Final Technical Report - EGC

Project

European Green Cities

December 2001

Project Reference Number: BU-1001-96

Title of project: European Green Cities - European - Global Renewable Energy and Environmentally Responsible Neighbourhoods and Cities

3 CONSTRUCTION, INSTALLATION AND COMMISSIONING

3.1 Suppliers of Equipment and Services

3.1.1 Abruzzo, Italy

Water solar collectors	CHROMAGEN - Lavagno (VR)
Modusat (solar system)	GEMINOX
Local storing heat exchanger	CAPITO
Condensing multicells furnace	GEMINOX
Heat meters	KUNDO
Thermostatic valves	CALEFFI
PV modules	CHROMAGEN-SIEMENS
EMS	RADIAX TEL

3.1.2 Brescia, Italy

Water solar collectors	CHROMAGEN - Lavagno (VR)
Heat exchangers	PACETTI - Pesaro
Tele-monitoring system	COSTER T.E. spa - Milano
Heat meters	COSTER T.E. spa - Milano
Water volumetric meters	COSTER T.E. spa - Milano
Ventilators	DYNAIR - Lonato (BS)
PVC frames (conservatories)	SOTECO srl (SALAMANDER) - Quarto D'altino (VE)
Security doors	CORMO - Castiglione D/Stiviere (MN)
External wall paints	RIVAL - Pove Del Grappa (VI)
External building insulation	RIVIS CO 86 (STIROMAT) - Desenzano (BS)
Thermal regulation system	LANDYS – Segrate (MI)

3.1.3 Copenhagen, Denmark

Solar heating system	Batec solvarme Danmarksvej 8 4681 Herfølge

Heat recovery unit	Ecovent Rudolfsgårdsalle 1b 8260 Viby
Solar PV modules	Gair Solar Hammerholmen 9-13 2650 Hvidovre

3.1.4 Grenoble, France

Solar collectors :	CLIPSOL ZI Trévignin 73100 Trévignin Tel : +33 4 79 34 35 36 Fax : +33 4 79 34 35 30
PV modules :	PHOTOWATT 35 rue Saint Honoré ZI Champ Fleuri 38300 Bourgoin Tel : + 33 4 74 93 80 20 Fax : + 33 4 74 93 80 40
Energy system management and maintenance:	Compagnie de Chauffage 25 Avenue de Constantine BP 2606 38 036 Grenoble cedex 2 Tel : +33 4 76 33 23 60 Fax : +33 4 76 40 18 92

3.1.5 Herning, Denmark

Suppliers of specialist equipment for the Herning project are as follows:

Solar Collector	Arcon Solvarme Jyttevej 1 DK 9520 Skørping.
Ventilation	HJ Ventilation Service A/S Storegade 64 DK 6052 Viuf
Energy monitoring	Danfos System Automatik (t.a.c.) Gunnar Clausens Vej 19 DK 8260 Viby J

3.1.6 Hulshout, Belgium

Building block 1

insulation of windows	Glaverbel 166 Chaussée de La Hulpe

	1170 Brussel
insulation of roof, walls and floors	Rockwool Industriepark Keiberg 3 1930 Zaventem
condensing boiler with integrated mechanical ventilation with heat recovery	Storck Vriesenrot 26 9200 Dendermonde
individual solar heating collectors	Izen n.v. Vredestraat 38 2600 Berchem

Building block 2

insulation of windows	Glaverbel 166 Chaussée de La Hulpe 1170 Brussels
insulation of roof, walls and floors	Rockwool Industriepark Keiberg 3 1930 Zaventem
condensing boiler	Viessmann Belgium Hermesstraat 14 1930 Zaventem
mechanical ventilation with heat recovery	Storck Vriesenrot 26,9200 Dendermonde
collective solar heating collector	Viessmann Belgium Hermesstraat 14 1930 Zaventem
energy management system	Landis & Staefa Oud-strijdeerslaan 190 1140 Brussels

Building block 3

insulation of windows	Glaverbel 166 Chaussée de La Hulpe 1170 Brussels
insulation of roof, walls and floors	Rockwool Industriepark Keiberg 3 1930 Zaventem
condensing boiler	Viessmann Belgium Hermesstraat 14 1930 Zaventem
mechanical ventilation with heat recovery	Storck Vriesenrot 26,9200 Dendermonde

3.1.7 Kuopio, Finland

Suppliers of specialist equipment are as follows:

Electrical installations	Are Oy Mestarinkatu 5, 70700 Kuopio
The lighting automation	Helvar Oy PL 55 00381 Helsinki
The occupancy seasors	Elmika Oy/Visonic Ltd Isr Masalantie 375 02430 Masala
The solar panels	Neste Advanced Power Systems Oy (NAPS) PL 20 02151 Espoo
The access control	Kaba Låsbolaget Ab PL 15 00801 Helsinki
Heat exchanges	LMP-Group Oy Ldt PL 19 79101 Leppävirta
The pumps	Kolmeks Oy Ab PL 2 01741 Vantaa
The radiators	Retting Lämpö Oy PL 16 68601 Pietarsaari
Blowers	Koja Oy PL 351 33101 Tampere
Kitchenventilation equipments	Halton Oy Niittyvillankuja 4 01510 Vantaa
Ventilators	Halton Oy Niittyvillankuja 4 01510 Vantaa
Glycol LTO-eguipments	Oy Retermia Ldt Paininpuuntie 17 18100 Heinola

Building automation	Atmostech Oy Hiihtäjäntie 11 70200 Kuopio
Cooling eguipments	Kylmäntekijät Ky Ajajantie 3 70780 Kuopio
Windows	Fenestra Ltd 30420 Forssa Finland

3.1.8 Portsmouth, GB

Suppliers of specialist equipment are as follows:

Building Energy Management System (BEMS)	Caradon Trend Limited PO Box 34, Horsham West Sussex RH12 2YF - UK Tel: +44 (0)1403 211 888
Combined Heat and Power (CHP)	Enviropower Ltd Unit 6A, Lodge Way Severn Bridge Industrial Estate Caldicot, Gwent NP6 4TH - UK Tel: +44 (0)191 421 411
Ventilation & heat recovery unit	AirVex Denmark Rudolfgaardsvej 1b 8260 Viby J – DK Tel: +45 7023 1077
Solar collectors	BATEC A/S Danmarksvej 8 4681 Herfølge - DK Tel: +45 5627 5050
Photovoltaic Array	Solarpak Intersolar Group Magdalen Centre The Oxford Science Park Oxford OX4 4GA – UK Tel: +44 (0)1865 784 670
Water saving - WC	Armitage Shanks Armitage Rugeley Staffordshire WS15 4BT – UK
Windows	Futuremost Robinson Way

	Airport Industrial Estate Portsmouth Hampshire PO3 5SA – UK
Wall Cladding	Alueobond C.E.P. Cladding Division Verulam Road Staffordshire ST16 3EA – UK
Solar DHW tank	Batec Solvarme Aveat Heating Ltd Lambert House 7 Driberg Way Braintree Essex CM7 7NB – UK
Boilers	Wellman Robey Ltd Newfield Road Oldbury, West Midlands B69 3ET - UK Tel: +44 (0)121 552 3311

3.1.9 Radstadt, Austria

The name of the suppliers of the equipment and services are as follows:

Water	Fa.Präauer Salzburgerstraße 6 5600- St. Johann / Pg.
Heating	Fa. Dolschek 5541 - Altenmarkt/Pg. 21
Electricity	Fa.Kurt Schilchegger 5531-Eben/ Pg.

