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#### Danish pilot study - Health care building

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### Danish pilot study – Health care building National report – Denmark

Final report, June 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 Hørsholm, Denmark Telephone: +45-45-742 379 Email: kbw@SBi.dk





# Danish pilot study National report – Denmark

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Date: June 2007

Report Number:

EC Contract EIE/04/125/S07.38651

#### www.epa-nr.org

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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 Health care building, Møllegården care center



2.1 Project summary

#### Care Centre Møllegården, Gladsaxe

Sheltered Housing, elderly people's rest home and day centre. Contractor: Gladsaxe Municipality.

Type of building: Health care	Short description: The scattered buildings
Location: Scattered urban environment	at Møllegården consists 50 individual, shel- tered row houses and a 2 floor building with
Owner: Public	rooms for 56 elderly people's rest home.
Year of construction : 1977	The housing is owned by Gladsaxe municipality. The buildings are oriented along a
Total gross area (m <sup>2</sup> ): 10,139 m <sup>2</sup>	North-South axis and the rooms are thus oriented either East or West. There are
Total conditioned area (m <sup>2</sup> ): 9,562 m <sup>2</sup>	three primary zones: the residential area,
Building occupancy 24 hours per day all year	the common areas for day care and the kitchen area
Number of occupants: about 140 (106 elderly people plus staff).	Construction: Facades are made of con- crete elements with light parts covered with wood on the external and boards at the in- ternal faces. Roof is covered by roofing boards. The glass in the windows is tradi-



		tional double pane thermo windows.
		Heating / cooling/ ventilation/ lighting: Heating is via a local district heating plant. There are three boilers of which only two are running. The inhabitants do not want energy saving bulbs. There is mechanical ventilation in the kitchen and common ar- eas for day care.
Energy management: The essistem needs a general upda		Previous refurbishment : none
justment.		Planned refurbishment: The existing eld-
Energy consumption year 20	05 :	erly people's rest homes are located in the two floor building and its physical frame-
The building	National average	work is preserved during the renovation.
(According the bills)	(if known)	Three apartments will be joined together to
Fuel 182.3 kWh/m <sup>2</sup>	143 kWh/m <sup>2</sup>	two new apartments, making the centre
Electricity 48.2 kWh/m <sup>2</sup>	46.1 kWh/m <sup>2</sup>	apartment into a bathroom suited for dis-
Water 0.73 m <sup>3</sup> /m <sup>2</sup>	0.75 m³/m²	abled people. The dwellings are light and
		pleasant and will be made with focus on flexibility and individual adaptation. From the dwellings at the ground floor there is access to a terrace.
		In conjunction with renovation of the living conditions, the building's energy perform- ance will be upgraded.

The Care centre Møllegården and the surrounding 50 elderly dwellings are constructed in 1997 and appears with a "main street" in a village-like environment. Using a system of foot-paths and pedestrian tunnel it is possible access the centre facilities all year around.

The centre has 56 dwellings for elderly people distributed on two floors. In connection to Møllegården there is a senior citizen café, a day care centre for elderly people with a physiotherapy and occupational therapy section.

### 2.2 Audit of the building

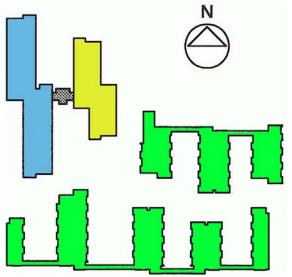
#### 2.2.1 Actual situation: measured energy

#### Facades

The major parts of the facades are covered by a wooden panelling that needs replacement. Adding a new facade covering will offer the possibility of adding additions insulation to the exterior side of the facades. The size of the roof eaves are plenty to give full protection for the new facade with additional insulation.

The facades in the sheltered homes are decided to be straightened and will thus result in a decrease in facade area. The new straight facade should have an insulation level of today's standard.





Plan of Møllegården. Green: Elderly peoples sheltered home; Blue: Elderly peoples nursing home; Grey: Connection building; Yellow: Service facilities, e.g. physiotherapy, kitchen, laundry, offices, OT ward, restaurant, etc.

#### Doors

All doors to the sheltered homes and most of the other doors are in a poor condition and with traditional double pane glazing. The doors are broader than standard doors to give access for wheel chairs and though heavier that a standard size door. It should be considered to replace the doors with aluminium doors to reduce the weight and decrease the wear on the hinges in the future. It should be noted that broad doors are more expensive than standard size doors, and this should be taken into account when calculating the investment needed for replacement of the doors.

#### Windows

Some windows have previously been replaced by triple pane glazing without low-e coatings. It will not be cost effective to replace these windows, but when they need replacement anyway, it should be to double pane glazing of today's energy standard.

