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RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Content

1. Ostfildern

1.1 SIEDLUNGSWERK Residential Buildings

Scharnhauser Park, Ostfildern, Germany

Building Type: Residential

1.1.1 General description

- The residential section of the area Scharnhauser Park was constructed by a range of investors. The largest investor of this section was the Siedlungswerk Stuttgart (SWS), which represents the investor/building society side as a partner in the POLYCITY project. All building projects in the Scharnhauser Park are constructed with low energy standards. The Siedlungswerk Stuttgart have been working on the construction of 15.000 m² of residential surface started at the end of 2004.

In the first construction phase, 12 flats, 4 double houses and 6 single family houses were developed and marketed. The flats are constructed in multi-storey building at the west end of the site.

The following innovative measures have been implemented:

- The partner SWS integrated a *mechanical exhaust ventilation system* in this building.

- Special care has been taken to obtain high quality air tightness to reduce the ventilation losses. *Blower door tests* have been done for quality assessment of the airtight construction.

- A low temperature heating system (*floor heating*) was installed, which helps to deliver low return temperatures of the district heating network.

- Low *emission glazing* was used and the special plastic spacers reduce the thermal losses of the windows.

Building Automation System:

- The heating energy consumption of the building and of all 12 apartments is monitored by electronic meters connected to a modem.

Heating

- Heat is being provided by the biomass based ORC-cogeneration plant.

1.1.2 Building specification

General information		
Building characteristics	Heated building volume	5 015.5 m³
	Total envelop area	1 688 m²
	Useful floor area	1 605 m²

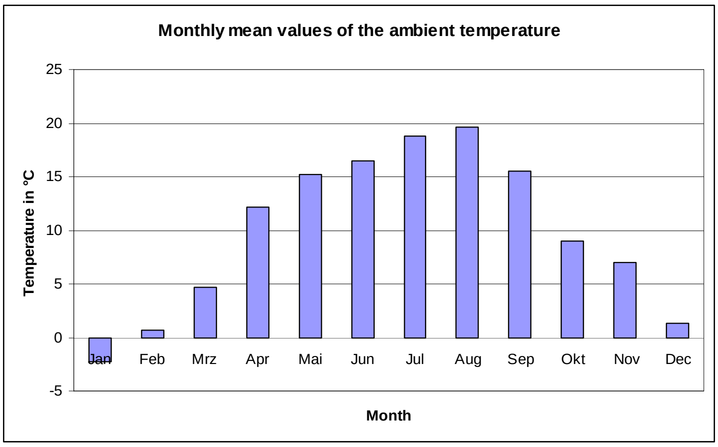
	Max. heating load			
Envelope construction				
Element of building envelope	**National Standard according to BEST sheets** new building		**CONCERTO specification flat** new building	**As Built**
	EnEV 2004 H_T'		**H_T' -30%**	
	U-Value **[W/m^2K]**		**U-Value** **[W/m^2K]**	**U-Value** **[W/m^2K]**
Façades/wall	≤ 0.44 – 1.05 [window ratio < 30%] ≤ 0.58 – 1.55 [window ratio > 30%] (depends on A/V)		0.301	0.302
Roof			0.226-0.309	0.236-0.309
Ground floor			0.261-0.361	0.328
Windows			1.2	1.2
	Nr. 1	Nr. 2 (blower door test)	blower door test	
Air tightness	Class 2 / 3 DIN EN 12207	$n_{50} \leq 3 / \leq 1.5$ (mech. ventilation) h^{-1}	$n_{50} \leq 1.0\ h^{-1}$	1.3 h^{-1}, 1.1 h^{-1}, 1.4 h^{-1}
Ventilation Rate	n = 0.7 h^{-1}	n = 0.6 h^{-1}	n = 0.7 h^{-1}	n = 0.55 h^{-1}
Energy consumption				
	National Regulation [kWh/m^2 a]		**CONCERTO specification [kWh/m^2 a]**	
Total Space Heating	90		56	
Electricity	32		25	
Lighting	25		3	
Cooling	0-20		0-10	

1.1.3 Location and weather conditions

Location:	**Latitude: 48.7° North**	**Longitude: -9.3° West**

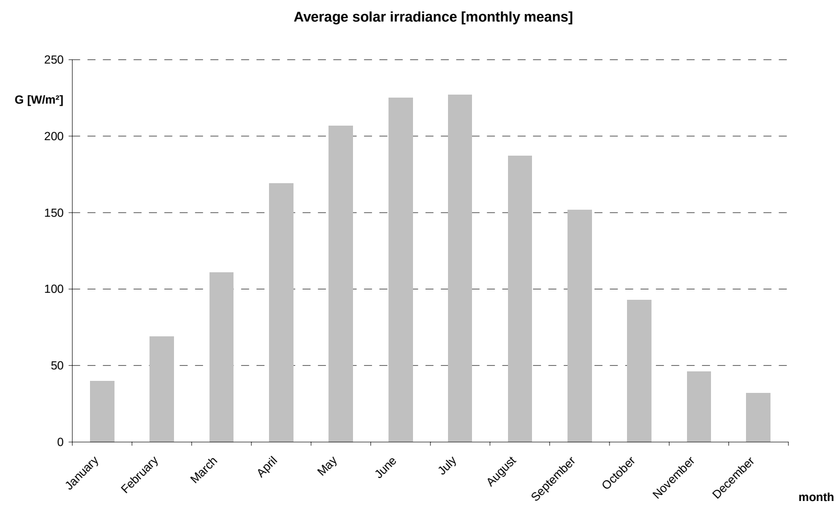
Annual temperatures

Mean values	°C
Long term average	**9.3**
2006	10
2007	10.3
2008	9.9
2009	9.9
2010	NA



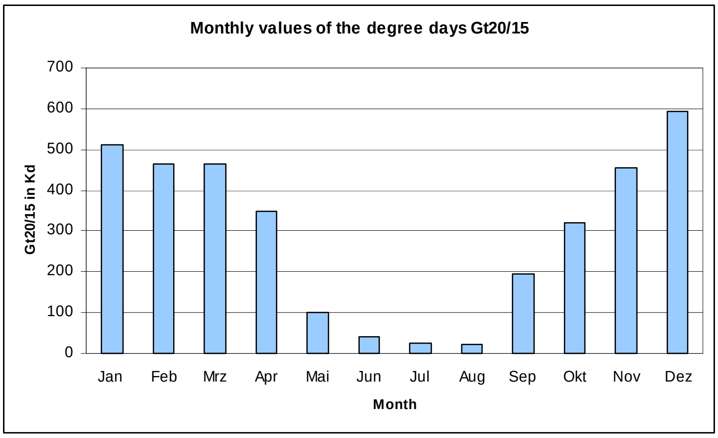
Annual solar irradiation

Total values	W/m²
Long term average	**130**
2006	NA
2007	NA
2008	NA
2009	129.94
2010	NA