3.1.10 Vilanova, Spain

Solar collectors for DHW and water tank	Manufacture: SAUNIER DUVAL C/ Botànica, 57-61 08908 Hospitalet de Llobregat, Barcelona Supplier: SOLARING Avda. de la Pineda, 2 08860 Castelldefels, Barcelona
External walls with low-k bricks (microporous)	Manufacture: Consorcio Termoarcilla C/ San Bernardo 22, 1ª 28015 Madrid Supplier: Ceràmiques Llinars S.A. Carretera Sant Celoni s/n 08450 Llinars del Vallès

Double glazing (Climalit)	FUSTERIA MOYA	Prolong. Agricultores Sector Norte C/B 08800 Vilanova i la Geltrú, Barcelona
Indoor eco-labelled Paint	ORBLAN, S.L.	Pol. Ind. Can Roqueta Avda. Can Camps, Nau 9 08202 SABADELL, Barcelona
Double flush toilet	Manufacture: ROCA Supplier: S/A BIOSCA	Rambla Lluch 2, 08850 Gavà, Barcelona Ronda Europa, 69 08800 Vilanova i la Geltrú, Barcelona
Mono-control mixer taps with air system and water flow regulator.	TRES	Calle del Parque, S/N. 08739 Ordal, Barcelona
Natural gas boiler Model MICRA	SAUNIER DUVAL	C/ Botanica, 57-61 08908 Hospitalet de Llobregat, BCN
Wiring system	GUERIN SA	Passeig Zona Franca 137-139 Local 3, 08038 Barcelona

3.1.11 Volos, Greece

For Tsalapatas building the contractors are:

We do not have a list of suppliers for things been done , we only have the names of contractors (builders) that did the work.

For Tsalapatas building the contractors are:

Name of company	IASON TECHNIKI S.A.	FILIPPOS GESKOS	K. KALAMPOYKAS-D.TSOLIS
Contact person	PAPAIOANNOY IOANNIS	FILIPPOS GESKOS	D. TSOLIS
Address	SKOYFA 60, ATHENS	SOKRATOUS 28, VOLOS	AG. NIKOLAOY 103, VOLOS
Tel	+3010 3610633	+304210 31309/21646	+304210 52667
Fax	+3010 3630679	+304210 21646	+304210 48734

For ENERGY CENTRE building the contractor is:

Name of company	TECHNIKI THESSALIAS Ltd
Contact person	KARAGIANNIS NIKOLAOS
Address	SOFOKLEOYS 32
tel	+304210 35027
fax	+304210 21539

3.2 Project Management

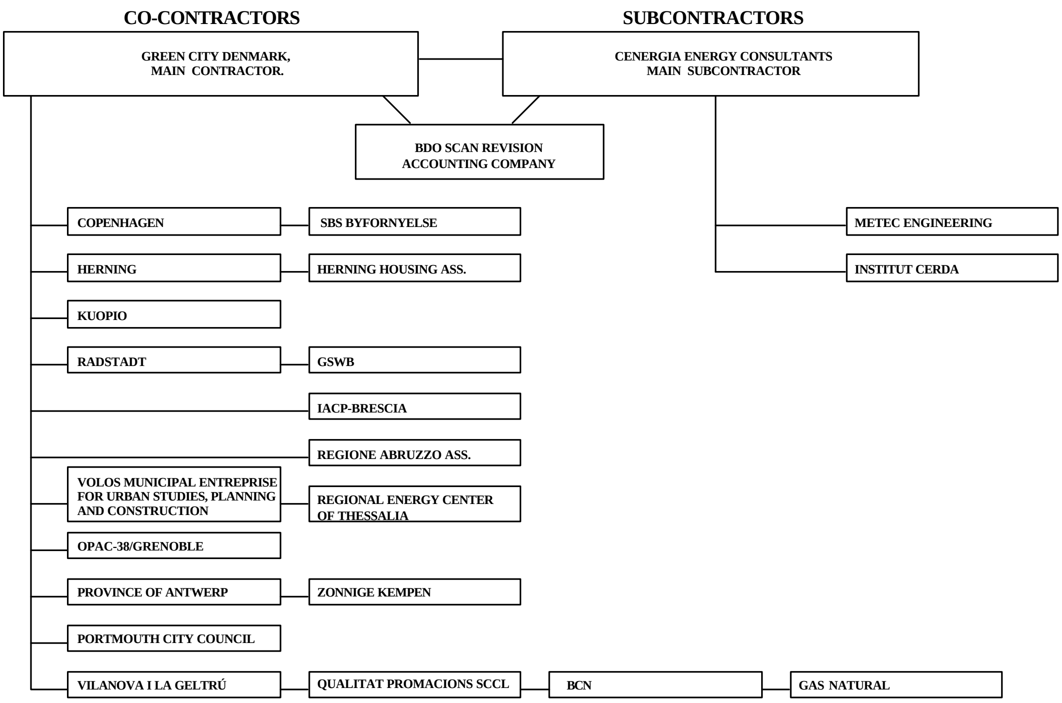
After consultations with the European Commission a management structure as described in figure 3.5.1. was agreed. This means that the involved cities and builders were all contractors with Green City Denmark as coordinator.

Cenergia was main subcontractor, responsible for the technical coordination and working in cooperation with Metec Engineering and Institut Cerda.

All important decisions should be made by the steering committee which included all the contractors, while day-to-day organisation was taken care of by the management team.

To reduce the burden of taking care of too many projects is was agreed that Cenergia should take care of the projects in Copenhagen, Herning, Kuopio, Portsmouth and Houtvenne while Metec took care of Abruzzo, Brescia, Grenoble and Radstadt and Institut Cerda dealt with Vilanova y la Geltru and Volos.

EUROPEAN GREEN CITIES - MANAGEMENT STRUCTURE



ALL CONTRACTORS AND SUBCONTRACTORS ARE MEMBERS OF THE STEERING COMMITTEE OF THE TARGET PROJECT.
MANAGEMENT TEAM: GREEN CITY DENMARK, CENERGIA ENERGY CONSULTANTS, METEC ENGINEERING, INSTITUT CERDÁ.

Figure 3.1

The experience has been that this has proven to be an efficient way to manage the project.

It has however at the same time also been our experience that there are many obstacles when realising such a large project.

One important experience is that it is very important with clear agreements in detail about what the involved local partners shall supply at what time.

At the same time it is important to ensure that each local team includes all the necessary expertise e.g. including monitoring and that the people responsible for this has some power to ensure that such parts of the project are taken seriously.

Partner meetings and meetings in the European Green Cities Thermie target project – steering committee are listed below. Minutes of the steering group meetings can be found in the technical reports.

20-22 May 1997	*Copenhagen*
	Starting meeting of the European Green Cities project at the city hall of Copenhagen.
26-27 January 1998	*Vilanova y la Geltru*
	Partner meeting focussing on horizontal activities like solar energy design, indoor air climate and healthy building materials, total economic optimisation and environmental assessment.
17-19 September 1998	*L'Aquila, Abruzzo*
	Technology Transfer Forum with presentation of best available technologies in cooperation with Metec.
20-24 March 1999	*Copenhagen/Herning*
	Training meeting focusing on how to introduce sustainable building and urban ecology planning in the cities.
11-12 October 1999	*Radstadt/Salzburg*
	Meeting with focus on low-energy housing in cooperation with SIR.
1-3 October 2000	Kuopio
	Final partner meeting with focus on finalising the training process, giving recommendations, continuation of the Green Cities cooperation and ending the project.

Final partner meeting with focus on finalising the training process, giving recommendations, continuation of the Green Cities cooperation and ending the project.

A large number of management team meetings have also be held in addition to the steering committee meetings.

June 9, 1997 – Copenhagen

October 10, 1997 – Brussels

December 12, 1997 – Brussels

March 27, 1998 – Brussels

May 5, 1998 – Brussels

May 29, 1998 – Lisbon (speech by Jens Frendrup at EU-meeting).