#### **Bay windows**

There are some bay windows in the care section of the estate, and these do possibly have limited insulation at the top and bottom. It will be easy to increase the insulation level of these bay windows as the facade covering is going to be replaced anyway.

#### Floors

In general the insulation level of the floors is expected to be lover than today's standard, but it is estimated being too expensive to improve it. All bathrooms however will be renovated and this is an obvious possibility for improving the insulation level under these sections of the floors. This will be an especially good investment as the bathroom floors all have floor heating and thus high heat loss.

#### Roofs

There is access to the roof insulation from the gable of care sections. If there is enough room for additional insulation without adding to the height of the roof, this would be a favourable energy saving measure.

The roof covering needs to be maintained and in some places replaced. If the roof covering is decided to be replaced, and there is lack of space for additional insulation in the attic, this would be the perfect time for adding to the roof height and installing additional roof insulation.



#### Corridors

Corridors connect the different sections of the estate. These are heated by convectors placed underneath the ceiling, but this is a relatively inefficient location. Further the ceiling is pitched with the pipes located underneath it. If the convectors are moved down along the wall as one layer radiators and the ceiling is lowered to cover the pipes, the heated volume will decrease – and thus the energy consumption - and the comfort level will increase.

#### Solar protection

All windows in the nursing and service sections, except those facing South and North, have fixed horizontal overhangs. This provides solar protection but dramatically reduces the availability of day-light. Removal of the overhangs in conjunction with the planned renovation will improve the daylight conditions and could be combined with movable solar shading as a more energy optimized solution.

#### Pumps

A large number of the pumps in the heating and domestic hot water distribution systems are old and can easily be replaced by new, electronic pumps with much lower electricity consumption.

#### **Burners**

There are three burners, two natural gas burners and one oil burner in reserve. One gas burner has been modified to be a condensing type and one is the original type. It is recommended to make the same modification to gas burner no. 2.

#### Lighting

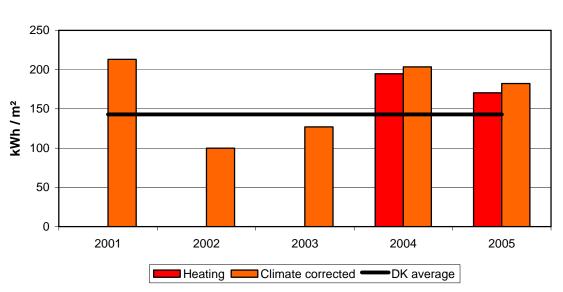
In general lighting needs to be revised. The lamps are equipped with grids or opal screens that reduce the light yield. Removal of the grids and installation of reflectors in wooden lamps will increase the efficiency of the lighting installation.

#### Domestic hot water circulation

The temperature in the circulation strings of the distribution network of the domestic hot water is at 52 °C. This temperature can be decreased without causing any problems with Legionnaires' disease as the temperature and the water flow in the hot water tank is sufficiently high.



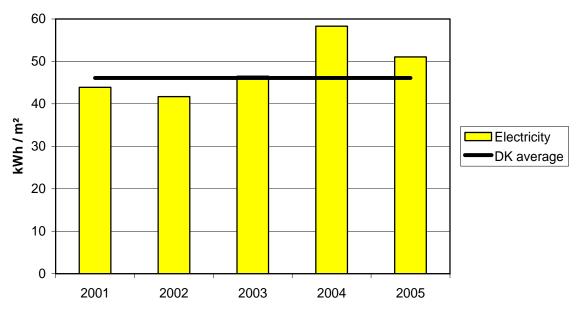
#### 2.2.1.1 Heating consumption



Heating

Figure 1. Heating consumption in kWh/m<sup>2</sup> in 2004 and 2005 (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 20 %.

There have been large variations in the hating consumption at Møllegården over the past years that can not be explained by any logic reasons.



2.2.1.2 Electricity consumption

Figure 2. Electricity consumption in kWh/m<sup>2</sup> in 2004 and 2005 and the Danish average consumption in buildings used for similar purpose and size.



#### 2.2.1.3 Water consumption

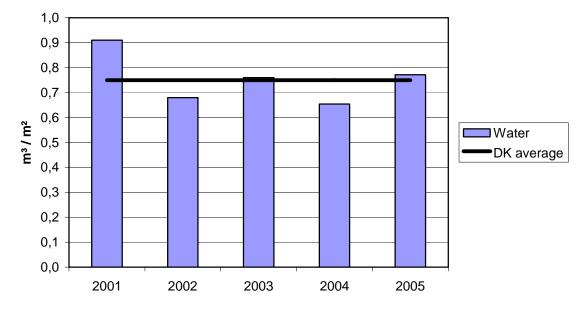


Figure 3. Water consumption at Møllegården in 2004 and 2005 in m<sup>3</sup>/m<sup>2</sup> and the Danish average consumption in buildings used for similar purpose and size.