Annual degree days

$G_{t20/15}$	Kd
Long term average	**3778**
2006	3569
2007	3322
2008	3540
2009	3487
2010	NA



1.1.4 Technical building equipment

System	Description	Power	COP
Heating System 	District heating with biomass co-generation	24 000 MW (max)	NA

1.1.5 Energy distribution systems

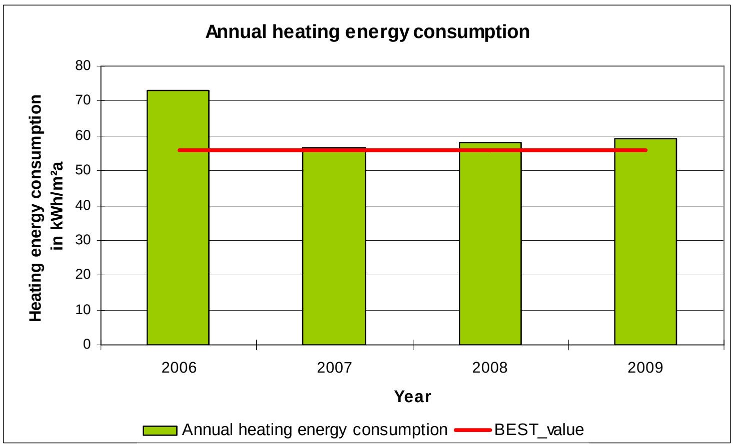
System	Description	Heating
Heat distribution System	Thermally activated concrete ceilings	
	- Supply and return temperatures of the water based system	90 °C / 60 °C
	- Max. specific heat transfer power	xx W/m²
Ventilation system	Displacement ventilation system without heat recovery.	
	- Total supply air volume flow	xx m³/h
	- Total return air volume flow	xx m³/h

1.1.6 Measured energy consumption

Annual heating energy consumption

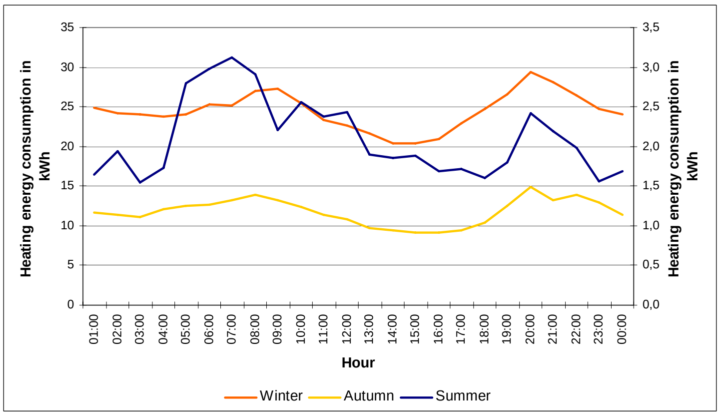
	kWh/m²a
2006	73
2007	56
2008	58
2009	59
2010	NA

Degree day corrected annual heating energy consumption

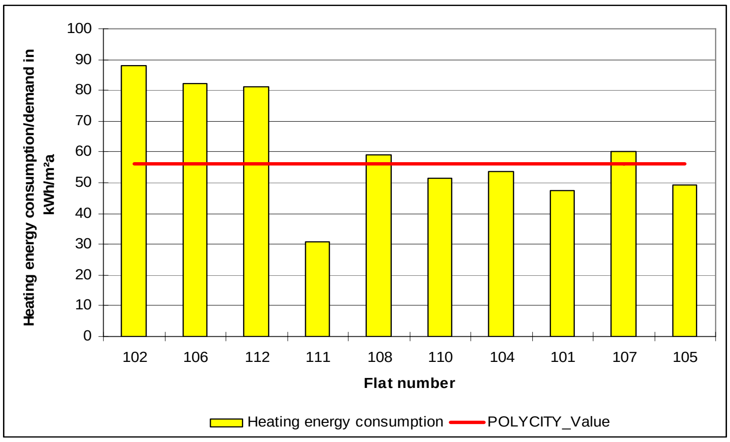


1.1.7 Detailed Performance Results

Hourly profiles of the whole building



Annual heating energy consumption of separate flats



1.1.8 Conclusions

- Higher supply system efficiency through lower temperature level of the heat
- Low transmission losses through a good building insulation
- Reduction of ventilation losses trough airtight construction of the building
- User acceptance/thermal comfort
- Significant difference between the heating energy consumption between individual flats

1.2 Biomass Cogeneration Power Plant

Scharnhauser Park, Ostfildern, Germany

Building Type: Technical supply

1.2.1 General description

- Description biomass furnace

Biomass wood chip combustion utilizing a grate furnace with 7MW maximum thermal output. Systems applied are:

Multiple recirculation vents, Multi cyclone and electric filter system, Economiser

- Description electric generation

Electric cogeneration based upon ORC-technology. 1000 kVA maximum design power. Temperature levels: 300 °C (feeding primary), 240 °C (return primary), 70°C (district heating feeding), 55°C (district heating return).