The organisations of the EGC Project consists of a management team:

Green City Denmark A/S – administrative coordinator

The Danish Ministry of Industry in cooperation with the Ministry of Energy and Environment initiated project ”Green City Denmark” to establish a showcase for Danish expertise within energy and environment – based on 20 years of environmental legislation and the connected environmental improvement research & development, education, etc. Green City Denmark is organised as a limited liability company with at present 222 shareholding companies, municipalities, counties, institutions, etc. from all over Denmark.

Cenergia Energy Consultants – technical coordinator

Cenergia Energy Consultants are consulting engineers specialised in energy saving technologies for building and utilisation of solar energy. Cenergia has initiated several major building projects in Denmark; demonstrating total energy designs with combined use of energy conservation, solar energy utilisation and energy efficient heat supply systems.

Institut Cerdá

Institut Cerdá is a private non-profit organisation, situated in Barcelona, which carries out applied research work in four different areas: telecommunications, logistics, environment and energy.

Metec Engineering

Metec Engineering situated in Torino works in the field of technological plan design and it treats research and development activities with own or customer’s ideas.

3.2.1 Abruzzo, Italy

Builder	ATER L’AQUILA (Public Housing Association)
Building contractor	Salvatore & Di Meo snc - Sulmona - Capogruppo - ANC ctg: 5H Zappa Benedetto Srl – Sulmona - ANC ctg.: 5H

	Sin Siteco srl – L'Aquila - ANC ctg.: 5°
	F.lli Franceschini srl - ANC ctg.: 5F1
Work supervision	Ing. Antonio Ponticiello
	Ing Pietro Centofanti
Design	Ing. Antonio Ponticiello
	Ing Pietro Centofanti
Project Responsible	ATER Technical Office: Arch. Manfredo Nanni Ing. Ugo Lepidi Geom. Antonio Viola

3.2.2 Brescia, Italy

The project involved the following local Authorities and consultants:

- ALER Brescia
- Municipality of Brescia
- Local Sanitary Company
- ASM Brescia (local energy utility)
- METEC ENGINEERING (Torino)
- Univerisity: Politecnico di Milano

Building contractor	A.B.P. NOCIVELLI – CASTEGNATO (BS)
Work supervision	ALER BRESCIA – Arch. Roberto SCARSI
Plant system design	METEC ENGINEERING - TORINO
Architectonic design	ALER BRESCIA – Arch. Ivan A. CIOCCHI
Project Responsible	ALER BRESCIA – Arch. Ivan A. CIOCCHI

3.2.3 Copenhagen, Denmark

Tøndergade/Sundevedsgade

Builder	Local shared ownership organisation/SBS
Contractor	Gregersen
Architect	C.F. Møller
Consultants Engineer	Cenergia
Energy Consultant	Cenergia Energy Consultants

Tøndergade 3-3A

Builder	A/B Lille Fryd Tøndergade 3-3A DK-1752 CopenhagenK
Contractor	

Architect	Alex Rosendals Tegnestue Willemosegade 61 DK- 2100 CopenhagenØ
Consultants Engineer	Fakon Falkoner Allé 54 DK-2000 Frederiksberg
Energy Consultant	Cenergia Energy Consultants

Sundevedsgade 26-28

Builder	SBS
Contractor	Høpfner & Co a/s Nordkranvej 5-9 DK-3540 Lynge
Architect	Arkitektgruppen København a/s, Charitianshavn Kanal 4 DK-1406 Copenhagen
Consultants Engineer	Erik K Jørgensen Kronprinsessgade 20 DK-1306 Copenhagen
Energy Consultants	Cenergia Energy Consultants Sct. Jacobs Vej 4 DK-2750 Ballerup

Byskoven

Builder	Dansk Boligselskab
Architect	Arkitektfirmaet 78 a/s, Østergade 13 6230 Rødekro
Energy Consultants	Cenergia Energy Consultants Sct. Jacobs Vej 4 DK-2750 Ballerup

3.2.4 Grenoble, France

Builder and main contractor :	OPAC 38 Mr GIBERT 47 Avenue Marie Reynoard BP 2549 38035 Grenoble Tel : +33 4 76 20 51 40 Fax : +33 4 76 20 51 47
Architect :	DUO Ms GIACOMETTI Centr'alp 137 rue Mayoussard 38430 Moirans Tel : +33 4 76 35 19 19 fax : +33 4 76 35 19 18

Consultant :	GTI Mr DAVID 141 rue des Alliés 38100 Grenoble Tel : +33 4 76 70 12 62 Fax : +33 4 76 21 86 66
Economist :	BETREC Mr CROCHET 24 bis rue de la Chantourne 38 706 La tronche Tel :+33 4 76 42 17 27 Fax : +33 4 76 42 85 28

3.2.5 Herning, Denmark

Builder	Herning Boligselskab
Architect	Kristian H. Nielsen Tingvej 28 DK 7400 Herning
Consultants Engineer	Rambøll Fredensgade 14-18 DK 7400 Herning

3.2.6 Hulshout, Belgium

The project management:

builder	Zonnige Kempen cv. Grote Markt 39 2260 Westerlo
architect	E. Maes Sint Niklaasstrat 25 2260 Westerlo
engineering	engineering office J.Daenen Gloriantlaan 12 3060 Bertem
main contractor building	Moons NV Hasselsebaan 73 3940 Hechtel
main contractor technologies	F. Geuvers A. Nijsstraat 7 3052 Blanden

3.2.7 Kuopio, Finland

Architects and contact persons:

Architecture planning	Qvick Arkkitehdit Oy Puijonkatu 29 A, 70100 Kuopio puh. (017) 262 8334, fax (017) 262 8335 Contact person: Jouni Ilmarinen
Structural planning	Rakennussuunnittelutoimisto Sormunen & Timonen Oy Jäniksenpolku 23, 70400 Kuopio puh. (017) 364 4000, fax (017) 364 4010 Contact person: Hannu Sormunen
Duct and ventilation planning	OK-Talotekniikka PL 189, 70101 Kuopio puh. (017) 288 2882, fax (017) 282 3729 Contact person: Osmo Karhunen
Electric planning	AH-Talotekniikka PL 189, 70101 Kuopio puh. (017) 288 2882, fax (017) 288 2880 Contact person: Aulis Kananoja
Site investigation	Kuopion kaupungin tekninen virasto Mittausosasto Suokatu 42, 70110 Kuopio puh. (017) 185 111, fax (017) 185 010 Contact person: Jorma Rusanen
Users representative	Esko Parkkinen, koulutuspalvelukeskus

Contractors and contact persons:

Construction contractor	Polar-Rakennus Oy/Korhonen Aseveljenkatu 4, 70620 Kuopio puh. (017) 261 7511, fax (017) 263 1612 Contact persons: charging supervisor Pauli Lappalainen, puh. (017) 363 5173, 050 620 72 and Project Manager Tarmo Stjerna, puh. (017) 353 174
HV-contractor	Are Oy Mestarinkatu 5, 70700 Kuopio puh. (017) 361 1430, fax (017) 361 2530 Contact person: Jussi Kupiainen, puh. (017) 552 7071
Ventilation contractor	Ilmapörssi Oy Puijonkatu 9 B 20, 70100 Kuopio puh. (017) 262 4500, fax (017) 262 4600 Contact person: Pekka Hotti, puh. 0500 277 773
Electric contractor	Are Oy Mestarinkatu 5, 70700 Kuopio puh. (017) 361 1430, fax (017) 361 2530 Contact person: Hannu Tuomainen
Building automation contractor	Atmostech Oy Hiihtäjäntie 11, 70200 Kuopio puh. (017) 282 5975, fax (017) 282 5979 Contact person: Mauri Rytkönen
Fixed-furniture contractor (manufacturing)	M-Erikoiskaluste Oy Sähkökierto 4, 70900 Toivala

	puh. (017) 465 2211, fax. (017) 465 2124 Contact person: Lauri Keinänen

3.2.8 Portsmouth, GB

Project management: Portsmouth City Council – City Engineers

Client	Portsmouth City Council – Housing Services
Architects	Portsmouth City Council - Architects
Quantity Surveyors	Portsmouth City Council – Engineering Consultancy
M & E Engineer	Merz Orchard, London
Main Contractor - Builder	Connaught Ltd