In 2005 the domestic hot water consumption constituted 1758 m $^3$  (28 %) of the total water consumption.

Energy consumption in the interest of EPA-NR process: presentation of figures about relevant energy consumption (if available).

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

#### 2.2.2.1 Energy characteristics of the building model (global)

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:

- 1. Zone 1: Service centre (1790 m<sup>2</sup>),
- 2. Zone 2: Nursing centre (2930 m<sup>2</sup>),
- 3. Zone 3: Sheltered dwellings (3180 m<sup>2</sup>),
- 4. Zone 4: Connection building (120 m<sup>2</sup>).

#### List of energy uses:

- Zone 1: heated and mechanically ventilated,
- Zone 2: heated and naturally ventilated,
- Zone 3: heated and naturally ventilated,
- Zone 4: heated and naturally ventilated.



#### Operational parameters used for the calculation:

	Zone 1	Zone 2	Zone 3	Zone 4
Heating temperature set point	21 °C	23 °C	22 °C	20 °C
Cooling temperature set point	-	-	-	-
Operation time for heating/year	8760 h/a	8760 h/a	8760 h/a	8760 h/a
Operation time for cooling/year	-	-	-	-
Operation time for ventilation/year	8760 h/a	-	-	-
Operation time for lighting/year	6570 h/a	6570 h/a	3285 h/a	8760 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 CO<sub>2</sub> emission of the building

Primary energy consumption of the building:	CO2 emission of the building: kg/m²/year
kWh/m²/year	
183.02	39.3

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

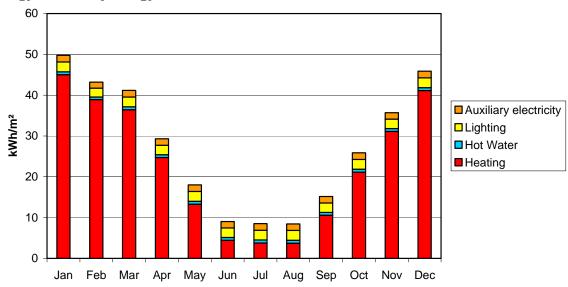
<b>3</b> ,	Annual final energy con-	Primary energy con-	CO <sub>2</sub> emission of the
	sumption* of the building	sumption of the building:	building:
	per fuel type:	kWh/m²/year	kg/m²/year
Natural gas	518.51 MWh/year	64.65	6.1
Electricity	379.71 MWh/year	118.36	33.2

\* Calculated under standard user pattern and outdoor conditions.

#### Energy demands by month

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

#### Energy demand by energy source



Energy consumption at Møllegården care centre is, as in most Danish buildings dominated by the energy consumption for space heating (above), but lighting plays an important role in this building due to the special needs for 24 hours a day service all year around.



	A	nnual losse	S		Annual	gains	
Total heating kWh/m²	Total	Trans- mission	Ventila- tion	Total	Solar	Sun space	Internal heat
Zone 1	180	96	84	95	17	0	78
Zone 2	196	89	107	66	11	0	55
Zone 3	324	233	90	87	45	0	42
Zone 4	339	205	134	39	39	0	0
Total	1039	623	415	287	112	0	175

### 2.3 Calculation of energy savings: scenarios for improvement

Some of the energy saving measures listed in this section is in line with the proposed renovation scenario from the consultant and some are based on the audit of the building. Some of the most obvious, small improvements are not part of the scenarios, but discussed in section 2.2.1., as the option will not exist in the renovated building.

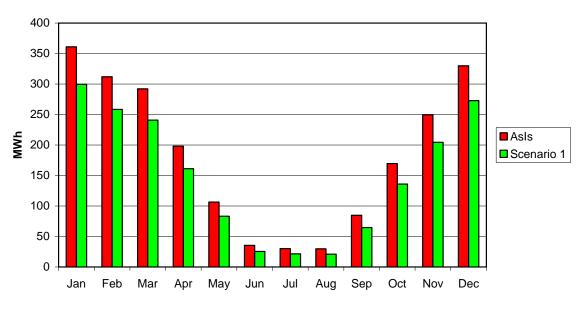
#### 2.3.1 Scenario 1 – New facades in sheltered dwellings

#### 2.3.1.1 Background and proposed solution

The sheltered dwellings do not meet today's Danish standard for this type of dwelling and a major renovation is planned for the autumn of 2007. During this renovation, the facades will be replaced and straightened to increase the insulation level and the area of the dwellings. The floors in the bath-rooms will be replaced and additional insulation will be mounted. All windows will be upgraded to low-energy glazing and the doors to a similar standard. Insulation in the roof will be increased to 300 mm.

