The Inspektoren Residential Area

Work Package 4.1

Kalmarhem Ltd

Electricity and Energy

– Report –

Kalmar, Sweden 2002

Kalmarhem Ltd – Scandiaconsult Sverige AB – BRa VVS Konsult AB – Graninge Småländsk Energi

CONTENTS

1. GENERAL

The Inspektoren area constitutes a rather typical residential area from the post-war era. The area, now under the administration of Kalmarhem AB, was completed in 1956 and consists of five three-storey buildings containing in total 159 flats with a living area of approximately 7000 m^2. The total land area amounts to some 15 700 m^2. Kalmarhem AB has carried out a total renovation of the residential area.

The overall goal for the Inspektoren area was that the refurbishment should be executed with as much consideration as possible given to economy of natural resources in addition to the fulfilment of Kalmarhem's residential policy. Planning and execution of the refurbishment took place in close consultation with the residents.

A number of different technical system solutions were studied in the pre-construction phase.

All the basic consumption parameters and their respective environmental factors were measured within the framework of a particular measurement group with the aim of evaluating conditions in the area.

2. ASSUMPTIONS

The following material has been used as a basis for the current investigation and the calculations involved:

- Measurements derived from the comfort account system
- Measurement of district heating consumption
- Measurement of electricity consumption
- Measurement of solar collector system
- Measurement of heat pump system

2.1 Goals related to electricity and energy consumption

The following goals were set up for the refurbishment of the Inspektoren area regarding electricity and energy consumption:

- To decrease electricity consumption in flats and common installations in the property to 45 kWh/m^2 per year.
- To decrease energy consumption of purchased energy for transmission + ventilation + hot water to 145 kWh/m^2 per year.

The following goals were set up before the refurbishment regarding the heat pump system and the solar collector system:

- *Heat pump system*: savings of approximately 38% of the heating requirements for transmission and ventilation via exhaust air heat pump system. Savings of around 429 000 kWh purchased energy per year.
- *Solar collector system*: Savings of about 186 000 kWh purchased energy per year

3. ELECTRICITY AND ENERGY SYSTEMS

3.1 External supply systems to Inspektoren area

3.1.1 Electricity system

Agreement

The electricity supplier to the Inspektoren area is Sydkraft. Kalmarhem has signed an agreement with HBV on behalf of all residents and for electricity to the property.

The various parts of the supply of electricity from Sydkraft are illustrated below:

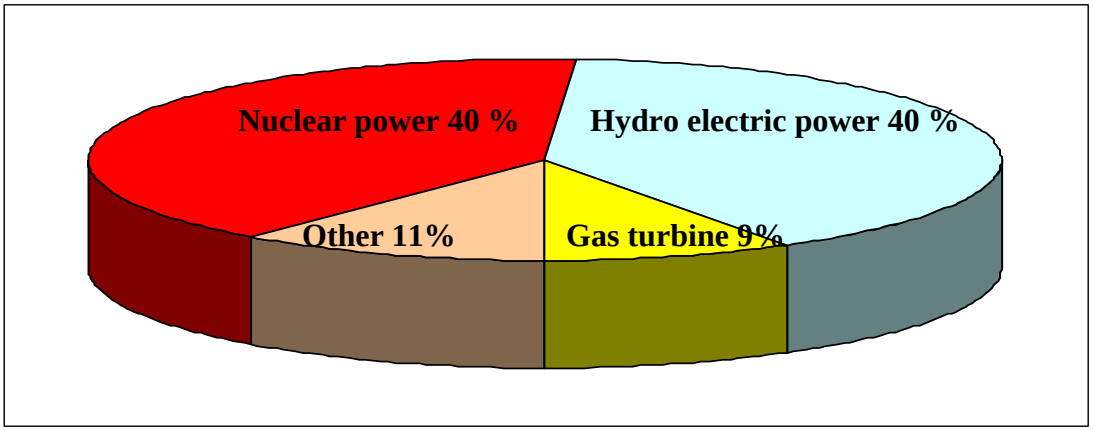

Figure 1: Production sources of electricity

City electricity grid
The grid owner inside Kalmar city limits is Graninge Kalmar Energi.
Power supply to the Inspektoren area is through electricity cubicles to each residential building.