3.2.9 Radstadt, Austria

Project partners

Public administration	The municipality of Radstadt (contractor)
Housing association	Gswb - nonprofit housing association Salzburg Ignaz-Harrer Strasse 84 5020 Salzburg / Austria
Project managment and coordination	SIR - Institut for urban planning and housing Salzburg Alpenstrasse 47 5020 Salzburg / Austria
Architect	Arch. Hanns Peter Köck Brandstättengasse 1 5760 Saalfelden / Austria
Consultants engineers	TAP - technical planning and design Seegasse 2 5700 Zell am See / Austria
Consultants physics and noise-protection	Reiner Rothbacher Am Schilf 15 5700 Zell am See / Austria
Energy Consultants	Dr. Manfred Bruck + Dr. Harald Koch 1010 Vienna / Austria

3.2.10 Vilanova, Spain

Project partner

Public administration	The Municipality of Vilanova (Contractor)
Developer in Vilanova	Qualitat Promocions SCCL (Contractor)
Consultants and Local Project Co-ordinator	Institut Cerdà (Associate Contractor)
Architects and engineering	BCN Cambra Lògica de Projectes SL (Associate

	Contractor)
Gas utility	Gas Natural SDG, S.A. (Associate Contractor)

3.2.11 Volos, Greece

DEMEKAV is the owner of the buildings and the company that carry out the whole project.

3.3 Problems, Solutions and Successes

3.3.1 Abruzzo, Italy

The differences from the original project concern the water saving and electricity saving equipments that they haven't been installed because the realization of a more efficient EMS was preferred. Moreover the heater cable foreseen to avoid the risk of ice of the distribution pipes was substituted by a cheaper use of an anti-freeze fluid.

During the year 2000 the EMS was implemented and tested: preliminary data about energy consumption and about solar energy contribution have been measured and they appeared according to the foreseen hypotheses.

3.3.2 Brescia, Italy

The construction phase started on 24/12/1998 but it at once stopped because of the winter season and because ALER of Brescia had some problems to obtain the building permission from the Municipality of Brescia as far as the closure of the loggias and the displacement of the thermal power plants concerns:

- Difficulty to obtain the permission from ASL (Local Sanitary Company) to close the loggias because of a local regulation;
- Necessity to aquire three public areas in order to realise three new rooms where to locate the solar local storing heat exchangers and to move the heat exchangers connected to the district heating network for the heating space.

In fact, the project foresaw to realise the two following interventions:

- the existing loggias on the south facade have been equipped with external windows frames in order to create a sun-space for the winter season and to have a consequent improving of thermal comfort of the near living room. During summer period, the conservatory can be completely opened and are in function darkening systems.
- two local storing heat exchangers have been installed in three common rooms at the first floor of each block, supplied by district heating, during winter, and by solar system during the summer period. The local storing heat exchangers serve all the apartments of the related block. The heat exchangers supplying the heating space system and connected to the district heating network have been moved in the same rooms.

These problems were solved after several months and the building permission concerning the above mentioned interventions was issued on 07/01/2000.

The main problem consisted in developing a project taking into account that the apartments are occupied by tenants. This is an important aspect that must be considered during the working phase especially during the realisation of the mechanical ventilation system and the installation of the new energy meter system.

In fact the designed mechanical ventilation system encountered some difficulties because of some problems regarding the opportunity to realise an individual system for each apartment or a centralised system for each building block.

It has been decided to locate the ventilators on the roof of the three buildings so as the solar panels.

Concerning the monitoring system and of the remote unit of tele-controlling, a little modification has been required by ALER of Brescia to the supplier in order to better manage the data acquisition system.

First data about energy consumption and about solar energy contribution have been measured and they appeared according to the foreseen hypotheses but the solar contribution appeared very different between the three building blocks. This required a check of the three solar plant systems.

3.3.3 Copenhagen, Denmark

Tøndergade 3-3A

There have been problems with the ventilation system. The noise level from the air inlet valves was too high during some periods. The fans on the loft caused the noise. Because of a special control system that modulate the amount of air inlet depending on the air flow through the PV-Modules. With small airflow the system make noise and vibration.

The PV installations had to fit into the design of the existing building. Furthermore the architect was interested in a uniform look of the building, which was not possible due to amount of PV modules to be installed. It was finally decided to use “dummies”, modules, looking like the others, but not connected. There have been some problems with the communication between the inverters and the monitoring computer, but these is solved by now.

Tøndergade/Sundevedsgade

The project includes a number of new technologies that are not common practice by renovation of buildings. Often this has meant that workmen do not have the necessary experience of the new technology and this has resulted in several slips during construction. It has not been taken sufficiently into consideration that the new technologies demand more space and this has meant that the installations are not very service available.

The heat supply consists of an internal district heating network, which is preheated by district heating via a heat exchanger and solar heating from the air solar collector on the roof. The internal district heating network supply radiators, floor heating, the hydraulic board and heating coils in the ventilation ducts. There are thus many different units with a control system each and then a higher risk of errors.

The hydraulic board has a complicated control system and due to dirt in the cold water, these installations have been blocked.

Sundevedsgade 26-28.

In the middle of the construction period the main contractor go bankrupt. It takes ¾ of a year to get a new contractor to complete the project.

The total water consumption is even lower then the 10 % reduction which was the aim of the project. The monitored months even show a reduction of 65 % comparing to the average. Due to the low total water consumption also the energy needed for hot water is reduced. Therefore the energy consumption for DHW is also reduce approximately 65 % comparing to the average.

The solar heating system performs very well. The differences between the predicted values and the monitored values can partly be explained by the good weather in this period.

In most cases the total heat consumption of the building is lower then the predicted values. This can partly be explained by the good weather in this period. Also the conclusion can be drawn that the insulation and solar gains working very well.

The electricity consumption turned out to be higher then predicted. This can be due to the fact that the laundry machines for common use are installed in the monitored network. Excessive use of these machines can lead to this high electricity use. Also the ventilation system and pumps use electricity. It would be nice to monitor the electricity use only for the technical installation. Unfortunately this has not been done.

The output of the PV-modules is in all months drastic lower then the predicted values. As shown in appendix 21. Even though the solar radiation in the monitored period is higher then in the test reference year. The low output of the solar cells could be due to the poor orientation of the modules and the shading, the shading on the due to the building is apparently very high. This factor has been clearly underestimated in the predictions.

3.3.4 Grenoble, France

The most important difficulty encountered has concerned the floor of the flat roof, which was too weak to sustain the thermal solar panels. The solution adopted was to realise a ridge roof on the part of the buildings where the thermal solar panels are to be installed. The structure of this ridge roof is shown on the photo below.

Figure 3.1: Photo of the project - Surieux. View from the ridge roof.

The automatic switching on and off of the lights in the communal spaces, in particular the entrances and the staircases, had to be disabled. It created a feeling of insecurity among the tenants as they had to approach a dark entrance, or where stepping out of their apartment into a initially dark hallway.

3.3.5 Herning, Denmark

The ventilated solar wall is expected to give some benefits to the temperature in the ventilation air, however not very much. It is very difficult to get exact measuring due to the construction, and therefore adjustments are not well founded.

The ventilation is by law meant to work 24 hours each day, but dwellers are annoyed by the noise and by the draught from the air inlets. Accordingly we this summer have established a timer, to overrule the revolutions in the ventilator system. The timer has been set to make the machine work according to our idea of the need in the building.