Seen upon as solely energy saving measures, these interventions will not be economically appropriate, but as the dwellings are having an upgrade anyway, the additional cost is marginal. When undertaking a radical renovation, as the one planned at Møllegården, the Danish Building Regulations requires that the new thermal envelope elements meets the requirements for new buildings, if at all possible due to economical (marginal) and architectural reasons.





#### Enegry for DHW

Energy consumption for heating, before and after renovation of the sheltered dwellings section of the building complex.

The annual saving is calculated to 409 MWh equal to a cost of about €51000 with an investment of one hour work or about €830 000. This gives a simple pay-back time of 16 years.

#### 2.3.1.2 Recommendation

As the sheltered dwellings are going to be renovated anyway, energy saving measures is only a marginal cost. Further, energy saving measures that are economically sound (savings in money times life-time of the measure in years divided by the investment in money > 1.33) must be carried out when undertaking a major renovation in a Danish building. A renovation is major if it influences more than 25 % of the thermal envelope.

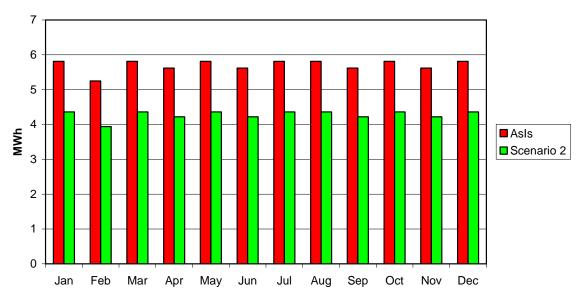
#### 2.3.2 Scenario 2 – Derease of DHW circulation temperature

#### 2.3.2.1 Background and proposed solution

The set-point temperature for the domestic hot water circulation is at the moment about 52 °C and can easily be decreased without causing any Legionnaires' disease problems. The distribution network for domestic hot water is about 1300 meters of relatively well insulated pipes located in the technical galleries in the basement.

As energy saving measure, this is a simple intervention that can be done by the technical staff of the school within about half an hour. The pay-back time does thus not exist.





#### Enegry for DHW

Energy consumption for domestic hot water, before and after decreasing the water temperature in the distribution network. Estimated distribution efficiency changed from 0.6 to 0.8.

The annual saving is calculated to 17 MWh equal to a cost of about €2100 with an investment of one hour work or about €50.

#### 2.3.2.2 Recommendation

It is highly recommended to carry out this measure, also after the renovation of the buildings.



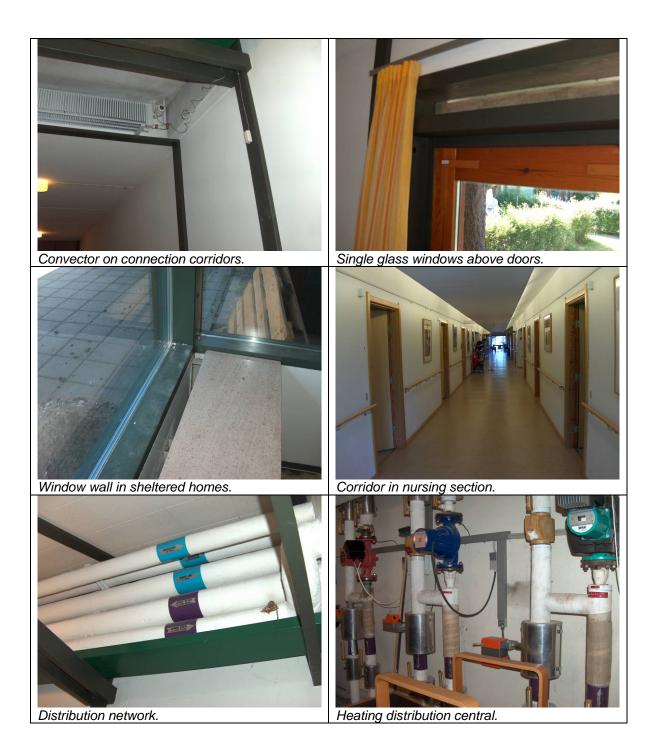
## 3 Appendix 1: additional information about pilot projects

### 3.1 Health care building, Møllegården care center Møllegården elderly peoples rest home and care centre have been under planning for an extensive

Møllegården elderly peoples rest home and care centre have been under planning for an extensive renovation – including energy renovation - over the past 5-7 years, but no action have been taken yet. The building conditions do thus not meet what could be expected from similar buildings of the same type and age, especially when talking about the facilities for the elderly people. Møllegården is owned and managed by Gladsaxe municipality.