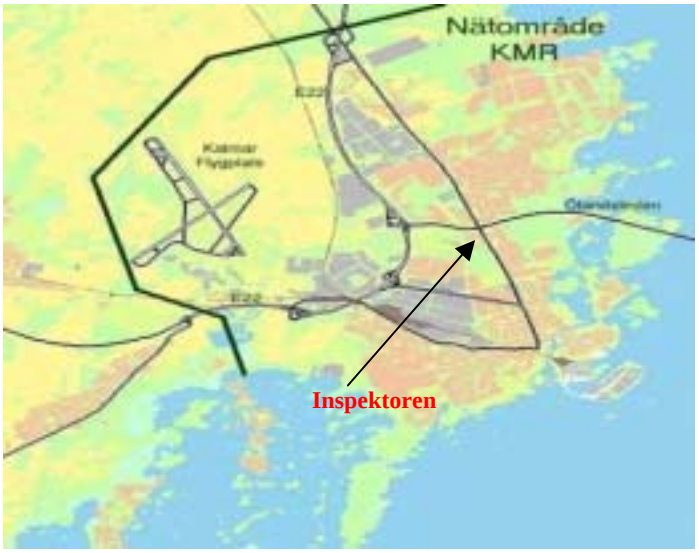

Figure 2: Grid area covered by Graninge Kalmar Energi

3.1.2 Energy systems

The Inspektoren area has been connected to the district heating network since the mid-1970's.

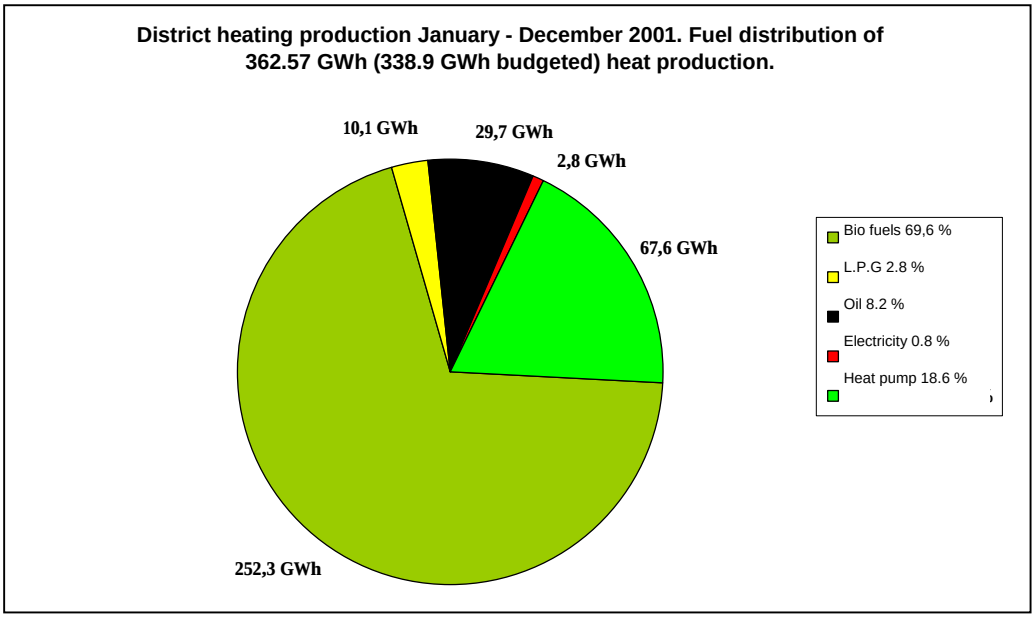

Figure 3. Fuel distribution for district heating

3.2 System construction in the Inspektoren area

3.2.1 Previous electricity and energy systems in the Inspektoren area

Existing electricity system

Power supply in the Inspektoren area was installed in connection with the construction of the buildings in the mid-1950's.

