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Pilot study – Office building National report – Denmark

Final report, May 2007

Energy Performance Assessment of Existing Non-Residential Buildings

Report Number: EC Contract: EIE/04/125/S07.38651 www.epa-nr.org Title of contact: Kim B. Wittchen Danish Building Research Institute, SBi AALBORG UNIVERSITY Hørsholm, Denmark Telephone: +45-45-742 379 Email: kbw@SBi.dk





Pilot study – Office building National report – Denmark

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1 Introduction

This is the Pilot study National report performed in the frame of Work package 4 of the EPA-NR project.

The pilot Study consists of three Pilot projects for non residential buildings:

- Pilot project for one education building
- Pilot project for one offices building
- Pilot project for one health care building

Pilot projects are real buildings for which the EPA-NR method was applied.

1.1 Goal of pilot study

The goals of pilot study are:

- The evaluation of EPA-NR method , including the building diagnosis and the EPA-NR software
- The assessment of Energy Performance of the building and creating an useful Energy Performance Advice for the owner of the building

For the first objective, an evaluation procedure was defined and a questionnaire [1] was performed. The questionnaire was filled for each pilot project by the person who applies the EPA-NR method to the building.

The analysis of all the questionnaire answers was the basis of the evaluation of EPA-NR method and the recommendations of modifications.

The evaluation of EPA-NR method including recommendations for modifications are described in a specific (internal) report [2].

The assessment of Energy Performance of the building indicates the actual performance of the building and some proposed energy saving measures to reduce the energy consumption taking into account the indoor environment, investment costs, payback times and technical feasibility.

The assessment of Energy Performance of the pilot projects including a set of energy saving measures is described in this report.

The results of the pilot study will serve as demonstration for dissemination.

1.2 Structure of the report

The report is divided into three chapters:

- Chapter 2 concerns the pilot project for education sector
- Chapter 3 concerns the pilot project for offices sector
- Chapter 4 concerns the pilot project for health care sector

The characteristics of the building surveyed are described in paragraph 1 of the chapter.

The results of building diagnosis including a description of actual situation of the building and energy demand calculation using EPA-NR software are described in paragraph 2 of the chapter.

Paragraph 3 of the chapter presents a number of scenarios to improve the energy performance of the building, for each scenario, the energy saving, the investments and payback time are given and finally the most appropriate scenario as an advice to the owner is described.



2 Office building, Rosenkæret 39

2.1 Project summary



Rosenkæret 39, Office building, Gladsaxe Owner: private. User: Gladsaxe municipality.

Short description: The building is orientated			
same height and moderate density. The build- ing can be considered being one zone, consist-			
ing of offices, reception, and meeting rooms.			
Construction: It is a typical Danish hollow			
core masonry building constructed in 1950'es.			
60'es. There are two ordinary floors plus two			
floors in the attic and a full basement. At West end of the building there is an extens with wooden facade covering. The 45 ° slop			
roof is covered by traditional red roofing tiles.			
Heating / cooling/ ventilation/ lighting sys- tems: All systems in the building can be de- scribed as traditional systems for low tech Dan- ish office buildings. Heating is made by a natu- ral gas boiler located in the basement.			



Energy management: The temperature of the
heating system is controlled by an outdoor tem-
perature sensor allowing for a lower temperature
at high outdoor temperatures.Previous n
North at 3'd
ergy glazin
time and are
system upd
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	The building	National
		average
Fuel	126 kWh/m ²	105 kWh/m ²
Electricity	39 kWh/m ²	43 kWh/m ²
Water	210 l/m ²	250 l/m ²

Previous refurbishment: Windows towards North at 3rd and 4th floor replaced with low energy glazing. Other windows replaced over time and are all less than 15 years old. Heating system updated in '93 and '95. Roof insulation at main (old) building decreased with 70 mm and roof construction made ventilated in 2003. Refurbishment of extension building and establishment of mechanical ventilation in 2005.

Planned refurbishment: No further refurbishment is planned.

Rosenkæret is located in an area with light industry in buildings of the same or lower height. The building was constructed in the early fifties and extended in the early sixties. Originally the building was used to light industry, but was later rebuild to meet the requirements of an office building.