## 4 Appendix 2: inputs 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 figure to the right.

1	3
2	4

#### 29,3 29,3 Building: Mollegården AsIs Zone: Service centre Ground construction Gross area, m<sup>1</sup> Specific internal heat capacity, kJ/m<sup>2</sup> K 1790 165 9,2 Name Floor Area, m<sup>2</sup> 895,0 $U,\,W/m^{2}K$ B\_g\_h, • 0,50 B\_g\_c. • Specific internal coupling coefficient, W/m2 K Int Temp Heating, "C 21 Service Centre AHU Int Temp Cooling, °C 30 Fraction of tim Temp. rise by fans, 9 Lighting Total installed lighting power, W 14320 Invest 4380 Heating part Daylight time usage per year for lighting, hours Non-daylight time usage per year for lighting, he Daylight dependency factor for lighting, -2190 Active true Supply temp., \*C 21 2,2 cupance factor for lighting, -Mechanical ventile Fraction not removed by exhaust ventilation. 0 Heat rec. eff. по circ. fac Lighting controls stand-by energy no Cooling part Active Supply temp., "C Heat Production / Fraction of time cupants, W/m<sup>2</sup> action Persons pre-5,4 Mechanical ventilation, m Cool rec. eff, -20 Recirc. factor, -0.4 Humidification p Appliances, W/m<sup>3</sup> Airflow rate Active false 0,537 Hum. supply air, g/kg 1,074 Eff. hum. recovery, tural vent, m<sup>3</sup>/s 1,074 Fraction Nat Vent is present, 0.5 Auxiliary fan energy Domestic hot water Spec. electricity cons. for fans, Ws Average DHW consumption, m//m//yea 0,062 System ler Temp, °C 60 Heating on He ing System Cold-water Temp., °C 8 Dhw Common Dhw System Opaque Construction Common Heating System Factor on fuel consumption. Area, m<sup>2</sup> Tilt, deg Orientation, deg J, W/m²K Alpha, R\_se, m<sup>2</sup>K/W F\_h, • F\_0, F\_f. -Same Invest/m Use Solar Colle East Facade, South 125,0 90,0 90 0,40 0,6 0,04 0,80 0,70 1,00 0.00 Aux energy and operation time fraction ame f\_contr, Feb p\_pump East Facade, North West Facade South West facade, North W/m<sup>2</sup> 117,0 90 0,70 0,90 0,40 0,6 0,8 rating Avec or eff. and lo 119,0 270; 0,65 0,40 0,70 0,70 1,00 0,00 0,04 Name Efficiency, COP 101, 270 90 0,40 0,6 0,0 0,70 0,70 0,90 0,00 as viler 0.98 Natu high 0.00 Distribution 180,0 90,0 0,400 0,80 1,000 outh 112,0 895,0 0,400 0,65 0,600 1,000 0,700 0,0 90,0 1,0 0,0 1,000 1,000 0,00 ame Emission Transpare жу, • Area, Orien m<sup>2</sup> Tilt, deg G\_g, G\_g\_s, F\_h, F\_o, F\_f, U, W/m²K U\_5, W/m²K F. s. F\_with. Invest/m? Radiator ame Windows East, South 41,6 90,0 3,00 3,000 0,720 0,72 0,000 0,800 0,500 90,0 0.00 Common Dhw System 0,00 Factor on fae Use Solar Co Windows East, North 23,9 90,0 90,0 3,000 3,000 0,720 0,72 0,000 0,700 0,500 0,700 Windows West, South 0,00 Gener 47.7 270,0 90,0 3,000 3,000 0,720 0,72 0,000 0.600 0.500 Name Effi Jan Feb Jul Dec 270,0 3,00 3,00 0,720 0,72 0,0 0,00