Further attributes: Recuperator, single stage turbine

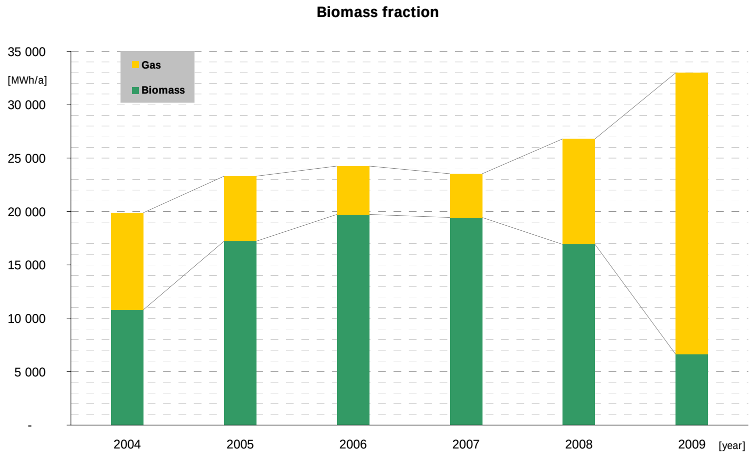
1.2.2 System design specification

General information			
Building characteristics	Building volume	NA	
	Total envelope are	NA	
	(Useful floor area)	NA	
	Max. heating load	NA	
Thermal power specifications			
Fuel Specification	Wood chips, lop	<60% RH	<15% ash
Fuel consumption	200 m³/d	43000 t/a	-
Thermal output (peak)	8000 MW* (biomass)	5 +9 MW (gas)	-
Thermal annual output	Biomass	Gas	-
Electric output (peak)	1 MW	-	-
Electric annual yield	Find enclosed (performance)	-	-
Specific aux. energy demand	25 kWh/MWh	3,7 kWh/MWh	
Exhaust gas specifications	0.016 g/kWh (particulates)	0.589 g/kWh (Nox)	0.002 g/kWh (CO)
Degree of efficiency	91 % (biomass)	92% (gas)	
Cycle power specifications			
Cycle type	Organic Rankine		
Thermal power	6356 kW (in)	5300 (out)	
Generator	Weier Electric 1400 kVA		
Degree of efficiency	15% (electric)	78 % (thermal)	
Re-cooling power	2600 kW		
Turbine	Tuthill Nadrowsky single stage		
Heat transfer fluid	Therminol66®		
Fluid	Octamethytrisiloxane (MDM)		
Temperature levels	300-270 °C (feed)	50-90°C (return)	
Energy demand			
Thermal energy demand	**NA**		

Water demand	NA	
CO_2-Savings		
Fossil fuel saving	38 000 MWh/a	
CO_2-Savings annual	7 000 t/a	

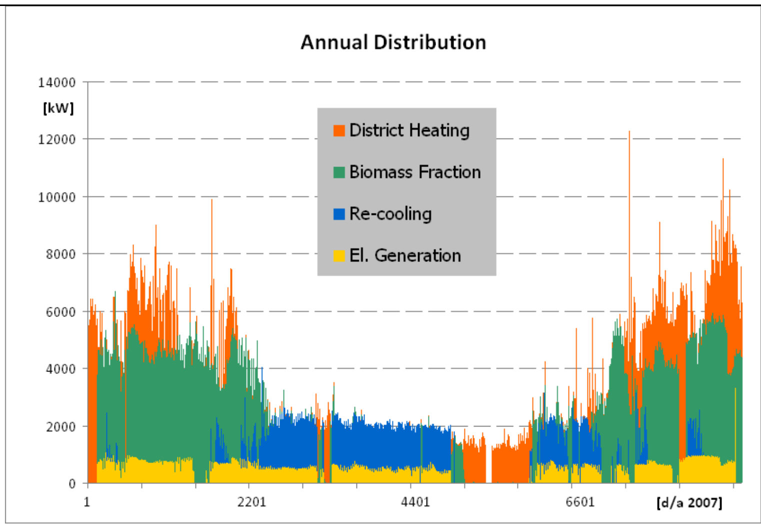
1.2.3 Detailed Performance Results

Biomass/gas distribution 2004-2009



Performance overview 2004-2009

Year [-]	Th. power (gr.) [MWh/a]	Gas [MWh/a]	Biomass [MWh/a]	El. gen. [MWh/a]	Biomass [%]
2004	19 899	9 097	10 802	1 103	54.3%
2005	23 306	6 086	17 220	1 212	73.9%
2006	24 255	4 539	19 716	278	81.3%
2007	23 544	4 103	19 441	3 308	82.6%
2008	26 810	9 886	16 924	3 527	63.1%
2009	28 517	26 350	6 632	517	23.3%

<table>
<tr>
<td>Load distribution/duration 2007</td>
<td>
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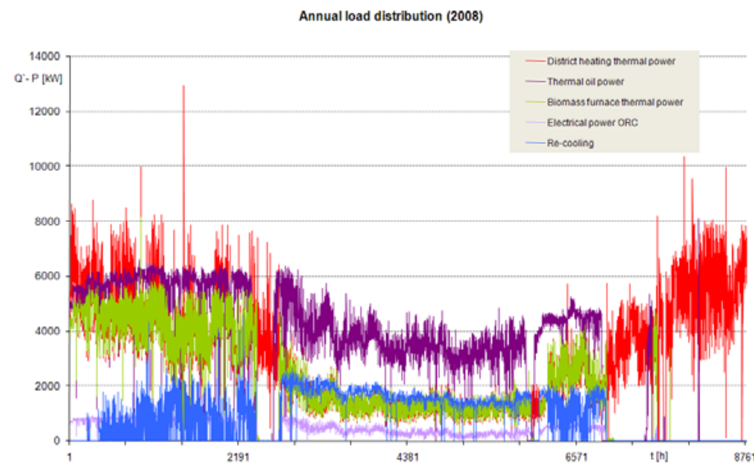
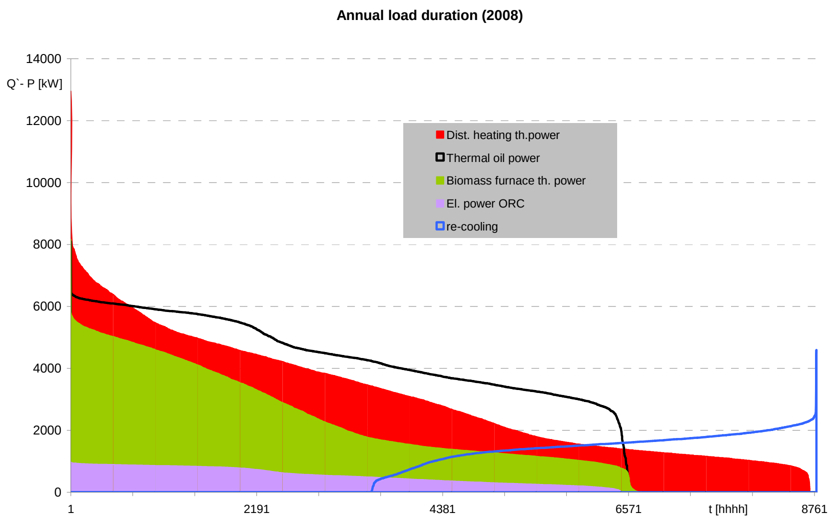
<tr>
<td>Load distribution/duration 2008</td>
<td>


</td>
</tr>
<tr>
<td>Load distribution

2009</td>
<td>Not available due to down time of power plant after fire incident in November 2008. Next monitored period 2010.</td>
</tr>
</table>

1.2.4 Conclusions

Improvement of performance in the first years of operation: Biomass to gas ratio has been steadily increased. Steady technical and safety modifications. In the down time after fire incident in November of 2008 the performance of the facility could not be monitored and analysed for more than one year. Further results are expected for the 2010 period.