The building is owned by a private company and rented to Gladsaxe municipality.

2.2 Audit of the building

2.2.1 Actual situation

The building has problems regarding air tightness at the two under-roof floors. These problems was introduced in 2003 when 70 mm of the roof insulation was removed to increase the ventilation in the roof construction and in this way eliminate a mould growth problem. The mould problem was introduced some years earlier in conjunction with additional insulation of the roof to save energy.

Some of the windows in the old part of the building are with traditional double pane glazing. These windows do also cause problems with cold draft.

The heating system is old and based on eight natural gas boilers operating in cascade. Occasionally it is not possible to produce sufficient heat for space heating, and it is thus not possible to operate the building with night set back of the indoor temperature.

The windows in the roof top are of many different sizes and shapes. This is because the building was used as demonstration site for the former owner. It gives a disorderly visual impression of the roof top. The many different sizes and shapes may also result in increased costs with respect to maintenance and replacement.





Heating

2.2.1.1 Heating consumption

Figure 1. Recorded heating consumption in kWh/m² in 2003 - 2006 (meter reading and climate adjusted respectively) and the Danish average consumption in buildings used for similar purpose and size. The degree-day independent heating consumption constitutes about 20 % of the total heating consumption.

Energy consumption for space heating and domestic hot water has been stable since 2003 and around the Danish average for office buildings. Seventy millimetres of the insulation in the roof construction was removed in 2003 because of mould growth. This action have increased the ventilation over the insulation, eliminated the mould growth and increased the heating consumption.



2.2.1.2 Electricity consumption

Figure 2. Recorded electricity consumption in kWh/m² in 2005 and 2006 and the Danish average consumption in buildings used for similar purpose and size.



The electricity consumption in Rosenkæret 39 is about 20 per cent lower than the Danish average for office buildings. There are several reasons for this, and among those are: the building is partly natural ventilated, there are almost no mechanical cooling, there is only four floors and the elevators are thus not being used intensive, at the two top floors there are many windows in the 45 ° ceiling contributing considerably with daylight in most of the office hours.





Figure 3. Registered water consumption at Rosenkæret 39 in 2004 and 2005 in m³/m² and the Danish average consumption in buildings used for similar purpose and size. The domestic hot water consumption is estimated to be 30 % of the total water consumption.

2.2.2 Calculating energy 'demand' using EPA-NR software based on actual situation

2.2.2.1 Energy characteristics of the building model

The energy performance was calculated under standard conditions with the EPA-NR software. For the EPA-NR calculations, the building was divided into the following four zones:

- New extension building (430 m²),
 Basement, 1st and 2nd floor of old building (1986 m²),
 Offices under roof on 3rd and 4th floor (823 m²),
- 4. Canteen on 3rd floor (150 m²).

List of energy uses:

Zone 1: heated, mechanically ventilated with VAV control.

Zone 2: heated, naturally ventilated.

Zone 3: heated and naturally ventilated

Zone 4: heated, cooled and naturally ventilated

All zones have artificial lighting. Zones 2-4 have automatic window openers to control the indoor temperature by natural ventilation.



Operational parameters used for the calculation:

	Zone 1	Zone 2	Zone 3	Zone 4
Heating temperature set point	20 °C	20 °C	20 °C	20 °C
Cooling temperature set point	-	-	-	23 °C
Operation time for heating/year	5110 h/a	5110 h/a	5110 h/a	5110 h/a
Operation time for cooling/year	-	-	-	8760 h/a
Operation time for ventilation/year	2365 h/a	-	-	-
Operation time for lighting/year	2340 h/a	2340 h/a	2340 h/a	500 h/a

Input data used for the calculation is found in Appendix 2 as documentation produced by the EPA-NR tool.

2.2.2.2 Results

Primary energy demand and CO2 emission of the building

Primary energy consumption of the building:	CO2 emission of the building: kg/m²/year
kWh/m²/year	
202.32	29.8

Final energy demand, primary energy demand and CO2 emission by energy carrier

			<u>, , , , , , , , , , , , , , , , , , , </u>
	Annual final energy con-	Primary energy con-	CO ₂ emission of the
	sumption* of the building	sumption of the building:	building:
	per fuel type:	kWh/m²/year	kg/m²/year
Natural gas	507.95 MWh/year	149.88	14.2
Electricity	75.15 MWh/year	55.43	15.5

* Calculated under standard user pattern and outdoor conditions.

