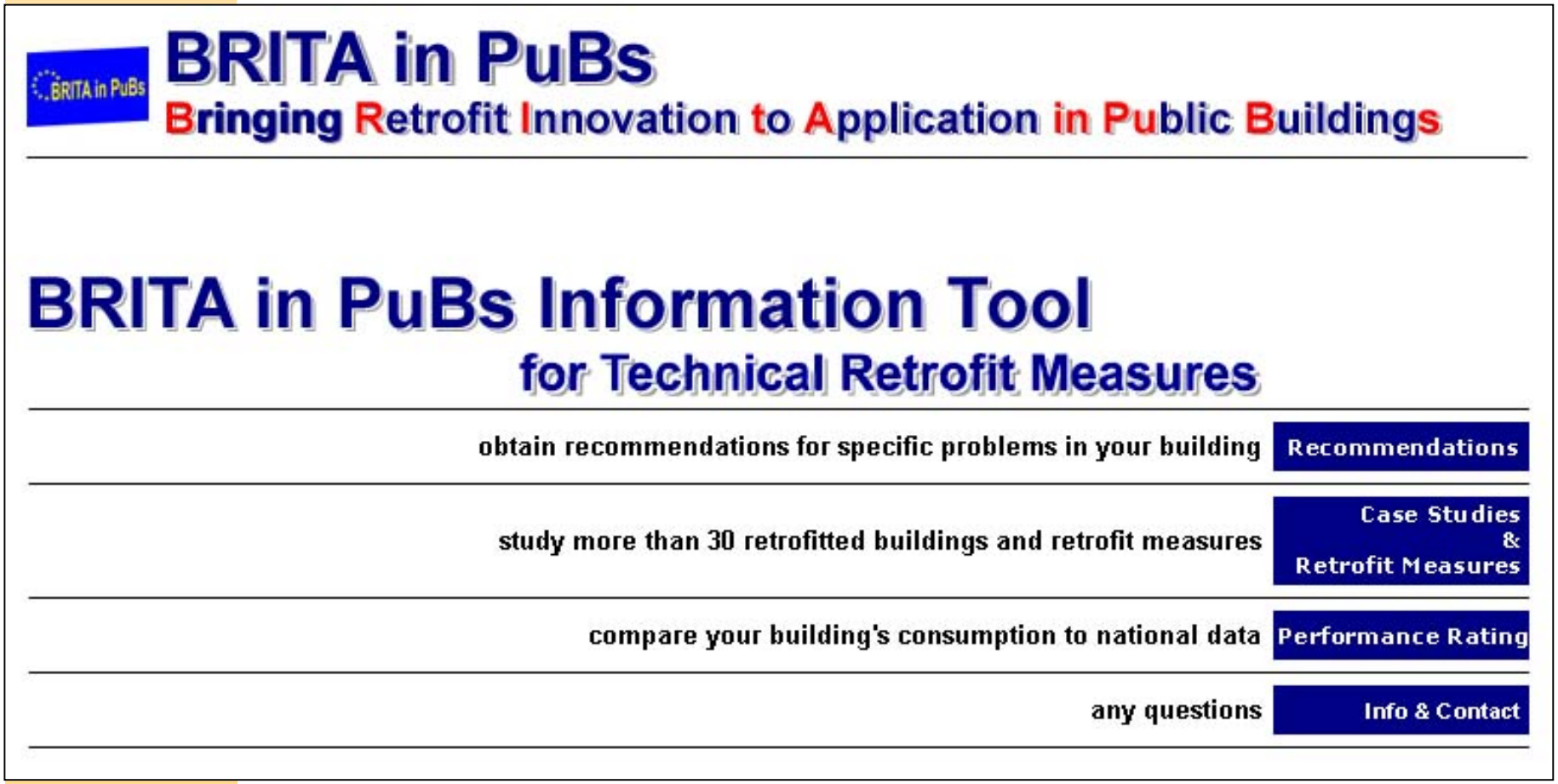
Building envelope	introduction (insulation, thermal bridges, air-tightness), windows (frames, glazing, U-value, g-Value), doors (draught sealing, insulation), insulation materials and systems (thermal conductivity), walls (interior/exterior, thermal composite system, overcladding, solar walls), roof (between the rafters, below or above the rafters), ceilings/basement (post-insulation, thermal bridges), innovations (three pane glazing, improved spacers, improved frames, improved insulation material), links
Heating systems	introduction, heating, domestic hot water, energy sources, control systems, innovations, links
Ventilation systems	introduction, natural ventilation, mechanical ventilation, hybrid ventilation, control and information, innovations, links
Solar control & cooling systems:	introduction, shading and glare protection, cooling systems, air-conditioning, control systems, innovations, links
Lighting & electrical appliances	introduction, lighting systems, electrical appliances, daylighting technics, control systems, innovations, links
Management	introduction, energy auditing, commissioning, education and training, non-investment, innovations, links
Renewables	introduction, solar thermal, PV, heat pumps (ground source, air-air, air-water, sea water-water), urban wind turbines, biomass heating, (hydrogen), innovations, links