1.3 District Heating Network

Scharnhauser Park, Ostfildern, Germany

Building Type: Technical supply

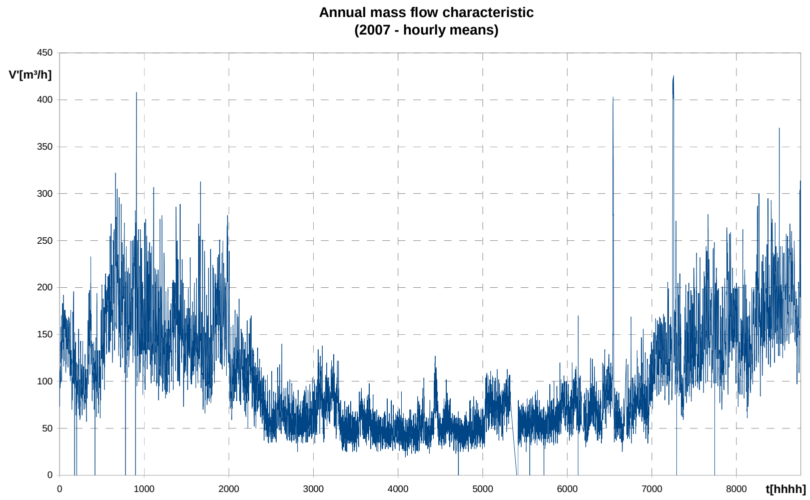
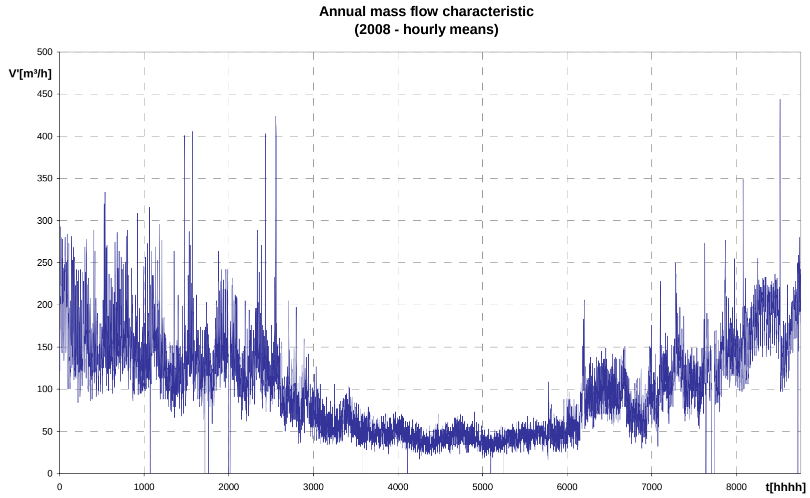
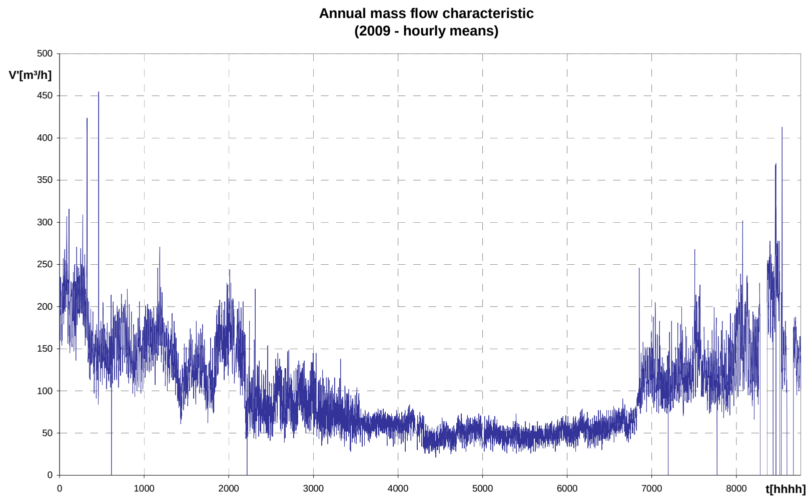
1.3.1 General description

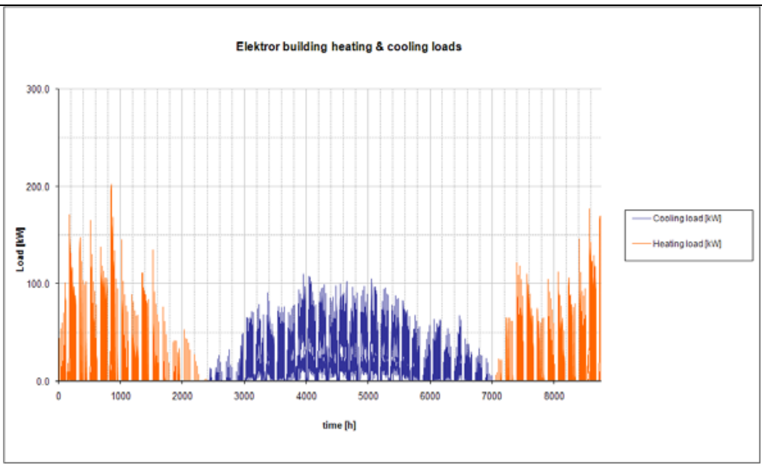
District heating network with multiple-loop topology. Utilised for heating and cooling supply.

1.3.2 System design specification

General information			
System characteristics	Total length	13.5 km	
	Total users	523	
	Tube dimensions	DN25-DN300	
	Fluid	water	
Specifications			
Max. heating load	16 MW		
Total Volume	280 m³	-	-
Mass-flow	12-127 m³	-	-
Volume flow	43,5-460 m³/h	-	-
Pressure loss	0,7-1,1 bar	-	-
Pressure	5-6 bar (feed)	4-5 bar (return)	-
Temperatures	70-90 °C (feed)	55-65°C (return)	
Mean temperature difference	25 K	-	-
Number of pumps	3		
Pump power	3 x 18.5 kW		

1.3.3 Detailed Performance Results

Mass flow distribution 2007	
Mass flow distribution 2008	
Mass flow distribution 2009	

Cooling loads 2008	

1.3.4 Conclusions

- The operation of the district heating network was so far unobstructed.