Energy demands by month

Energy demand



Distribution of heating demand on different sources: Lighting; Domestic hot water; Cooling; and Heating.



90 80 70 60 50 Natural gas, high energy ЧММ Electricity 40 30 20 10 0 Feb Jun Jul Oct Jan Mar Apr May Aug Sep Nov Dec

Fuel consumption

Energy demand by energy source

Energy consumption at Rosenkæret 39 is, as in most Danish office buildings dominated by the energy consumption for space heating (above).

The cooling energy consumption is reduced due to optimal possibilities for utilization of natural ventilation and manually controlled solar shading in the old part of the building, which is the part that has the highest potential solar loads during summer time (see table below).

	А	Innual losse	S	Annual gains						
Total	Total	Trans- mission	Ventila- tion	Total	Solar	Sun space	Internal heat			
kWh/m² (heating)	136.21	50.09	86.12	54.65	23.64	0	31.01			
kWh/m² (cooling)	329.21	130.42	198.79	58.06	27.05	0	31.01			

Old building	A	Innual losse	S		Annua	l gains	
Total cooling kWh/m²	Total	Trans- mission	Ventila- tion	Total	Solar	Sun space	Internal heat
0, 1 & 2 floor	281.85	111.08	170.77	53.39	19.0	0	34.39
3 and 4 floor	477.87	120.97	356.9	59.99	27.76	0	32.23
Canteen	58.39	36.9	21.49	46.68	24.02	0	22.66



2.3 Calculation of energy savings: scenarios for improvement

2.3.1 Scenario 1- PV system on South facing roof face

2.3.1.1 Background and proposed solution

Integration of a photo voltaic solar system in the South facing roof face with a 45 ° inclination was the initial idea to reduce energy consumption from the building. This action was suggested to create a more uniform appearance of the roof and minimise the visual impact of the many windows in the roof. It was thus suggested to apply PV solar cells to the entire opaque surface of the South facing roof (325 m²). With an overall efficiency factor of the PV system of 9 %, such a system will produce electricity as shown in the figure below.



The annual electrical output from the PV system is calculated to be 35.63 MWh giving a payback time of about 40 years when the cost for installing the system is 8000 DKK (1070 €) per m².

2.3.1.2 Conclusion

Installation of a PV system on the entire South facing roof face is not, as an energy saving measure, cost effective, but from an architectural point of view it could improve the visual impression of the building, creating a more uniform view of the roof-top. In addition to this, the South facing roof face is the one facing the main entrance of the building and the access road.

2.3.2 Scenario 2 – Replacement of boilers to natural gas condensing boilers

2.3.2.1 Background and proposed solution

The existing boilers (eight natural gas boilers in cascade) are old, inefficient and do not provide the necessary amount of heating at any given time. A new rack of boilers is suggested by the user of the building. The cost for installing new boilers in the building falls in the user, and cost analyses have not been performed yet.



2.3.2.2 Calculation results



Fuel consumption

The annual consumption of natural gas decreases from 422 MWh to 389 MWh, equal to a reduction of 8 per cent. With an investment of 40 000 DKK (5300 \in) per gas boiler in the cascade of eight gas boilers, gives a simple pay-back time of 11.6 years.

2.3.2.3 Conclusion

A pay-back time of about 12 years would normally be considered a good investment if the owner and the user of the building is the same entity. In this case however, the user and the owner is not the same. In addition to this is the cost of the boilers to the user of the building. To justify such an investment a long term rental contract or a buy-back obligation should be possible.

2.3.3 Scenario 2 – Replacement of windows in parts of the building

2.3.3.1 Background and proposed solution

The windows in the basement, first and second floor of the old building are traditional double pane windows with a U-value of 3 W/m²K. Replacement of these windows to today's standard with an overall U-value of 1.5 W/m²K would reduce the energy consumption for space heating and decrease the registered problems with draft near the windows.