### 4.1 Health care building, Møllegården care center



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Cold-water 1	Temp., °C														8 Emission																	
0															Name									Efficiency, -								
Opaque Co				Tilt.			_	P	_			_			Taps etc								0,9									
Name	Area, m <sup>2</sup>	Orienta	tion, deg	deg U	U, W/m <sup>2</sup> K	Alpha	-	R_se. m <sup>1</sup> K/W		F_h, •	F_6	0, *	F_f	Invest/m	Zone: Shet	and dwellin					_			_	_		_		_			
East	442,6		90,0	90,0	0,400	0,	55	0,04		0,800	0,5	500	0,900	0,00	Gross area.		••					-					_					
West	439,2		270,0	90,0	0,400	0,	55	0,04		0,700	0,5	500	0,900	0,00			ocity, kJ/m <sup>3</sup> K	:			_	+	_	_	_	_	_	_		_	_	_
South	111,7		180;0	90,0	0,400	0,	55	0,04		0,850	0,9	900	0,950	0,00			g coefficient, 1		_	_	_	+	_	_	_	_	_	_		_	_	_
soum	111,7			90,0	0,400	0,		0,04		0,650	0,9		0,950	0,00							_	+		_		_	_	_		_	_	
North				0.0	0,250	0,	90	0,04		1,000	1,0	000	1,000	0,00	Int Temp H	ating, "C					_	+		_	_	_	_	_		_	_	
North	1465,0		0,0												Int Temp H							_					_					
North Roof	1465,0														Int Temp H Int Temp C						_			_		_	_	_	_	_	_	
North Roof Transparen	1465,0		180,0	-		10-1		1.5.1		_					Int Temp H Int Temp C Lighting	oling, °C	ower. W					-								_	_	_
North Roof Transparen	1465,0 at construction	_		-	J_s, W/m/K	G_8.	G,	F_5.	F	with	F_h,	F_0,	F_f. •	Invest/m	Int Temp H Int Temp C Lighting Total instal	oling, °C ed lighting p		1g. hours			_	F										
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Noeth Roof Transparen Name Area m	1465,0 at construction a, Orientati a <sup>2</sup> 4 9	on, Tilt, deg deg	180,0 U, W/i 3,	m'K U		0,720		0,000	F	0,000	0,700	0,500			Int Temp H Int Temp C Lighting Total instal Daylight tir Non-dayligh	eoling, °C ed lighting p se usage per f time usage	year for lightir per year for li	ghting, ho	urs		_			_	_		_	_		_		
North Roof Transparen Name East 61,/	1465.0 at construction a, Orientati 4 9 8 27	on, Tilt, deg deg 0,0 90,0	180,0 U, W/ 3,	m'K U	3,000	0 0,720	0,72	0,000	F	0,000	0,700 0,650	0,500	0,900	0,00	Int Temp H Int Temp C Lighting Total install Daylight tir Non-dayligh	ed lighting p et usage per t time usage	year for lighti per year for li tor for lightin	ghting, ho	ars.					_			_	_			_	
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Neeth         Image: Constraint of the second of the s	1465.0     at construction     atrong to the set of the	en, Tilt, deg deg deg deg 0.0 90.0 90.0 90.0 90.0 90.0 90.0 90.0 90.0	180,0 U, W/i 3, 3, 3, 3, 3, 3, 3, 4rea, m <sup>2</sup>	m'K U .000	3,000 3,000 3,000 3,000 U, W/	0 0,720 0 0,720 0 0,720 0 0,720 0 0,720	0,72 0,72 0,72	0,000 0,000 0,000 0,000 B_g_1	h. •	0,000 0,000 0,000	0,700 0,650 0,800 0,600 B_s	0.500 0.500 0.900 0.900	0,900 0,900 0,700	0.00 0.00 0.00 Investim 0.00 1 1 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	In Temp H In Temp H In Temp H Lighting Total install Daylight in New-dayligh Daylight d Occupance Fraction to Cocupance Invest Heat Fraction to Cocupance Invest Heat Fraction to Cocupance Invest Heat Fraction to Cocupance Fraction to Cocupance Invest Heat Fraction to Cocupance Fraction to Fraction to Fraction Fraction to Fraction to	when the set of the se	pear for lightin per year for lightin tring exhaust ventil ging energy y energy tion of time - - 200, -	ghring, ho g														_