2. Cerdanyola

2.1 Synchrotron Office Building

Parc de l'Alba, Cerdanyola del Vallès, Spain

Building Type: Office

2.1.1 General description

The office building (4,054m2) if the Synchrotron Light Laboratory constitutes the first specific example of the application of measures to reduce energy demand. The developer of the building is CELLS (Consortium for the Construction, Equipment and Exploitation of the Synchrotron Light Laboratory – www.cells.es) and the architectural and engineering team is the company Master Ingeniería y Arquitectura. The energy efficiency measures incorporated are:

Sunshade in south facade:

The main facade is oriented to the south, which reduces needs for heating but increases the needs for cooling in the summer. To prevent the latter, the main facade contains a solar protection cover projected from the roof in the highest floor and others projected from each floor.

Curtain wall with low transmittance:

There is a double glazing curtain wall divided in two parts: upper translucent part (U=1.4 W/m2K) and lower opaque part that combines glass with a panel of aluminium (U=0.41 W/m2K). The overall transmission of the wall is U=0.94 W/m2K. Besides, the kind of glass reduces solar radiation transmitted to the building, without compromising natural lighting.

Roof with low transmittance:

The roof of the building is made of a special sandwich panel: external layer of aluminium, internal layer of micro perforated steal sheet. Between them, there are a steam barrier and an additional thickness of rock wool to improve thermal insulation. The transmittance of the roof is U=0.30W/m²K.

Low transmittance floor:

A 4 cm thick layer of extruded polystyrene will be added will be added under the ground floor to reduce thermal transmittance to 0.5W/m²K.

Building Management System:

A Building Management System is installed in order to ensure comfort conditions while improving the overall efficiency of the mechanical and electrical services of the office building. The BMS not only allows monitoring the energy consumption of the building, but also to control the heating, ventilation, cooling and lighting equipment.

2.1.2 Building specification

General information

Building characteristics	Heated building volume	Not available
	Total envelop area	Not available
	Useful floor area	4,054 m^2
	Max. heating load	20 $kWh/m^2 \cdot y$

Envelope construction

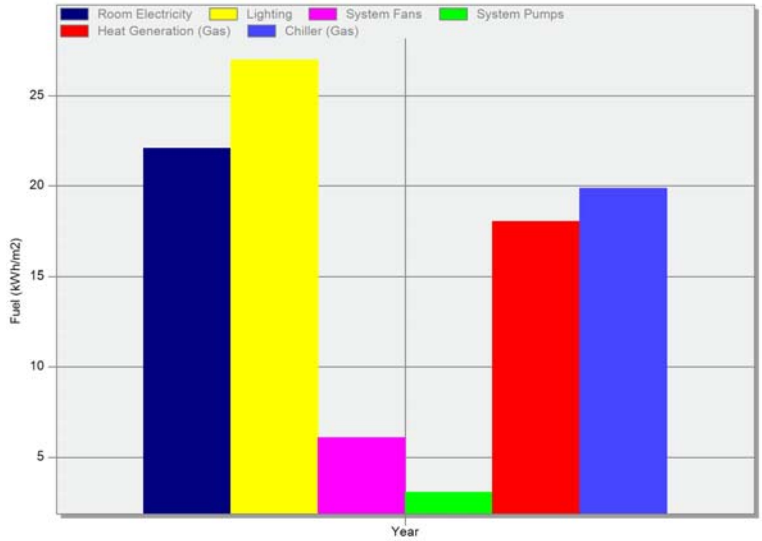
Element of building envelope	**National regulation**	**CONCERTO specification**	**As Built**
	NBE-CT-79 (Now already substituted by CTE)		
	U-Value [W/m²K]	**U-Value [W/m²K]**	**U-Value [W/m²K]**
Facades/wall	Nonexistent values in old national regulation	0.6	0.55
Roof		0.3	0.30
Ground floor		0.5	0.41
Windows		1.3	1.4
Ventilation Rate		0.5 ach	NA

Energy consumption

	National Regulation [kWh/m² a]	**CONCERTO specification [kWh/m² a]**
Total Space Heating	50.5	40.5
Electricity	38.5	34.5
Lighting	36.5	25.5
Cooling	77	54