2.3.3.2 Calculation results



Fuel consumption

The annual consumption of natural gas decreases from 422 MWh to 391 MWh, equal to a reduction of 7 per cent. With an investment of 1200 DKK (160 \in) per m² windows, the calculated energy savings gives a simple pay-back time of less than 7 years.

2.3.3.3 Conclusion

Replacement of the glazing in the windows from traditional double pane thermo coupled glazing to a more energy efficient window of today's standard is an economical sound investment, especially if it is done in conjunction with a scheduled maintenance of the building.



Appendix 1: additional information

The office building at Rosenkæret 39 was established in 1993 in an old factory building originally constructed for light industry. The building is privately owned but the municipality of Gladsaxe rents the premises. Even though the size of the building has a size that made it mandatory to be in the ELO energy certification scheme (since 1997), it has never been labelled.







Landscape offices at 3rd floor.



Landscape offices at 4th floor



Wall mounted condenser for cooling engine for canteen.



Internal meeting rooms with replacement air from surrounding office landscape.



Natural gas boilers operating in cascade.

Domestic hot water storage.









Appendix 2: Input data for calculations

The following summary of inputs is taken directly from the EPA-NR calculation tool, exported into one pdf-file per pilot project.

The reproduction of the input summary should be read as indicated in the figures to the right, depending on the number of pages shown on one page of this report. three or four pages:



one or two pages:

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West door	2,4	90,0	90,0	3,000	3,000	0,500	0,50	0,000	0,000	0,250	0,050	0,050	0.00	Name ¹²⁻³ Wim ² [_contr, - Jan Feb Mar Apr May Jan Jai Ang Sep Oet Nov Dee					
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12 South	32.4	180,0	90.0	3,000	3,000	0,700	0,70	0,000	0,000	0.150	0.050	0.050	0.00	Generator eff. and load contribution					
- 2nd floor	0.0	0.0	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.000	0.00	Name Efficiency,- Corr, Fuel Invest Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec					
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Heating distrib	ution syst	em, standard va	lae						0,93				0	Kanteen I 0					
Emission		_	_	-								_	8	Old building, 3 & 4 floor 1 0					
Name				-				Efficien	ку, -				Invest	Old bailing, 0, 1 & 2 fleer 1 0					
Convectors	16.50			+				-	0,95				0	New Dhw System					
Old building 3	& 4 floor			+					0,95				0	Factor on fuel consumption, - 0					
Karfeen				+				_	0,95				0	Use Solar Collector No					
				÷					<i>.</i>					Generator eff. and load contribution					
New Heating S	system					_								Name Efficiency, Puel Invest Ian Feb Mar Apr May Jun Ial Aug Sep Oct Nov Dec					
Factor on field	orisangti actor	00 ₆ +				-							0 No	Distribution					
Auxements	ne come surfacement												140	rsame Efficiency, - Invest					
Name	p	pump,	erent.		E.c.	No.	4.00			400	-	0-1	No. D	Name Efficiency . Tasset					
same		W/m²	conff, -	Jan	reb.	stat	Apr	atay	and hit	Aug	sep	0d	New Dec	Landary, " Inter-					
Heating Aux		0	0	1	1	1	1	1	1 1	1	1	1	1 1	New Dirw System					
Generator eff.	and load	COP.	<u> </u>	T									_	Factor on fuel consumption, - 0					
Name Uffic	teticy, -	Fud	Inves	Jan	Teb	Mar	Apr	May	Ain Ail	Aug	Sep	Oct	Nov Dec	Concerne comment No					
Distribution				_										Name Efficience - Fail Invest Jan Feb Mar Are May Jun Jal Ann Son Fed New Tree					