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North Roof Transparent Transpa	1465,0           st construction           a           b           0           145,0           a           3           3           3           a           y           a           y           a           y           a           y           a           y           a           y           a           y           a           y           a           y           a           y           a           y           a           y           a           y           a           y           a           y           a           a           a           a           a           a           a	en, Tilt, deg deg deg deg 0.0 90.0 90.0 90.0 90.0 90.0 90.0 90.0 90.0	180,0 U, W/i 3, 3, 3, 3, 3, 3, 3, 3, 4rea, m <sup>2</sup>	m'K U .000	3,000 3,000 3,000 3,000 U, W/	0 0,720 0 0,720 0 0,720 0 0,720 0 0,720	0,72 0,72 0,72	0,000 0,000 0,000 0,000 B_g_1	h. •	0,000 0,000 0,000	0,700 0,650 0,800 0,600 B_s	0.500 0.500 0.900 0.900	0,900 0,900 0,700	0.00 0.00 0.00 Investim 0.00 1 1 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	In Temp 19 and 1	oling, "C of lighting pg and the state of th	rent for lightin per year for li for for lightin ting, - exhaust ventil ging energy y energy tion of time - m, - m, -	gkring, ho R			U. 1			lpha.	- R			FJ			£.	
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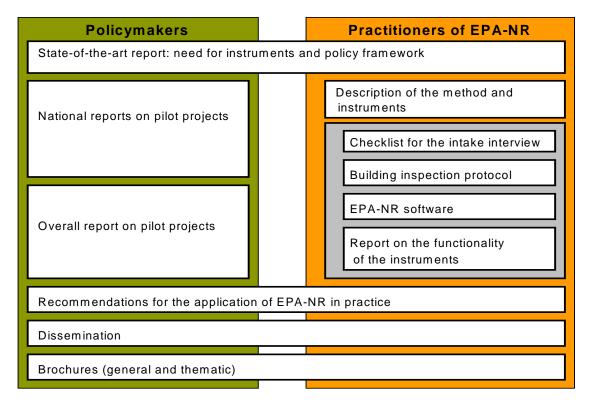
Facades,	1	645,0			180,0	90,0		0,400		0,6	65	0.0	4 0,900	0,900	1,000		0,00		stic hot																		
south Facades.	+				$\rightarrow$	$\rightarrow$			⊢		+		+			-					tion, s	i²/m²/year															0
Facades, North	<u> </u>	645,0			0,0	90,0		0,400		0,6	_	0,0	-		1,000		0,00		Temp.								+										60
Roof		3180,0			180,0	0,0		0,250		0,8	80	0,0	4 1,000	1,000	1,000		0,00	Cold-1	vater Te	emp., °C																	8
Transparent	construct	tion																Opaqı	ie Con	struction																	
Name	Area, m <sup>2</sup>	Orientati	ion,	Tilt, deg	U W/m <sup>2</sup> K	U W/m <sup>3</sup>	÷ c	g G	j_g_s,	F_5	F_	vith, •	F_h, -	F_0, •	F_f	Inv	rest/m <sup>2</sup>	Name		Area, II	e (	rientation	deg	Tilt, deg	U, W	'n'K	Alph	a, •	R_s m <sup>2</sup> K/	w	E.J	h, -	F_e		F_f,	- Inv	vest/m <sup>2</sup>
Windows,	<u> </u>		deg			-		+				-		_	_			South	$\rightarrow$	33,	6	1	80,0	90,0	(	,400	0	.65	0,0		0,8	000	0,6	00	0,600	,	0,00
East	567,0	9	10,0	90,0	3,000	3,00	10 0,7	720	0,72	0,000	<u> </u>	0,000	0,750	0,600	0,700		0,00	North		50,	4		0,0	90,0	(	,400	0	.65	0,0	04	0,7	100	0,6	00	0,600		0,00
Windows, West	483,0	27	0,0	90,0	3,000	3,00	10 0,7	720	0,72	0,000		0,000	0,800	0,600	0,700		0,00	Roof		72,	0	1	80,0	0,0	(	,250	0	,80	0,0	04	1,0	00	1,0	00	0,800		0,00
Windows,	54,0		0.0	90.0	3.000	3.00	10 0,1	720	0,72	0.000		0.000	0,700	0.600	0.900		0,00																				
connections	.4,0			74,0	2,000	1	~ ~		0,74	0,000	1	0,000	0,100	0,000	0,700		0,00		Area.	Orient	_	Tilt.					G_8.	G e	s, F_5	T			F_h,	F_0,			
Ground const	truction																	Name	m <sup>2</sup>		deg	deg	U, W/	$\rightarrow$	U_s, V		· ·			<u> </u>	F_wi	-	· ·		F_£.•	Inv	vest/m <sup>2</sup>
Name			A	rea, m <sup>2</sup>	-	ι	J, W/m	'K		В	g_h, •		В	g_c, •		Inv	vest/m²	South	33,6	<u> </u>	180,0	90,0		,000		3,000	0,720	0,		_		_	_	_	0,600		0,00
Floor				2880,0			0,8	00			0,50			0,50			0,00	North	16,8		0,0	90,0	3	,000		3,000	0,720	0,1	2 0,00	<u></u>	0	,000,	0,650	0,500	0,600		0,00
Floor heating bathrooms	in 50			300,0			0,5	00			0,70			0,70			0,00	Grou	id cons	truction																	
_					_													Name				A	es, m²	<u> </u>		U, W/			В_	g_h, •			B_8			Inv	vest/m <sup>2</sup>
Common Her	ating Syst	tem						_										Floor					70,0			0,	800			0,50				0,50			0,00
Factor on fael		tion, -															1	Comm	an He	ating Syst																	
Use Solar Col																	No			consump																	1
Aux energy a	-		ractio	n .	_		_	_	-	-		-							dar Col				_	_	_	_	+	_	_	_	_	_	_	_	_	_	No
Name	P	pump, W/m <sup>2</sup>	f_co	atr, -	Jan	Feb	Ma	4	pr )	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Aux e	nergy s	and opera	tion tir	ae fractio															
Heating Aux		0,3		1	1	1		1	1	1	1	1	1	1	1	1	1	Name		T	pump. W/m <sup>2</sup>	f_co		Jan	Fel	м	ar A	φr	May	Jun	Ju	4 A	118	Sep	Oct	Nov	Dec