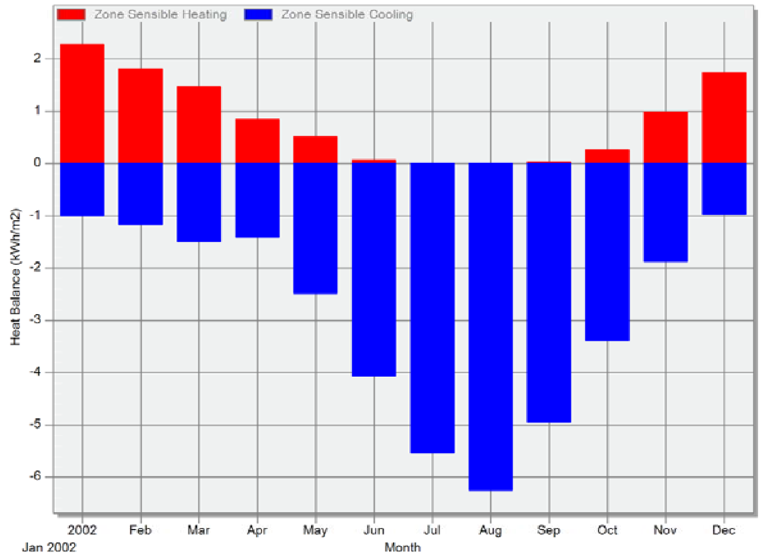
2.1.3 Simulated energy consumption

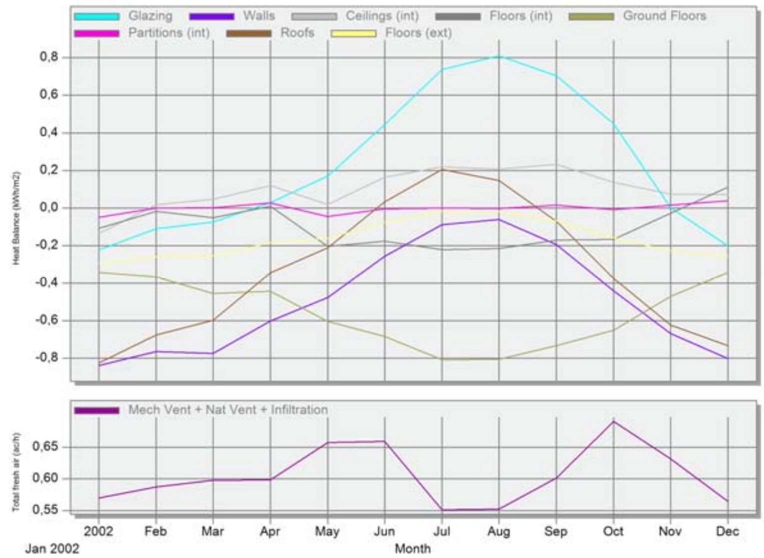
Breakdown of annual energy consumption



2.1.4 Detailed Simulation Results

Annual profile for heating and cooling demand of the whole building



Gains through fabric elements and ventilation rate	

2.1.5 Conclusions

- Energy demand values for the building are lower than the ones specified by CONCERTO, which at the same time, are more restrictive than the legislation in force.
- Impact of the curtain wall: the greatest heat gains in summer are through the glazing elements.
- Apart from the high efficiency achieved thanks to the passive strategies (presented in the graphics above), it is necessary to take into account that the building is connected to the polygeneration plant and it supposes a higher CO2 emission savings.
- The user thermal comfort is acceptable.

2.2 La Clota - Residential Building

Cerdanyola del Vallès

Spain

Building Type: Residential

2.2.1 General description

One of the residential buildings in the Polycity Project is “Clota Social Residences Block B” developed by the public company INCASOL and designed by architect Jaime Pastor Sánchez. The building has a built area of 2.786 m2 and has 53 dwellings of between 40 and 43 m2 each. These dwellings are designed to be rented to young people.

The energy efficient measures applied to the building are:

Increased insulation thickness:

The envelope of the building has an additional insulation thickness, which provides thermal transmittance of the walls lower than the Concerto specification (0.6 W/m2K). Besides, the ground floor (adjacent to the underground parking garage) includes a 0.09m of layer of extruded polystyrene class 0.034.

Glazed gallery:

In the south-west facade, there is a glazed gallery. Balconies have double glass sliding windows with external blinds on the outside, and one double glass sliding door on the inside. This allows preheating in winter and solar protection in summer.

Natural ventilation:

All apartments are designed to allow cross ventilation, by having windows in both facades. Besides, they have access to one chimney with operable openings, which promotes natural (stack driven) ventilation.

2.2.2 Building specification

General information		
Building characteristics	Heated building volume	NA
	Total envelop area	NA
	Useful floor area	2786 m^2
	Max. heating load	16 $kWh/m^2 \cdot y$

Envelope construction

Element of building envelope	**National Regulation**	**CONCERTO specification**	**As Built**
	NBE-CT-79 (Now already substituted by CTE)		

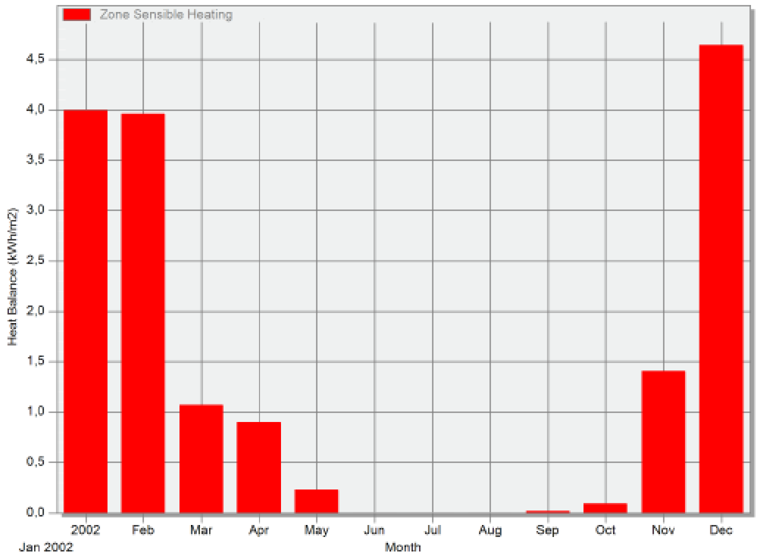
	U-Value [W/m²K]	U-Value [W/m²K]	U-Value [W/m²K]
Facades/wall	1.2-1.8	0.6	0.4
Roof	1.4	0.3	0.24
Ground floor	1.4	0.5	0.45
Windows	2.5–3.5	1.3–1.7	1.63
Ventilation Rate	Nonexistent values in old national regulation	0.5	NA
Energy consumption			
	National Regulation [kWh/m² a]	**CONCERTO specification [kWh/m² a]**	
Total Space Heating	54	43	
Electricity	52.5	47	
Lighting	4.5	3	
Cooling	10	7	

2.2.3 Simulated energy consumption

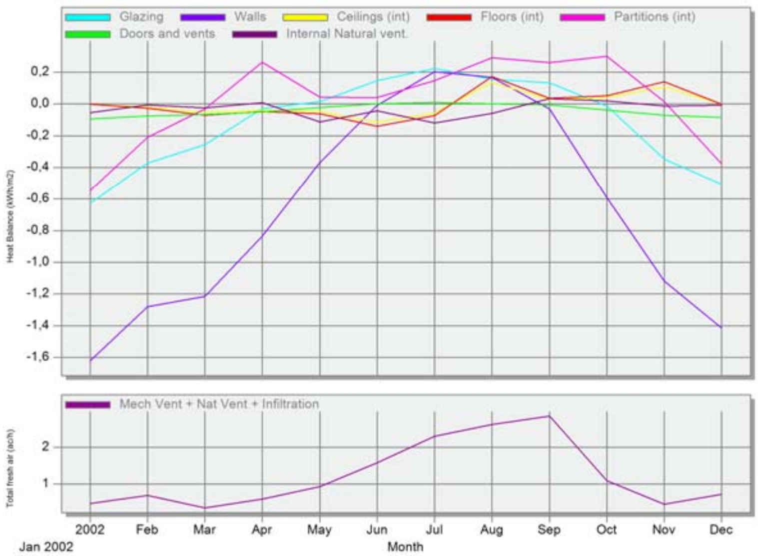
Breakdown of annual energy consumption

2.2.4 Detailed Simulation Results

Annual profile for heating demand of the whole building



Gains through fabric elements and ventilation rate



2.2.5 Conclusions

- Heating demand of la Clota residential building fulfils only too well the requirements of CONCERTO and it represents a remarkably improvement compared with other conventional buildings.
- Sensible reduction of heating demand due to the envelope optimization and, especially thanks to the glazed gallery.
- The building doesn't have any cooling system; that is why there is no data of cooling consumption. The cooling load is actually low (about 3 kWh/m^2·a), but thermal comfort could be improved in summer, since indoor operative temperature is above 25ºC during 30% of the occupied hours.