Distribution	Aux energy and operation time fraction
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Emission	Heating Ass. 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Name Efficiency, - Invest	Conceptor off and lood contribution
Zane-Old building: 1.6.4 flase	
Gross atea, m ² 823	Name Elisticity,- , Fue arrest an Fee Mar Apt May an au Aug Sep Cet NOV Dee
Specific internal heat capacity, kJ/m² K. 124	Distribution
Specific internal coupling coefficient, Wmr K 9,2	Name Efficiency, - Invest
Int Temp Heating, °C 20,5	Emixdon
Int Temp Cooling, °C	Name Efficiency, - Invest
Lighting	New Heating System
Total installed lighting power, W \$235	Factor on fuel consumption, - 0
Daylight time usage per year for lighting, hours 936	Use Solar Collector No
Non-daylight time usage per year for lighting, hours 1404	Aux energy and operation time fraction
Daylight dependency factor for lighting, - 1	Name p.juarp, f_contr,- has Feb Mar Apr May Jun Jul Ang Sep Oct Nov Dec
Occupance factor for lighting, - 1	
Practien net removed by extanal ventilation, -	Generator off, and load contribution
Entrogency agring courging energy no	New Process COP, But have he Tab Mar he Mar he had he for the New Pro-
Invest 0	Name Eusciency,- , Pain invest Jan Peo Mar Age May Jam Jai Aug Sep Oct Nov Dec
Hest Production / Fraction of time	Distribution
Occupants, Wim ²	Name Efficiency, - Invest
Fraction Persons present, - 0,26	Eminion
Appliances, Wm ² 4,45	Name Efficiency, - Invest
Fraction Appliances ate on, - 0,35	New Heating System
Airflow rate	Factor on fiel consumption, - 0
Infiltration, m/s 0,11	Use Solar Collector No
Natural vent, m/s 2,5	Aux energy and operation time fraction
Fraction Nat Vent is present, - 0,3	Natne P_Jmarap, Witter f_contr,- Jan Feb Mat Apr May Jan Jul Ang Sep Oct Nov Dec
Demestic het water	Heating Aux 0 0 1 1 1 1 1 1 1 1 1 1 1 1
Average DHW consumption, m/m?year 0,07	Generator eff. and load contribution
Down Temp, 52 05 Coldwater Temp, 92 16	Name Efficiency,- COP, Fuel Invest Jan Feb Mar Are May Jun Mil Are Sep Oct New Day
Cooward temp, -C. IV	Lanna mananada. * Lana maren ina Len lana Life madi ana Lana ina inak data tara anan
Opaque Construction	Distribution
Name Azea, m ² Orientation, deg Tilt, U, Winr'K Alpha, - R. se, F_h, - F_o, - F.f. Investim	Name Elizadity, - inves
West Wall 71.0 270.0 90.0 0.300 0.70 0.04 0.050 0.000 0.000 0.00	Rainon
East Wall 101.0 90.0 90.0 0.300 0.70 0.05 0.050 0.000 0.000 0.00	Name Elisionity, - inves
North Reef 414,0 0,0 45,0 0,200 0,90 0,04 0,000 0,000 0,000 0,00	Canteen Cooling System
South Reed 325.0 180.0 45.0 0.200 0.90 0.04 0.000 0.000 0.000	Factor on fuel consumption, -
	Aux energy and operation time fraction
Transparent construction	Name P.Pump. Contro- Jan Feb Mar Ant May Jun Jul Ant Sep Oct New Dec
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Comment With Comment in the second se
West 7,0 270,0 90,0 3,000 3,000 0,700 0,700 0,000 0,000 0,050 0,050 0,000 0,00	
Windows 7,0 50,0 60,0 5,00 0,00 0,00 0,00 0,00 0,	Name Efficiency,- Fuel Invest Jan Feb Mar Apr May Jun Jul Ang Sep Ort Nov Dee
North roof windows, 3 18.4 0.0 45.0 2,000 2,000 0,630 0,600 0,300 0,000	Cooling gmention 1 3,5 Electricity 0 1 1 1 1 1 1 1 1 1 1 1 1 1
North reef 17,6 0.0 45,0 2,000 2,000 0,630 0,63 0,000 0,300 0,000 0,020 0,010 0,00	eff
Sathroof	Distribution
windows, 3 4.2 180,0 45,0 2,000 2,000 0,630 0,40 0,000 0,500 0,000 0,020 0,010 0,00	Name EBiotexy, - Invest.
Scuth roof sindews, 4 15,6 180,0 45,0 2,000 2,000 0,630 0,40 0,000 0,500 0,000 0,020 0,010 0,00	U.P. U.P. 0
	Name Efficience - Insure
Ground construction	Karlen 1 0
Name Area, m ² U ₁ Wint K U <u>1</u> J ₂ - U <u>1</u> J ₂ - Investim ²	
Shared Heating System	Shared Dive System
Factor on fael consumption, - 1	Partier on test consumption, - 1
Use Solar Collector No	Unit of the Constant No.
Aux energy and operation time fraction	Name Efficiency . Fait Invest Jan Feb Mar Are May Jun Jul And See For See Tool
Name P_pump {_f_contr Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	DI(W
Heating Aux 0,3 1 1 1 1 1 0,75 0,25 0 0 0 0,25 0,75 1 1	penerated in 0,89 Natural gas, 0 1 1 1 1 1 1 1 1 1 1 1 1
Generator eff, and load contribution	0.html
Name Efficiency,- COP, Fad Invest Jan Feb Mar Apr May Jan Jul Aug Sep Oct Nov Dec	Distribution
Cascade gas Anno 3 Natural gas, Anno 4 Natural gas	Name Efficiency, - Invest
boders 0,89 1 high energy 0 1 1 1 1 1 1 1 1 1 1	9,7 0
Distribution	Laurenter
Name Efficiency, - Invest	Kathen I n
Heating distribution system, standard value 0,93 0	Old bailding, 3 & 4 floor 1 0
Emission	Old hubbing, 0, 1 & 2 floor 1 0
Name Efficiency, - Invest	
Lonvetors 0,93 0	New Dirw System
Old building, 3.6.4 floor 0.95 0.	Pactor on test consumption, - 0
Karteen 0,95 0	Vite Sear Antonion No
	Venterator est, and sold confirmation
New Heating System	remon sounding, run mean out ren mar Age may Jun Ai Aug Sep Oct Nov Dee
Factor on flud consumption, - 0	Distribution
Use Setter Concensit	namenBCy, • Invest