The system is constructed around distribution centres in the basements of each building. Electricity meters were installed in each flat and also for the communal property consumption.

Tenants signed their own agreements with the electricity suppliers.

Lighting was mainly by incandescent lamps and to some extent fluorescent tubes of the older type.

Existing heating system
Hot water was centrally produced in the existing district heating sub-station, installed in the mid-1970's, located in building 3. A heat exchanger was installed in the sub-station for the production of radiator water and hot tap water. The sub-station is connected to the municipal district heating network. Secondary culverts consist of concrete pipes for the distribution of heating and domestic hot water to the other buildings, these installed in the mid-1950's. Secondary heating systems of the same installation year consist of a closed, twin pipe radiator system with thermostat regulated radiators commissioned in accordance with the Kiruna method.

Pipe material in the secondary heating system is threaded steel pipe SMS 326 up to 40 mm and steel pipes SMS 1880 from 50 mm upwards.
The pipe material in the domestic hot water system is copper.

Existing ventilation system
Mechanical, type F with one central fan in a chamber per building. Supply air is through fresh air ventilators under the windows. Installation in mid-1950's.

3.2.2 Electricity and Energy Systems in the Inspektoren area after refurbishment

Electricity system
All electricity systems were replaced during the refurbishment.
Individual metering for each flat was retained.
There is also metering of electricity consumption for communal property and heat pumps.

The requirement for accessibility to the flats was set at 70%. To achieve this, lifts were installed in eight of the 17 staircases in the area.

Heating system
The heating sub-station connected to the municipal district heating network has undergone complete modernisation, which means the following replacement of materials:

- New prefabricated flat plate heat exchangers for radiators/ventilation and domestic hot water
- Closed system expansion chamber
- New electric fittings for shutting off/commissioning
- New culverts of PEX type, Maxitherm brand, between buildings
- New secondary heat pipes, dimensions from 10 – 50 mm, annealed galvanised steel pipes, Mannesmann brand.
- New insulation, mineral wool with reinforced plastic surface layer
- New radiators, Epecon Modul brand, with new thermostat valves, MMA brand, with maximum limits
- In bedrooms and living rooms, new supply air units with supply air chambers including filters to take in exterior air, filtered and draught-free.
- An exhaust air heat pump system has been installed to produce background heat for the radiator system
- Solar collectors have been installed to produce background heating for the domestic hot water system
- New electronic regulation equipment, INU brand, has been installed for central control monitoring of all communal systems in the buildings, connected to Kalmarhem's main computer.

Ventilation system
- Mechanical exhaust air type F with supply air units. New duct system using spiroducts in galvanised sheet steel.
- One governed exhaust air fan with heat exchange battery installed in the fan room in the attic of each building.
- In bathrooms and wardrobes, exhaust air vents of the check valve type.
- In kitchens, hoods above cookers with timer-controlled dampers for forced draught, plus inbuilt fluorescent tube lighting and filters.

Heat Pump System
After exhaustive studies, cost estimates, environmental evaluations and experience of exhaust air heat pumps in earlier Kalmarhem houses, it was decided to install an exhaust air heat pump system. From past experience the decision was taken that the exhaust air heat pump would only be connected to the background heating for the secondary radiator system.
Three heat pumps for indoor use, Carrier brand, type 30SM 036 with cooling medium R134A, were selected.
Using heat exchange from exhaust air, it is calculated that 38% of the heating needs for transmission and ventilation could be produced from the exhaust air heat pump system. In round figures this means that the proportion of purchased district heating could be decreased by 615 000 kWh per year. The operating costs for electricity to the heat pumps is estimated at 186 000 kWh for the same period.