2.3 Còrdova Residential Building

Cerdanyola del Vallès,

Spain

Building Type: Residential

2.3.1 General description

The second residential building of the POLYCITY Project has 24 subsidised dwellings to be rented to families and it is located in the Parc de l'Alba. It has also being developed by the public company INCASOL and it has been designed by the Frutos-Sanmartin firm of architects. The building has a built area of 2.172 m² with residences with a net usable area of between 71 and 77 m² each. The energy efficient measures applied to the building are:

Building envelope:

The envelope of the building has an additional insulation thickness made of recycled materials, which provides thermal transmittances lower than the Concerto specifications, for example:

- Walls: U-value < 0.6 W/m²K
- Roof: U-value < 0.3 W/m²K
- Ground floor: U-value < 0.5 W/m²K

All windows have double glazing, with a maximum thermal transmittance of 1.3 W/m²K.

Trombe walls:

All the flats have modules of Trombe walls in the south facade, that work as thermal collectors, with polycarbonate glazing and two adjustable vents on the outside (top and bottom), and cellular concrete with two internal manual dampers added to the top and bottom, to allow natural convection, on the inside. This allows preheating in winter and ventilating the facade in summer. Besides, there are balconies that provide solar protection in summer.

Natural ventilation:

All the flats are designed to promote natural ventilation, either by having windows in both facades (cross ventilation) or by having access to one chimney with operable openings (stack ventilation).

2.3.2 Building specification

General information

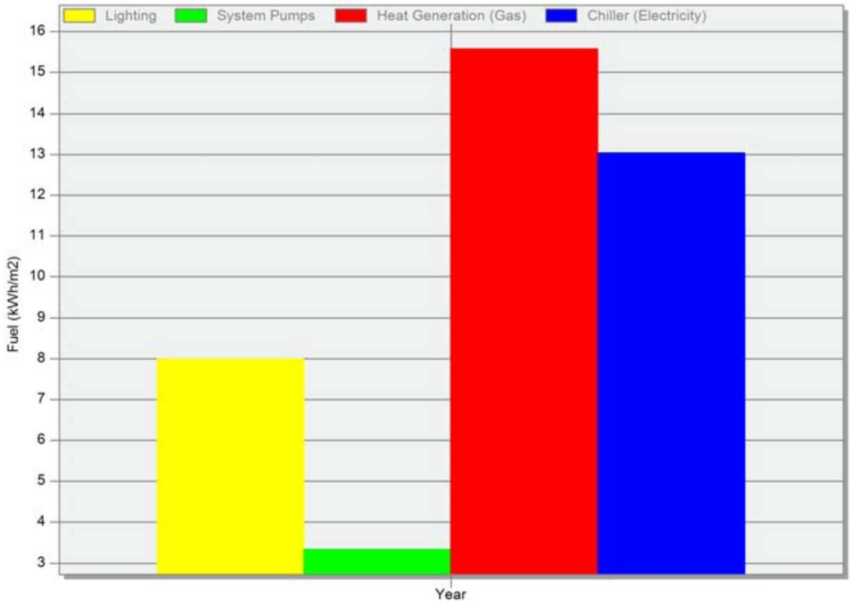
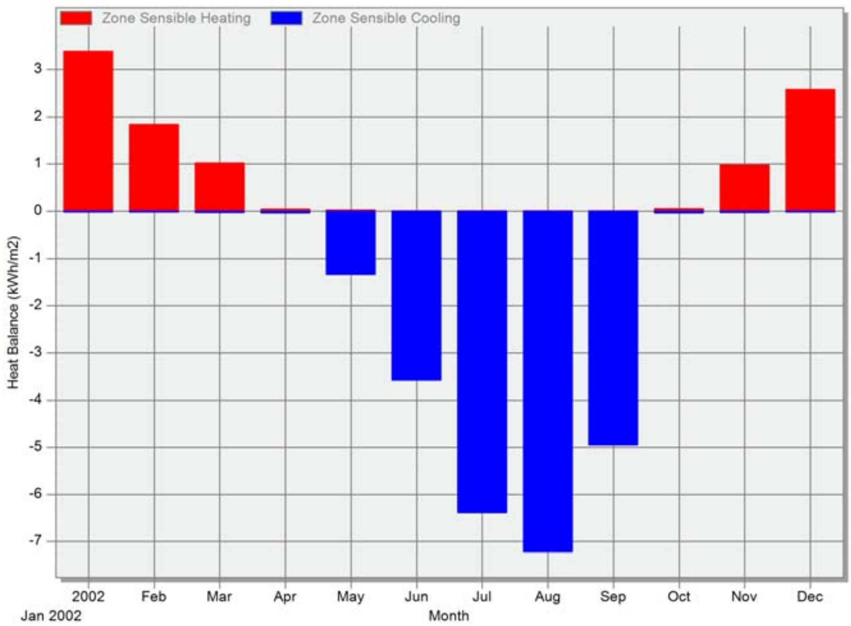
Building characteristics	Heated building volume	Not available
	Total envelop area	Not available
	Useful floor area	2,172 m^2
	Max. heating load	10 kWh/m^2·y