Emission	Dhw Shared Dhw Sviten									
Name Efficiency, - Inv	4									
Nan Blue Section	Shared Heating System									
New Date System Factor on fiel consumption -	Factor on find consumption, -									
Use Solar Collector	Aux energy and obseration time fraction									
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Name Efficiency, - Inv	d Generator eff, and load contribution									
Emission	Name Efficiency,- COP, Fuel Invest Jan Fele Mar Apr May Jan Jul Aug Sep Oct Nov Dec									
Name Efficiency, - Inv	at Cascade gas 0,89 1 Natural gas, 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1									
Zone: Kanteen	Distribution									
Gross arm, m ^e	0 Name Efficiency, - Invest									
Specific internal heat capacity, k3/tm² K	14 Heating distribution system, standard value 0,93 0									
Specific internal coupling coefficient, W/m ² K	2 Emission									
Int Temp Heating, 1C 2	Name Efficiency, - Invest									
Inf Tomp Cooling, "C	0 Convectors 0,05 0									
Lighting Total installed lighting pager W	Chi balling, 3, 4 floor 0,95 0									
Davlight time usage ner year for lighting, hours	2 Karteen 0,95 0									
Nen-daşlight time usage per yoar for lighting, heurs	8									
Daylight dependency factor for lighting, -	1 New Heating System									
Occupance factor for lighting, -	1 Use Schar Collector Vu.									
Fraction not removed by exhaust ventilation, -	1 Aux energy and operation time fraction									
Emergency lighting charging energy										
Lighting controls stand-by energy	0 rome Winr Loont, Jan Peo Mar Apr May Jan Jal Aug Sep Oct Nov Dec									
Unit in a second	Heating Aux 0 0 1 <th< td=""></th<>									
Occupants. Winf	S Constant of the second secon									
Fraction Persons present, - 0	Name Efficiency,- ^{COP} , Fuel Invest Jan Feb Mar Apr May Jan Jul Aug Sep Oct Nov Des									
Appliances, Witte'	5 Distribution									
Fraction Appliances are on, - 0	7 Name Efficiency, - Invest									
Airflow rate	Emixien									
Infiltration, m ^{1/3} 0	2 Efficiency, - Invest									
Natural vent, m/w	0 New Heating System									
Practice Nat Verilis present, -	Factor on fial consumption, - 0									
Deservice for water Assessed DBW concurrention millionar	Use Solar Collector No									
Consequences of the second sec	Aux energy and operation time fraction									
Boller Temp, "C 0	5 Name. P_pump, Wim ² f_confr,- Jan Feb Mar Apr May Jun Jul Ang Sep Oct Nov Dec									
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Opaque Construction	Generator eff. and load contribution									
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Seath reef 96,9 180,0 90,0 0,200 0,80 0,04 0,000 0,000 0	0 Name Efficiency, - Invest									
Tennent estentia	Emission									
Atta Orientation Tilt	Name Efficiency, - Invest									
Name m ² dag dag U, Wim ² K Wim ² K F with F with F to Invest	f New Headlas Statem									
Scuthroof 8,1 180,0 45,0 2,000 2,000 0,630 0,40 0,000 0,500 0,000 0,050 0,050 0	Factor on fluid consumption, - 0									
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Latter Stand to Of scale 4 a 2 4 4 a 10 4 a	Name P. parren. f. contr Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec									
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Harding part	A losing contained. " Los luces hall los une tide and build out out the									
Active	INSTRUMENT									
Supply temp., "C	8 Padrolen									
Mechanical ventilation, m/s 0	6 Name Efficiency. • Invest									
Heat rec. eff, -	0									
Recirc. factor, -	0 Canteen Cooling System									
Cooling part	Parter on turn consumption, -									
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Cool rec. eff,-	0 Cooling Ams 0.5 1 1 1 1 1 1 1 1 1 1 1 1 1									
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Generator eff.	and load contribu	tion			_		_	_					_	_			
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DHW generated in heating system	0,89	Natural gas, high energy	0	1	ī	1	4	3	i	j.	1	1	1	1	1		
Distribution							_	_	_			_	_				
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Project Description