The solar cells on the roof produces a big amount of hot water in the summer, where the dwellers has a reduced need for room heating. This has caused an overheating of the system, why we have changed the set points for closing for circulation.

The water tank for rainwater is app. 11 m³, and too small. Further the settings for supplying domestic water; stop for supplying domestic water; and setting for alarm were not optimal. However our monitoring revealed this fault, and settings has been corrected.

Heating the apartments only by floor-heating, gives the inconvenience that dwellers in the small apartments not can change the room temperature within the hour, e.g. at bedtime, but it takes 4-8 hours. In the 2-rooms app. there is only one valve to set room temperature, so that bedroom not can be kept cooler than living room/kitchen.

3.3.6 Hulshout, Belgium

Because of lots of rain in autumn 1998, the buildings had some problems with flooding. The construction was delayed with several months. Concerning the installation of new technologies the following problems were encountered:

(1) Problems with the installation of the collective solar collector system of building block 2. Overpressure valve with too low pressure (3 bar) was installed. In case of high solar radiation, overpressure valve opened.

(2) Collective solar collector efficiency (building block 2) is to low (10% - 20% instead of 60%). A detailed analysis has to be made. Problems are probably due to too low flow in primary circuit (between collector and storage vessel) or to incorrect control settings.

(3) Too low air tightness of the air ducts in the building blocks.

3.3.7 Kuopio, Finland

The project has been a success in that the building is serving its purpose as a basic school. It is clear that as new technology is brought into a project, there are a fair number of problems especially during the initial period and quite a lot of co-ordination work has to be done at least during the first guarantee year. The following are some of the main problems and solutions found to them in various fields.

Heating, drawing, ventilation and building automation equipment

The biggest problem with the sewage piping work came up at the beginning, when it was found out that there is a natural spring under the building site with a flow rate of at least 0.5-1.0 l/s which needed attention. The solution was to install two pumps under the building with an alarm in case of function problems connected to the monitoring system.

Pressure peaks in the warm water pipes are common in this as well as in other buildings. This problem was addressed by developing a small membrane expansion vessel in connection with the water exchanger.

The ventilation equipment was installed according to plan. A problem occurred in the maintaining of duct pressure in a situation where there was a large load in one and/or two classroom wings (air volume at maximum level) and only on classroom elsewhere in the building needed more air either for maintaining the temperature or because of the CO2 concentration. There was a disturbing amount of noise due to rising duct pressure in the main duct. The problem was solved by remodelling the duct network system on the Master PC. As keeping the CO2 levels down in classroom air allows diminishing the maximum air volume by 15%, the maximum duct pressure in the main ducts could be lowered by about 30%. After these changes, the system has functioned without problems and the room temperatures and CO2 levels have been well under control.

As far as the building automation management system is concerned, there were no problems with the basic technology. The work was carried out according to plan.

Implementation of the LON network was laborious and caused problems because the field control readings and sensor readings arrived at the monitoring centre after a delay. To begin with, it was also difficult to read the follow-up usage parameters through the LON network. During the implementation period the clearest problem was that as equipment from several (three) suppliers was connected in the same segment of the system, those concerned tended to assume in problem cases that the fault lay with the equipment delivered by the other parties. Usually the fault was found to be in the components or programmes that were first suspected of being faulty.

The supplier of the locking system installed his equipment and programmes separately as ordered by the builder at a point when the instalment and implementation of the rest of the LON network had not been finished entirely. The change made in the programme structure of the system control PC computer rendered access control inoperable. There was also a faulty power source in the equipment. The supplier had no experts available in Finland and it was difficult to find anyone who would take responsibility for putting the system right.

However, the LON network equipment was repaired during the one year guarantee period, and there has been hardly any adverse feedback.

3.3.8 Portsmouth, GB

Two issues are considered as the main reasons why the completion of the project was delayed from the initial proposed schedule of August 1998:

1. Residential consultation resulted in a high number of families wishing to remain in occupation whilst the retrofit was carried out (66%). This immediately impacted on the way the contract could be managed.
2. Poor quality dry-packing concrete in the horizontal bedding joints questioned the large panel system structures ability to support the additional loads of the pitched roof proposed.

Advice from the Building Research Establishment (BRE) recommended that every joint should be inspected and repaired before any additional loading of the structure. This meant that as a high number of residents had chosen to remain in occupation that each flat had to be vacated for a time to carry out the inspections and repair.

The programming of resident's relocations and returning to their original flats resulted in 216 moves to be organised. 80 families within the block and 56 permanent relocations.

The original start to the contract was subsequently delayed 18 months until 15th May 2000 with completion programmed for end December 2000.

The rescheduled programme has been delayed further due to poor performance by the contractor and the project is not expected to be fully complete until 15th May 2001.

The district heating system and CHP installation has been completed and has been running since end November 2000. Especially the CHP unit has been running without any problems providing base heat to the system and generating electricity for the boiler and landlord supply together with exporting excess electricity to the grid.

The delays caused by the contractor also shows in technical delays with the commissioning of the Building Energy Management System (BEMS). This resulting in manual monitoring of the project performance adding additional expenditure to the project.

3.3.9 Radstadt, Austria

From the situation two problems have to be solved before realisation:

1) On the area were old, private garages and several pipes and canals were in the ground and had to be removed.

2) The transit-road is passing the area on the north - so noise protection was a very important point

To 1) The municipality of Radstadt made a contract with each private owner of one garage. The old garages were torn away and new garages on the north side of the area were built. So the private owners got new and better garages and this work as a noise protection for the new houses.

The canals and pipes in the ground have to be moved away for the building of the houses and the underground parking area. The ground was very difficult because it was partly rock and partly sand were we had to make a pile foundation.

To 2) The new garages stand between the transit-road and the new houses and further in the east is a noise-protection wall. The north-house has situated all living- and sleeping-rooms to the south. The complete north wall is a two-leaf brick wall with a very good noise protection.

All this points were known before the EU-proposal and were already calculated, so there have been no changes in the time table or the costs because of this.

3.3.10 Vilanova, Spain

There are two questions to be mentioned:

1) time delay

2) costs

The delay in relation to the land works. The problems were not directly connected with the Thermie project, but the delay affected some of the promotions that were being built in the zone.

The main problem encountered afterwards has been the increase of the investment for the centralised system as it was expected to be done. After long discussions with all partners, and after having done two specific engineering projects for a better study of technical solutions, the building developer decided, in 1998, that the centralised natural gas boiler was not economically feasible in the project development due to the installation costs of this solution.

The developer expressed his interest in all the other energy and environmental related measures and decided to proceed with them in this building. Moreover, the builder expressed his interest to continue in the EGC project for the sake of the general interest that he had in these topics.

Therefore, the main problem encountered has been the conversion from collective system to individual installation. The collective installation showed that it is not feasible because of the relation between energy saving and installation costs. As a consequence, the proper solution adopted was the conversion from collective to individual system.

In this context, two more causes for the conversion was the lack of enterprises with proven experience in these specific installations, as well as the lack of tradition in Spain in this field.

3.3.11 Volos, Greece

Basically we did not face any problems constructing the buildings. Problems occurred because there were special procedures on the Urban planning issues and the legal approval of plans needed, as they have to be approved both by the Municipality in the context of urban renewal plans of the area and the local department for heritage and recent monuments of the Ministry of Culture, as Tsalapatas building is a listed protected monument.

Finalizing the project on time we faced as well problems of political and administrative nature. Between the years of constructing those two municipal buildings we had elections and new municipal authority and in a sort while again, repeating elections (after resignation of mayor) and again new authority. This had a time delay effect on the project. Despite the delay the project was very successful before even finished, We get at least 2 schools every week visiting both building sites the last six months.