Generator eff	f. and loa	d contribu	tion												_				g Aux		0.3		-	1		1	+ -	-			-	1	1	1	-	1	1
Name Eff	iciency, -	COP,		Fuel	Invest	Jan	Feb	Ma	r Ap	и М	lay Ju	Ju	d Au	s Seg	Oct	Nov	Dec		_	f. and loa		ibution	41				4	-	4				-1		4	1	
Gas	0,98		Natur	il gas.	-	<u> </u>	<u> </u>		1			$\vdash$		1	<u> </u>	<del>  </del>	-	Name		iciency, •	COP.	- anneal	Fuel	ler			6 Ma				Jun	Test.	Arres		0.1	Nov	Dec
boiler	0,98	1	high e	nergy	0	<u>'</u>	, I		1	<u>'</u>	<u>'</u>		·	<u> </u>	<u> </u>	'	1		En	ciency, -			Fuel	Invest	Ja	i Fe	0 MB	۲ A	pr Ma	γ 	2m	Jul	Aug	Sep	Oct	NOV	Dec
Distribution					_													Gas boiler		0,98	1	Naturi high e	l gas, nergy	0			1	1	1	1	1	1	- 1	1	- 1	1	1
Name										Effici	ency, •						Invest	Distri	bution					_	<u> </u>	<u> </u>	<u> </u>	<u> </u>		<u> </u>	<u> </u>						<u> </u>
Common distr	nëution p	etwork									0,8						0	Name											Efficie	mcy.							Invest
Emission					_					Effici	ency, -						Invest	Comm	on dist	ribution na	twork									0,8							0
Radiators			_	_	+			_			0,9						0	Emiss	ion					_							_						
					_													Name						⊢					Efficie	<u> </u>	1						Invest
Common Dhy								_										Radiat	ors											0,9							0
Factor on fael	consump	908, *						+									1	Comu	oon Dh	w System																	
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	ciency, •	I	Foel 1	Invest	Jan	Feb	Ma	w /	Apr 1	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			f. and loa	l contr				_		_	_				_	_				
Gas boiler		Natural					I .						- 1	- 1				Name	Eff	ciency, -		Foel	nvest	Jag	Fe	6 N	tar /	\pr	May	Jun	71	4 4	ug	Sep	Oct	Nov	Dec
+ water	0,8	high ene	rgy	0	1	· 1	1	1	1	1	1	1	- 1	- 1	- 1	1	1	Gas boiler			Nati	ral gas,															
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Distribution Name					_					100.0	iency, -						Invest	tank Distril			_					_				_		_	_	_			
DHW distibut	tion w. cir	culation			+					EUK	0.6						0	Name	outon.					<u> </u>					Efficie	tocy.	1						Invest
Emission																	_	DHW	distibu	tion w. cir	ulation	1		$\vdash$						0,6	$\vdash$						0
Name					T					Effici	ency, -						Invest	Emiss	ion												_						
Taps etc											0,9						0	Name											Efficie	mcy, •							Invest
Zone: Connec	ction buil	Mina																Taps e	1c											0,9							0
Gross area, m						_		Т	_							_	120																				
Specific intern	nal heat co	apacity, kJ/a	m <sup>1</sup> K	_				Ť		_							124																				
Specific inten		ng coefficie	ent, W	m² K													9,2																				
Int Temp Heat								+									20																				
Int Temp Coo	ding, °C																30																				
Lighting								-																													
Total installed			obtine	hare				+									620 4380																				
Daylight time Non-daylight					otes			+									4380																				
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Fraction not re	emoved by	y exhaust v	entilati	ion, -													0																				
Emergency lig			RY .														no																				
Lighting contr	rols stand-	-by energy						+									80																				
Invest	dan / Pr	ation - tot		_		_	_		_	_		_		_	_	_	0																				
Heat Product Occupants, W		coon of tin	u¢														0																				
Fraction Perso		d. •						+									0																				
Appliances, W																	0																				
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Fraction Appli Airflow rate Infiltration, m	i∜s			_				Ţ									0,124																				
Fraction Appli Airflow rate	<sup>1</sup> /s m <sup>3</sup> /s							$\downarrow$									0,124																				



## **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



**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