Solar collector system
After exhaustive studies, cost estimates and environmental evaluations of solar collector systems, it was decided to compare the three most interesting systems manufactured by TeknoTerm, Solonor and Viessmann.

Table 1: Comparison of solar collectors – savings etc.

Parts/Manufacturer	**TeknoTerm**	**Solonor**	**Viessman**
Solar collector	300 m²	240 m²	67,5 m²
Accumulator tanks	18 m³, place build	12 m² (3x4 m³)	6,5 m³ (12x0,5 m³)
Estimated savings	156 000 kWh	80-100 000 kWh	186 000 kWh 6300 I 45°C/day
Cost *	About 632 000 SEK (69 942 Euro)	About 340 000 SEK (37 627 Euro)	About 640 572 SEK (70 891 Euro)
Payback time (0.45 SEK/kWh)	About 9 years	About 7,6 years	About 7,6 years
Water content	About 1 500 litres	About 1 200 litres	About 115 litres

*Price is 1998, excluding installation

After evaluating the three above systems it was decided to install a solar collector system manufactured by Wiessmann: the Tubusol model, incorporating vacuum tube collectors. This technology was relatively new on the Swedish market at the time. The collectors are both more compact and efficient than the alternatives compared.

Lifts
Measurements were made of the energy consumption of two lifts.
The figures below illustrate the energy consumption of two lifts over a six-month period.

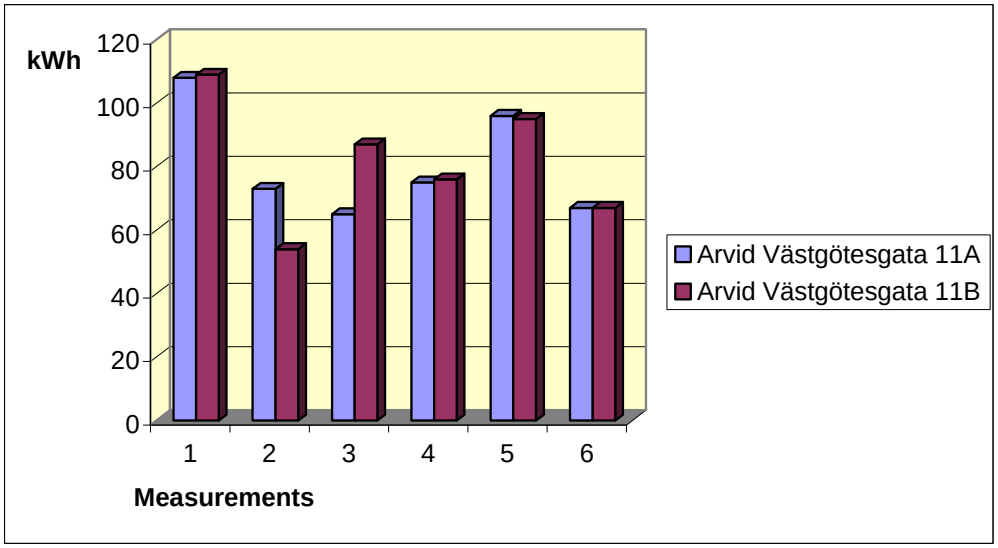

Figure 4: Electricity consumption of lifts per month

The total energy purchased after refurbishment of the area decreased to the set goals.

