



## Lauritz Sørensens gård (Denmark)

**Savings on district heating 30-40 %**

**Preheating of ventilation air**

**PV cells, Preheating of ventilation air in Canadian solar wall**

### Project data

Location, address:	Lauritz Sørensens vej, 2000 Frederiksberg
Region:	Copenhagen
Surroundings:	Social housing blocks
Climate:	Mild and humid
Heating degree days:	2.906
Year of construction and renovation:	1921-1923 (construction); 2002 (renovation)
Typology:	Apartment
No of dwellings:	127 (+16 new)
Total floor area:	11,050 m <sup>2</sup>
Owner:	Frederiksberg Boligfond v/ Privatbo A.M.B.A
Architect and Builder:	Karsten Pålsson A/S Architects, maa; Frederiksberg Boligfond v/ Privatbo
Costs of energy saving measures:	€ 5.500 per house (incl. VAT)
Renovation financed by:	Frederiksberg Boligfond, EU and Danish Energy Authority



Fig.1: PV on roofs and new roof top apartments

### Objectives and Results

The main aim in the Lauritz Sørensens Gård project was to develop good standard solutions of roof integration of PV in the existing buildings with focus on cheap and good architectural solutions. Another very important part of project was to add new large apartments in the attic (approx. 100 m<sup>2</sup>– see picture).

The results turned out be good. The PV systems performs now electrically as expected based on the actual conditions.

### Renovation concept

#### Key renovation features

- Efficient heat recovery and exhaust ventilation with low electricity use
- Extra insulation
- Low energy windows
- Water savings domestic hot water
- PV electricity for ventilation
- Pre-heating of ventilation air through PV modules
- Low temperature heating
- District heating from combined heat and power plant

## State-of-the-art

### Before renovation

#### Constructions [U-values: $W/m^2K$ ]

- Roof [0,4]
- Façade [0,45-0,55]
- Cellar [0,4-0,5]
- Windows [2,8]

#### Installations

- District heating boiler room

### After renovation

#### Constructions [U-values: $W/m^2K$ ]

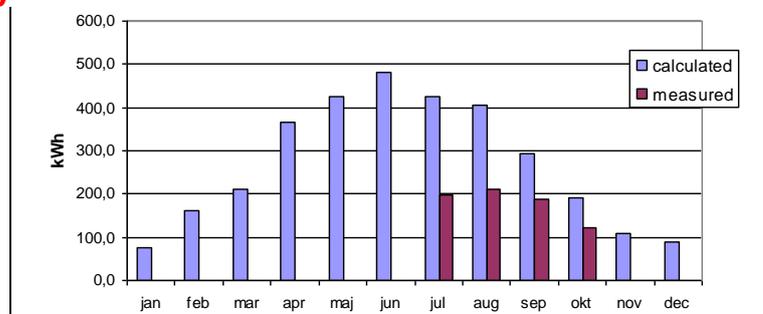
- Roof [0,]
- Façade [0,1]
- 
- Windows [1,1]

#### Installations

- Central heating and DHW system
- PV, heat recovery, pre heating of ventilation air, solar collector
- District heating from combined heat and power plant

## Energy saving and monitoring

New heat demand	134 kWh/m <sup>2</sup> a
Specific energy savings	40 kWh/m <sup>2</sup> a
Overall district heating savings	30-40 %
CO <sub>2</sub> -savings	68,0 t/a



Calculated and measured PV production in 2002.

## Additional information

- The PV modules are cooled by the ventilation air; this improves the efficiency of the PV modules.
- The preheated air is used in the ventilation system, thereby reducing the need for heating in the periods where there is sufficient sunshine.
- The electricity from the PV-panels is used for the ventilation system, thereby it is possible to install or improve a ventilation system and only increase the overall electricity consumption slightly.
- A heat exchanger with an efficiency of 80-85 % is used in this system. Furthermore low energy DC ventilators are used. These have an energy consumption of about 30 W per apartment, which is a reduction of 66 %, and on an annual basis this gives electricity savings of about 500 kWh per apartment compared to normal.
- The inlet air will be preheated behind a so-called Canadian Solar Wall, located on the roof. The Canadian Solar Wall consists of a metal plate with very small holes and an air-gap behind. The air is let in through the holes and thereby the heat energy just in front of the plate and in the air-gap is transferred to the inlet air.
- On some of the Solar Wall areas, PV solar panels are installed, delivering electricity to the ventilation fans. Since the electricity consumption per apartment is very small, about 1 m<sup>2</sup> crystalline PV modules per apartment is sufficient.

## Lessons learned and conclusions

It was in practice difficult to obtain a good enough air tightness of the apartments, especially in the roof top. Bad quality of ventilation works gave some problems in the beginning.

## References

[1] Cenergia Energy Consultants: "Tagintegration af solceller med tagpap-undertag og forvarmning af ventilationsluft i solceller" Energistyrelsens j.nr.: 51181/01-0013.