3.4 Modifications and Over-runs

3.4.1 Abruzzo, Italy

The differences from the original project concern the water saving and electricity saving equipments that they haven’t been installed because the realisation of a more efficient EMS was preferred. Moreover the heater cable foreseen to avoid the risk of ice of the distribution pipes was substituted by a cheaper use of an anti-freeze fluid.

The EMS was implemented and tested during the year 2000: preliminary data about energy consumption and about solar energy contribution have been measured and they appeared according to the foreseen hypotheses.

3.4.2 Brescia, Italy

ALER of Brescia had some problems to obtain the permission from ASL (Local Sanitary Company) to close the loggias because of a local regulation.

Another problem was the necessity to aquire three public areas in order to realise three new rooms where to locate the solar local storing heat exchangers and to move the heat exchangers connected to the district heating network for the heating space.

These problems were solved after several months.

The designed mechanical ventilation system encountered some difficulties because of some problems regarding the opportunity to realise an individual system for each apartment or a centralised system for each building block.

A centralised ventilation system for each building block was designed, but tenants didn’t accept the system and an individual ventilation system for each apartment was realised.

For this reason, it's very difficult for ALER of Brescia to control the efficiency and operation of the ventilation system. It's difficult to evaluate the increase of electricity consumption of each user due to the ventilation system.

The intervention was not eligible but it caused delay in the time schedule of the project.

ALER of Brescia required a purification system of the water stored in the solar tanks and a high temperature purification system of the water was foreseen.

Concerning the monitoring system and the remote unit of tele-controlling, a little modification has been required to the supplier by ALER of Brescia in order to better manage the data acquisition system.

3.4.3 Copenhagen, Denmark

Tøndergade 3-3A

The project has not been changed compared to the ordinary plan.

Tøndergade/Sundevedsgade

The pipe connections and the control of valves and pumps around the storage tank in the basement have been changed to obtain an increased flow temperature to the apartments and an increased cooling of the district heating.

The heating surfaces in the ventilation systems have been disconnected to obtain an improved flow division in the internal district-heating network.

In the design phase the solar collector area was 45m². It has changed because of a smaller roof area available for solar collector.

Sundevedsgade

During construction of the project, the contractor went bankrupt and it was necessary to find a new company to undertake the realisation of the project. Therefore the project was ¾ year behind schedule.

3.4.4 Grenoble, France

The floor of the flat roof is too weak to sustain the thermal solar panels. Another way to fix them was to be found.

The solution adopted : to realise a ridge roof on the part of the buildings where the thermal solar panels have been installed.

3.4.5 Herning, Denmark

Due to increased fire-demands, the exhaust pipes were altered, and divided into separate fire cells.

3.4.6 Hulshout, Belgium

Because of the problems with the overpressure valve in the solar collector system a new overpressure valve (6 bar) was installed. The problem was solved.

A meeting with the engineering office, the installer, the producer, the builder and the monitoring organisation will be organised in 2001 in order to solve the problems with the low solar collector efficiency in building block 2.

3.4.7 Kuopio, Finland

There were no changes made by the architect to the draft plans. The type and functioning principle of the water pool in the central hall were added at a later stage.

Changes in air, water and heating work were as follows:

Heat conducting equipment

- the configuration of the heat distribution centre was changed so that a membrane expansion vessel was added in the heat exchanger of the water apparatus in case of pressure peaks (extra cost FIM 5000).

Water and sewage equipment

- a pump pit was added in the cellar floor with 2 basic water pumps equipped with an alternating automation function and an alarm to the monitoring system (extra cost FIM 30000).
- a water fountain pump was added in the hall pool where water from the natural spring is circulated from the well to the fountain pool of the hall (extra cost FIM 7500).

Building automation system equipment

- some of the motorised adjustment dampers of the solar wall were removed as unnecessary (extra cost FIM 5000).
- alarms for the pump pit and the water fountain pump were added to the monitoring system as well as the controls of the fountain (extra cost FIM 4000).

Changes in air, water and heating equipment work caused no delays in the construction timetable.

During the construction period itself, there were not many changes in the innovative equipment and systems which would have caused extra costs. The basic system was built according to plan. A small change was that no trial was carried out on making hot water with the small-scale sun wall, as was intended.

The structure of the LON network was changed in that the control components in the classrooms were installed in casings inside the rooms and not in the local distribution centres as was originally planned.

LON controls were added to one small classroom because it was connected to a larger room in the plans but was actually built as a separate area.

3.4.8 Portsmouth, GB

Due to the delay to this project as described in 3.3.8 the project has not yet reached a stage where it is possible to evaluate the extent to which the modifications are necessary or advisable.

3.4.9 Radstadt, Austria

There have been no changes of the technical design since the proposal:

- The external walls are built with a high-quality insulation: combination of two-leaf brick walls and wood construction with a U-value of 0,2 W/m²K (Wood with 20cm rockwool and the brickwall with 16cm rockwool between) and high insulating glass for the windows with a U-value of 0,7 W/m²K.
- The heating system is connected with a district heating plant with wood-sheets
- The domestic hot water heating works with solar energy.
- The air ventilation works with heat recovery using a heat exchanger in the loft
- collection and usage of rainwater

3.4.10 Vilanova, Spain

After a long and hard dedication to study possibilities and technical solutions that would respect the THERMIE spirit, the promoter and the partners decided to substitute the following items:

- central heating by domestic individual boilers and
- central tank for domestic hot water from solar panels by domestic individual tanks.

This combination has also a great interest from the energy and technical point of view for existing and new urban buildings, because it combines solar energy with the most introduced systems: individual tanks.

The economical constraints of the promoter and the energy constraints of the THERMIE project lead the technical team to take the decision to modify the energy installation, which ended up in an energy innovation for social housing in Spain.

3.4.11 Volos, Greece

As said in 3.3.11, due to a lot of difficulties concerning the final design of the building because of the Ministry of culture, the changes made were on the position of the solar atrium, we placed it on a different side than the one described on the original proposal.

3.5 Time Schedule

3.5.1 Abruzzo, Italy

Manufacturing phase was completed on the 29.09.1999 and the conclusion of work was declared in February 2000 with all technical and administrative tests done.

Technological test of all plant systems and the maintenance manuals have been charged to specialised external contractor, that completed the work in December 2000.

The set up of the monitoring system and of the remote unit of tele-controlling was completed on the 06.09.2000.

From 15th of October 2000 started the energy metering and the monitoring phase according to the defined programme.

3.5.2 Brescia, Italy

The construction phase started on 24/12/1998 but it at once stopped because of the winter season and because ALER of Brescia had some problems to obtain the building permission from the Municipality of Brescia as far as the closure of the loggias and the displacement of the thermal power plants concerns.

So the works started on 01/03/1999.

Work phase was completed in March 2000.

End of work declared on 5/10/2000.

Technological test of all plant systems and the maintenance manuals were completed in December 2000.

In July 2000 the project was visited by the energy consultants (Cenergia and Metec).

The set up of the monitoring system and of the remote unit of tele-controlling was completed before the summer 2000.

From January 2000 started the energy metering and the monitoring phase according to the previous defined programme.

3.5.3 Copenhagen, Denmark

Tøndergade 3-3A

Design	
Construction	
Monitoring	October 1999 – October 2000

Tøndergade/Sundevedsgade

Design	
Construction	
Monitoring	October 1999 – October 2000

Sundevedsgade 26-28

Design	November 1997 – March 1998
Construction	May 1998 – March 1999
Monitoring	October 1999 – October 2000

Byskoven - Rødekro

Design	March 1998 – November 1999
Construction	November 1999 – November 2000
Monitoring	November 2000 – January 2002

3.5.4 Grenoble, France

The design phase took place during the year 1997 and the beginning of the year 1998. The works have begun during the second half of 1998 and continued until June 1999. The monitoring has begun in July 1999.