Heike Erhorn-Kluttig
Fraunhofer Institute of Building Physics

Work in BRITA in PuBs: Performance Rating

Data			Unit	Country								
				Czech Republic	Den-mark	Finland	Ger-many	Greece	Italy	Lithu-ania	Norway	UK
Heating energy consump-tion	Habitation	average	kWh/m²a									
		range	kWh/m²a									
	Social facilities	average	kWh/m²a									
		range	kWh/m²a									
	Education and research	average	kWh/m²a									
		range	kWh/m²a									
	Cultural Facilities	average	kWh/m²a									
		range	kWh/m²a									
	Services	average	kWh/m²a									
		range	kWh/m²a									
	Transport	average	kWh/m²a									
		range	kWh/m²a									
Electrical energy consumption			kWh/m²a									
Water consumption			l/m²a									

Work in BRITA in PuBs



Work in BRITA in PuBs: Status Case Studies

BRITA in PuBs | Case Study Viewer | Plymouth College of Further Edu

- General Data
- Site, Typology
- Before Retrofit
- Retrofit Concept
- Energy Savings
- User Evaluation
- Renovation Costs
- Lessons Learned
- Additional Information

BRITA in PuBs | Case Study Viewer

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BRITA in PuBs

- General Data
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a brewery had to be transformed into a modern social and culture center for students and academics. This task had a huge impact on the design phase, because all building services had to be designed from scratch. The possible options, however, were quite limited by "ancient" building constructions (1 meter thick brick walls can hardly be found in modern buildings). Nevertheless, the Brewery is a proof that the state of the art technologies like BEMS, VRV air conditioning or PV modules can be employed in retrofitting of old buildings.

ventilation.
- Additional insulation
- Low energy windows
- Water saving measures
- Daylighting
- PV integration, 19 kWp and
- PV/Thermal collectors, 6 KWp.

BRITA in PuBs | Case Study Viewer | The Main Building of Vilnius Gediminas Technical University | Download of REPORT as PDF

- General Data
- Site, Typology
- Before Retrofit
- Retrofit Concept
- Energy Savings
- User Evaluation
- Renovation Costs
- Lessons Learned
- Additional Information