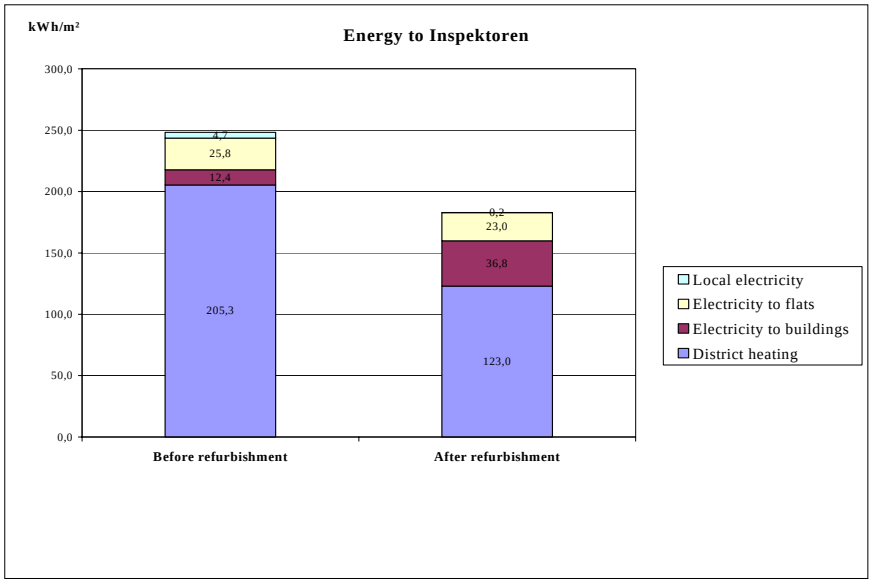

Figure 5: Energy consumption figures for flats and buildings

3.3 Comfort Account System

Function: The heating comfort in each separate room in the flats is registered in an electronic unit where consideration is given to various factors including insulation, room size and exterior temperature, all of which are needed to obtain an average comfort value for each flat.
This value is processed in a central computer program where the cost for the degree of comfort results in a price in SEK, which is either negative or positive in comparison with a comfort value assigned to the building.
Sensors are used to measure the consumption of hot and cold water and are connected to the above system.

After the above systems were installed in 1997, energy consumption in houses built in the 1960's is around 128 kWh/m^2 per year, compared with the normal value of about 160 kWh/m^2 – and this with satisfied tenants!

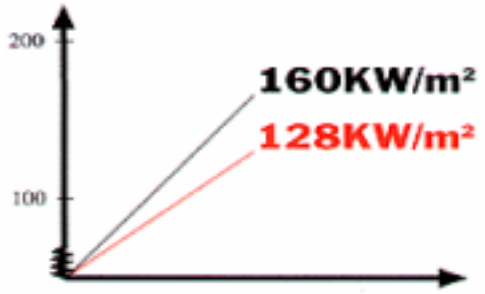

Figure 6: Savings figures for the comfort account system.

4. DISCUSSION

Energy consumption in a residential area is of course influenced to some extent by the residents.
It can be stated that the total energy consumption in the Inspektoren area has decreased.
The installation of heat pumps for energy recovery from exhaust air in flats effectively reduces the district heating consumption.
The installation of heat pumps, lifts and ventilation systems inevitably increases the consumption of electricity but the total energy consumption was reduced by around
65 kWh/m^2 per year.
Electricity consumption in the flats also decreased, thanks to the installation of new low-energy white goods.

Solar collector system
A short time after putting the solar collector system into service there were a number of break-downs.
See control report dated 04/06/00 draw up by BRa VVS-konsult AB and VVS-konsult – Appendix 1.
See special report – Appendix 2.

As a result of this investigation the system will be purged and temperatures secured and fulfilled using the new cooling medium of type TYFOCOR LS. This will take place in spring 2002. Measurements of energy savings through the use of solar collectors will subsequently be resumed.

5. SUMMARY

The goals set up before the refurbishment for energy consumption in the area have been fulfilled. Energy purchased in the form of district heating and electricity for the flats and the communal parts of the buildings amounted to approximately 250 kWh/m^2 per year. We can now state that the total energy purchased after the refurbishment is 183 kWh/m^2 per year. The goal set was to achieve a decrease of energy purchased to 190 kWh/m^2 per year.

To this should be added further savings made through the use of the solar collector system when it is up and running.

Kalmar, Sweden 2002

Kalmarhem AB
Lennart Holm

Scandiaconsult Sverige AB
Christer Forsberg

BRa VVS-Konsult AB
Bengt Persson

Graninge Småländsk Energi AB
Gert-Ove Nilsson