3.5.5 Herning, Denmark

The design phase lasted app. one year, and building started September 1998, and ended September 1999. Residents took over September 1999, and monitoring started January 2000.

3.5.6 Hulshout, Belgium

In the beginning of 1997 the architect and the accompanying workgroup of this project completed the final document ‘call for tenders’, taking into account the aims (application of energy efficient technologies) of this project. At the end of April 1997, this document was sent to the Government for approval.

On 27 June 1997 the building document was put out to tender and was sent to the ‘Town and Country environmental planning’ (AROL) of the Government for approval. It was approved on 22 December 1997.

The document ‘technical equipment’ was finalised in June 1997. The call for tenders took place in February 1998. The company that is responsible for the technical equipment is indicated on the meeting of 17 April 1998.

The construction of the 23 dwellings started on 1 March 1998.

The company Geuvers from Bertem was responsible for the building techniques. This company started with the work on 1 September 1998.

In 1999 the construction and the installation of the techniques was finalised. End of October 1999 the project was completed. The dwellings were rented by the social housing company Zonnige Kempen since 1 November 1999.

In December 1999 the installation of the meters for the project evaluation is started.

Since July 2000 the energy measurements started in the new social houses. The monitoring is in close co-operation with the research institute Vito and the University of Leuven (KUL). The University of Leuven started in October 2000 with a sensitisation of the tenants.

3.5.7 Kuopio, Finland

The project was carried out within the comprehensive timetable of the European Green Cities Thermie programme.

3.5.8 Portsmouth, GB

The design and consultation with residents commenced in Oct 1997. By January 1998 the high number of residents wishing to remain in the block together with becoming aware of the dry pack concrete difficulties caused a severe impact on the progress (refer to 3.3). These issues resulted in an 18 months delay.

Work on site commenced on 15th May 2000 with a completion expected at the end of December 2000. Unfortunately, mainly due to poor performance by the contractor, the completion is officially to be 14th May 2001. However, there are indications that the completion date is more likely to be early July as the contractor has recently admitted to be an additional 7-8 weeks behind scheduled programme.

The main utility monitoring started on 1st December 2000 and is ongoing.

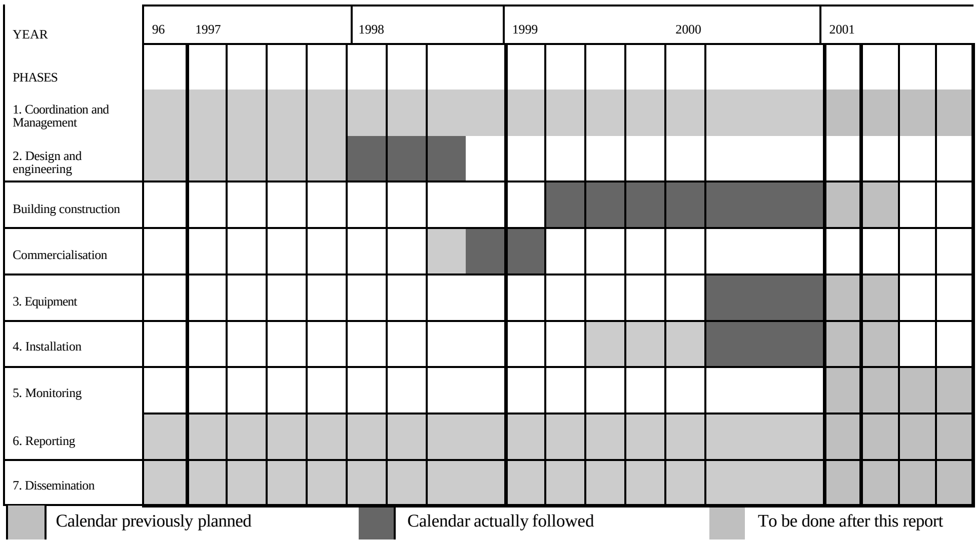
3.5.9 Radstadt, Austria

The permission of the building authority was given in January 1996. After that the Architect finished the detailed planning. In October 1996 they started with the pile foundation of the first house. Before the winter the cellar and the ground floor of the first house was finished.

Before winter the cellar and the ground floor of the first house was finished. In February the work went on.

The first house with 12 dwellings was handed over to the inhabitants on 15th of July 98. The other 24 dwellings were finished in November 98. In January 99 the monitoring started and shall be done at least for 3 years.

3.5.10 Vilanova, Spain



Construction history and situation

The 80 dwellings were constructed in 4 phases.

i. In1998 the architectural and installation projects were prepared.

ii. In1998 was also done the call for tenders for the private companies interested in the installation of the solar and in the conventional systems.

iii. The building phase was initiated in April 1999. Since then the building was under construction by QUALITAT PROMOCIONS SCCL.

3.5.11 Volos, Greece

The design phase for both buildings completed on March 1997, instead of November 1996, and the construction of the energy center building has finished on schedule by August 1998, but was not in operation until July 2000, Fully operate since August 2001. The Tsalapatas building completed December 2001 instead of September 1999 All the delays are due to the reasons described in 3.3.11.

3.6 Costs

The costs of the solar heating system are given in Table 3.1. It seems that the cost of the solar system varies between the projects. The cost of the solar system in Portsmouth is more than six times as high as in Abruzzo. There are a number of explanations for these variations. Big solar system and central system compared with individual systems have lower costs. A complex design, number of suppliers in the region and the installer's training in installing solar systems has influence on the costs. A more uniform and lower costs can be expected when solar system getting more widespread.

Table 3.1: Costs of the solar heating system in EGC projects.

Solar Heating System	Total costs, Euro	Number of dwelings	Costs per dwellings, Euro
Abruzzo Italy	41,321	54	765
Brescia, Italy	184,032	72	2,556
Copenhagen, Denmark	30,321	21	1,444
Copenhagen air collector	15,892	21	757
Grenoble, France	684,000	505	1,354
Herning, Denmark	51,315	42	1,222
Hulshout, Belgium	41,399	15	2,760
Kuopio, Finland			
Portsmouth, GB	33,962	8	4,245
Radstadt, Austria	123,861	36	3,441
Vilanova, Spain		80	2,104
Volos, Greece			

The costs of the ventilation system are given in Table 3.2. There is mechanical ventilation with heat recovery in the Danish and in the Belgium projects and the costs are approximately the same. In the Grenoble only a renovation of the existing system has been done.

Table 3.2: Costs of the ventilation system in the EGC projects.

Ventilation	Total costs, Euro	Number of dwelings	Costs per dwellings, Euro
Abruzzo Italy	0	54	0
Brescia, Italy	309,389	72	4,297
Copenhagen, Denmark1	28,210	21	1,343
Copenhagen, Denmark 2	24,046	21	1,145
Copenhagen, Denmark 3	88,022	21	4,192
Grenoble, France	30,000	122	246
Herning, Denmark	64,480	42	1,535
Hulshout, Belgium	31,359	23	1,363
Kuopio, Finland			
Portsmouth, GB	20,254	8	2,532
Radstadt, Austria	86,511	36	2,403
Vilanova, Spain		80	0
Volos, Greece			

The ventilation system in copenhagen3 include DC-fans.

3.6.1 Abruzzo, Italy

The total cost of the manufacturing/installation and commissioning consisted in 1.723.596.287 ITL (890.287 euro).

Intervention	Cost (ITL)
Windows	485000000
Insulation	497000000
Water solar collectors	80000000
Thermal storage	56000000
Modusat (solar system)	189000000
Multicells furnace	40000000
Heat metering system	12000000
Energy Management System	80000000
PV modules	24000000
Building construction	100000000
Plant system	160000000
TOTAL	**1.723.000.000**

3.6.2 Brescia, Italy

The total cost of the manufacturing/installation and commissioning consisted in about 1.670.000.000 ITL

The total cost of the solar system has been around 356,3 MITL.