EPA-NR is a project in the framework of the 'Intelligent Energy – Europe' Programme (IEE) of the European Commission. EPA-NR provides an assessment method for the Energy Performance Certificate according to the Energy Performance of Buildings Directive (EPBD) and offers additional advice for existing non residential buildings. The project, in which seven EU Member States are participating, is co-ordinated by EBM-consult, The Netherlands. It started in January 2005 and will last for two years.

The EPA-NR method consists of an energy calculation model and process supporting tools like inspection protocols, checklists and building component libraries. The EPA-NR method produces an Energy Performance Certificate for non-residential buildings with the possibility for additional advice. The two major target groups are policy makers and practitioners who are each addressed with a tailored set of deliverables.



The EPA-NR method:

- is in line with the EPBD and CEN-standards
- takes into account the local framework with respect to legislation, technical aspects, designand building maintenance processes and acceptance by actors in the market
- is modular and flexible and therefor easily adjustable to the national context, the diversity in the market and new or modified CEN-standards
- is tested through pilot projects in seven EU Member States
- · can be further developed and maintained at low cost due to the joint efforts
- offers additionally policy recommendations addressing all levels of authorities in Europe
- guarantees simple transfer to all EU Member States



Project Partners



Project Co-ordinators: EBM-Consult (The Netherlands) bpoel@ebm-consult.nl



Ein Unternehmen der Austrian Research Centers.

arsenal (Austria) Österreichisches Forschungs- und Prüfzentrum Arsenal Ges.m.b.H.



ÖÖI (Austria) Österreichisches Ökologie Institut



SBi (Denmark) Danish Building Research Institute Aalborg University



CSTB (France) Centre Scientifique et Technique du Bâtiment



Fraunhofer Institut Bauphysik Fraunhofer-IBP (Germany) Fraunhofer-Institut für Bauphysik



NOA (Greece) GRoup Energy Conservation (GR.E.C.) Institute for Environmental Research & Sustainable Development (IERSD) National Observatory of Athens



ENEA (Italy) National Agency for New Technology, Energy and the Environment



TNO (The Netherlands) Netherlands Organisation for Applied Scientific Research