General Data

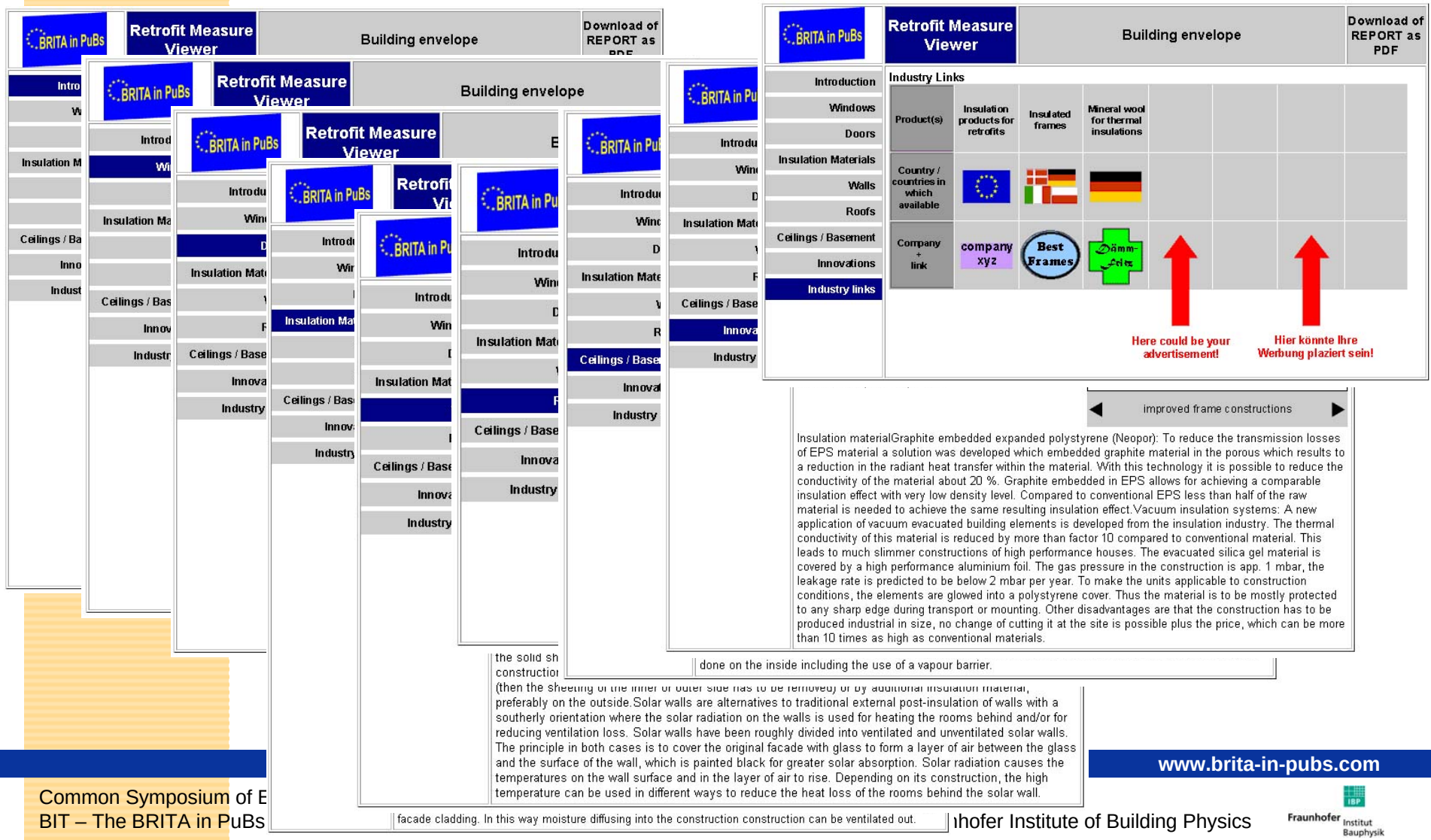
Address of project	The Main Building of Vilnius Gediminas Technical University Sauletekio al. 11 LT-10223 Vilnius-40 Lithuania
Year of construction	1971
Year of renovation	2004 - 2006
Total floor area	8484.20 m²
Number of occupants	1084
Number of rooms	219
Typical room	7.83 m²

The Main Building of Vilnius Gediminas Technical University (VGTU)

Project Summary
The original idea of the Main Building renovation was to replace windows, to renovate thermal unit, roof, heating system, to insulate facades and to change entrance doors. Basing oneself on the collected formation and the Multiple Criteria Decision Support System for Building Refurbishment (BRDS) system will be perform a multiple criteria analysis of the VGTU building retrofit project's components and select the most efficient versions. The construction will start in the end of 2004 and shall be finished at the beginning of 2006. After that a monitoring period is planned.

Retrofit features
U-values [W/m²K] of the main building structural units before retrofit and after retrofit: windows 2.5 and 1.16; walls 1.07 and 0.296; roof 0.8 and 0.2; doors 2.3 and 1.5.
Heating energy consumption [kWh/m²] before retrofitting (2002) - 178, after in 2006 - .....

Work in BRITA in PuBs: Status Retrofit Measures



Work in BRITA in PuBs: Status Info & Contact

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