The total cost for the local heat metering system and the Energy Management System has been around 332,4 MITL.

The cost of the mechanical ventilation system has been around 599 MITL (not eligible).

3.6.3 Copenhagen, Denmark

The extra costs of the energy savings technology installed in the project is as follows:

Tøndergade 3-3A

Extra costs without VAT	Budget DKR	Actual Costs Dkr	euro
PV-modules, inverters and installatios		241,703	32,443
Ventilation with heat recovery		210,000	28,188
Design costs		105,456	14,155
		557,159	74,786

The costs of the ventilation system are extra cost compared with a system without heat exchanger.

Sundevedsgade 26-28

Extra costs without VAT	Budget DKR	Actual Costs Dkr	euro
PV-modules, inverters and installation		341,000	45,772
Solar Collector system (35m²).		225,715	30,297
Windows		53,000	7,114
Ventilation with heat recovery		179,000	24,027
The Glased Balcony with improved daylight system		774,878	104,010
Design costs		327,000	43,893
		1,900,593	255,113

The standard support of the solar collector system from the national energy agency is not included in the cost table. The support is DKr. 45,200.-. The amount of support is based on a yearly performance of 10.8MWh.

The costs of the ventilation system are extra cost compared with a system without heat exchanger. The total costs of the ventilation system is DKK 394,000.

The actual cost of the energy project is 0.8% more that the budget.

The extra costs of the energy savings technologies installed in the project in Sundervedsgade/Tøndergade is as follows:

Copenhagen,
Sundevedsgade/Tøndergade

Extra costs without VAT	Actual Costs DKK	euro
Solar heating system	118,300	15,879
PV cells	149,700	20,094
Ventilation with heat recovery	655,250	87,953
CTS	203,200	27,275
Design costs	202,761	27,216
	1,329,211	178,418

There is no extra installation costs in Rødekro. A costs of a reference project is as follows (DKK without VAT):

Radiators and connections to district heating.	30,000
Floor heating in the barthroom	2,000
Standard ventilation (extract air)	13,000
Hot water installation	6,000
Total costs for a reference system	51,000
Total costs of the inovative installation in Rødekro	39,000

The heating installation in Rødekro is 12.000,- lower compared with a traditional installation. The Rødekro installation has ventilation with heat recovery unit to save energy for heating and the improve the indoor climate.

3.6.4 Grenoble, France

The extra costs of the energy savings technology installed in the project is as follows:

Measures	Number of dwellings	Cost (Euro)	Cost per dwelling (euro)
Windows replacement	122	593 000	4 861
External insulation	122	75 000	615
Closure of the loggias	20	45 600	2 280
Solar domestic hot water	505	684 000	1 354
Energy saving system	122	6 000	49
Ventilation retrofit	122	39 000	320
Photovoltaïc	122	125 000	1 025
Other costs	122	78 380	642
Works		**1 645 980**	**3 259**
Design		**197 518**	**391**
Works + design		**1 843 498**	**3 650**
Preinvestigation		24 019	48
Monitoring		21 732	43
Coordination and local partnership		32 598	65
Total Costs		**1 921 847**	**3 806**

3.6.5 Herning, Denmark

The extra costs of the energy savings technologies installed is for 42 dwellings DKK 3,040,000 The breakdown is as follows:

Tøndergade 3-3A

Extra costs without VAT	Actual Costs DKK	euro
Low energy glazing in windows	295,000	39,597
Extra insulation roof/wall	191,000	25,638
Floor heating system	150,000	20,134
Hot water system	47,000	6,309
Central heating system	164,000	22,013
Solar water heating system	382,000	51,275
Ventilation system	480,000	64,430
Solar wall	219,000	29,396
Electricity and water savings	389,000	52,215
Metering and BEMS	723,000	97,047
	3,040,000	408,054

3.6.6 Hulshout, Belgium

The expected extra costs of the energy saving technologies installed in the Hulshout project is shown per building block in the table below.

	Block 1	Block 2	Block 3

	(3 dwellings) (BEF)	(12 dwellings) (BEF)	(8 dwellings) (BEF)
extra insulation	385,470	1,128,490	566,600
heating	89,250	377,070	184,040
solar collectors	300,000	1,370,000	0
ventilation with heat recovery	165,000	660,000	440,000
electricity savings	60,000	240,000	160,000
environmentally friendly materials	181,150	724,610	483,080
water savings	120,000	480,000	320,000
energy management	0	670,000	0
energy metering	100,000	970,000	200,000

3.6.7 Kuopio, Finland

The extra costs due to structures and HVACA-installations aiming at energy conservation are about 4,7 million FIM excluding the common costs of the project. The allocation is as follows:

Extra costs	Budget	Actual Costs	
	FIM	FIM	euro
Planning and research	592,000	555,568	93,373
Installation work and supervision	4,141,022	3,903,446	656,041
Measuring and follow-up	123,900	360,000	60,504
Reporting	26,200	160,554	26,984
Total		4,979,568	836,902

Exchange rate 1 EURO = FIM 5.95

3.6.8 Portsmouth, GB

The breakdown of costs of direct and indirect energy saving measures is as follows (exchange rate 0.68 pounds = 1 Euro):

Extra costs	Budget	Actual Costs	
	£	£	euro
BEMS	40,000	41,680	61,294
CHP	250,000	311,152	457,576
Lighting improvements and extract ventilation fans	30,000	51,309	75,454
Solar collectors	78,000	23,094	33,962
Water Savings	8,160	13,788	20,276
Heat recovery reduction from 30 to 8 flat	35,000	13,773	20,254
Windows	220,000	285,330	419,603
Pitched roof	450,000	450,266	662,156
District heating works	276,134	375,783	552,622
Total	601,134	742,388	1,091,747

3.6.9 Radstadt, Austria

Total costs for the project Radstadt-West: (4.583.598 euro) 61.784.038 ATS

In the project Radstadt-West we had a cost reduction of about 4 Mill.ATS. This very good result was possible because of several positive circumstances:

- The low rates made it possible to find a good financing way of the project, so the credit costs could be kept very low
- In the way of creation the outdoor area it was possible to find more simple solutions for the green areas and the walking paths, that bring the same effect for the users and were much cheaper
- An old canal-system, that crossed the building area was necessary to remove and replace. This could be done easier, than first expected
- We calculated a safety-reserve in our financing-plan, that was not necessary to use

The energy efficient measurements themselves, that were the base for the EU-funding were not changed in the costs.

Extra costs per dwellings, Including VAT	Budget	Actual Costs ATS	euro
Solar system		47,343	3,449
Passive solar		43,667	3,181
Ventilation with heat recovery		32,984	2,403
Rainwater		4,758	347
Extra insulation		48,694	3,548
Low energy windows		13,333	971
		190,780	13,900

3.6.10 Vilanova, Spain

The economical overcost caused in this project by the technical and environmentally friendly criteria to the promoter *Qualitat Promocions* is specified as follows:

Extra costs per dwellings	Actual Costs Pta	euro
Solar heating system	350,000	2,104
Double glazing (Climalit)	25,000	150
Electrical wires without PVC and fire resistant	11,000	66
Double flush toilet	12,000	72
Mono control taps	8,000	48
Energy saving system for hot and cold water dishwashers	5,000	30
Natural gas boiler for individual system	360,000	2,164
Eco-paint in dwellings indoor	50,000	301
Total overcost per dwellings	821,000	4,934
Total overcost for all the 80 dwellings in this project	65,680,000	394,745

3.6.11 Volos, Greece

The total cost of the above-mentioned interventions was about 750 thousand Euro and was funded by the THERMIE programme (32%) and by the Municipality of Volos (68%).

The total cost of the bioclimatic interventions was about 300 thousands Euro and was funded by the THERMIE programme (32%) and by the Municipality of Volos (68%).