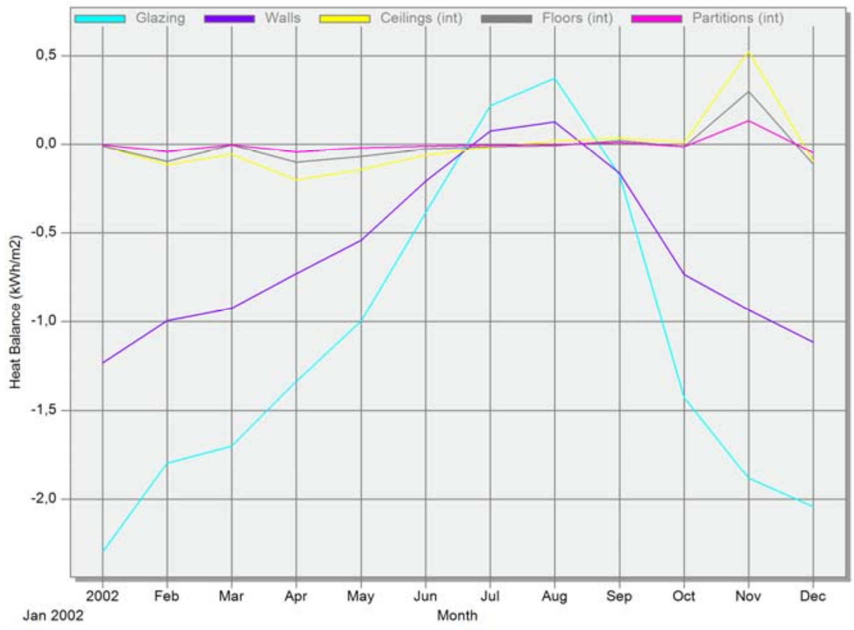
Envelope construction

Element of building envelope	National Standard	CONCERTO specification	As Built
	NBE-CT-79 (Now already substituted by CTE)		
	U-Value [W/m²K]	**U-Value [W/m²K]**	**U-Value [W/m²K]**
Facades/wall	1.2 - 1.8	0.6	0.32
Roof	1.4	0.3	0.27
Ground floor	1.4	0.5	0.35
Windows	2.5 – 3.5	1.3 – 1.7	0.6
Ventilation Rate	Nonexistent values in old national regulation	0.5	NA

Energy consumption

	National Regulation [kWh/m² a]	CONCERTO specification [kWh/m² a]
Total Space Heating	54	43
Electricity	52.5	47
Lighting	4.5	3
Cooling	10	7

2.3.3 Simulation energy consumption	
Breakdown of annual energy consumption	
2.3.4 Detailed Simulation Results	
Annual profile for heating and cooling demand of the whole building	

Gains through fabric elements	

2.3.5 Conclusions

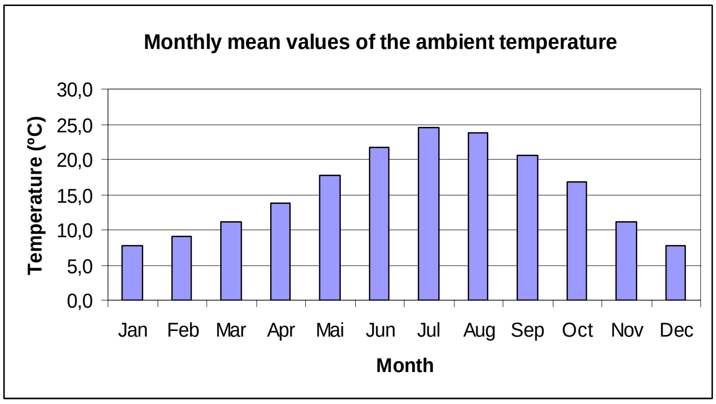
- Both heating and cooling demand comply the requirements set by CONCERTO and the building represents a remarkably improvement compared with other conventional buildings.
- Low transmission losses through a good building insulation.
- Regarding heating, the improved insulation of the building achieves more savings than its trombe walls.
- Concerning cooling savings, cross ventilation is the most effective measure, over of the slaps and other passive measures.
- Acceptable user thermal comfort, also in summer.

2.3.6 Location and weather conditions for the buildings

Location:	**Latitude: 41°29’28” North**	**Longitude: 2º8’26” East**

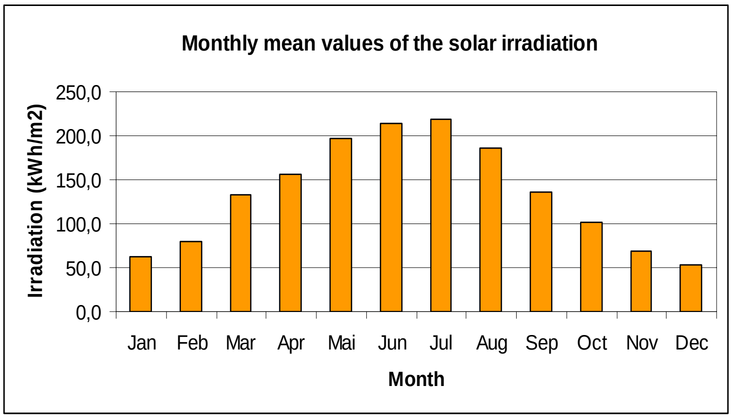
Annual temperatures

Mean values	°C
Long term average	**15.45**
2006	15.8
2007	15.2
2008	15.1
2009	15.7



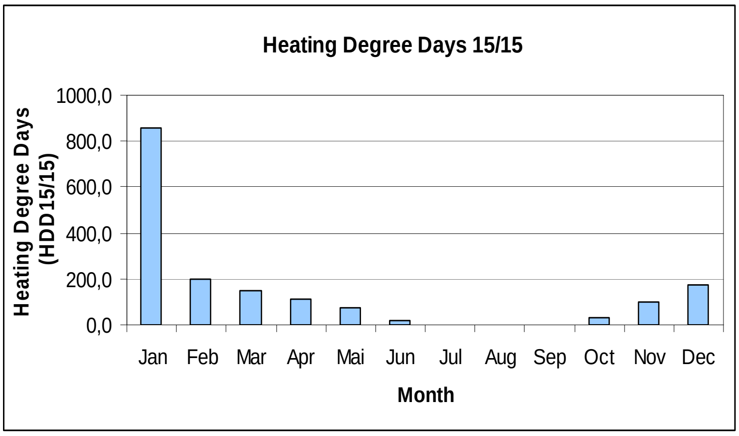
Annual solar irradiation

Total values	kWh/m²a
Long term average	**1605**
2006	1616
2007	1609
2008	1561
2009	1635



Annual degree days

$HDD_{15/15}$	
Long term average	**1710**



2.4 Polygeneration Plant ST-4

Parc de l'Alba, Cerdanyola del Vallès, Spain

Building Type: Technical supply

2.4.1 General description

The Cerdanyola del Vallès Parc de l'Alba project incorporates a highly efficient system for simultaneously producing electricity, heating and cooling. This polygeneration system represents a step forward in terms of the district's energy efficiency. On the one hand, the distributed production of electricity reduces losses through transportation; on the other hand the transformation of residual heat from the cogeneration engines into useful thermal energy (heating and cooling for air conditioning) provides a major saving in primary energy consumption with respect to conventional systems.

The Polygeneration system to be implemented in the Parc del Alba is made up of 4 cogeneration plants, mainly using natural gas, with an electrical power output of 47 MWe. It will also include single and double effect absorption chillers to take advantage of part of the heat given off by the engines for the production of cold water.

2.4.2 System design specification

General information

Building characteristics	Building volume	18 549 m³
	Area	2 447 m²

Thermal power specifications

(Estimated in the Lonjas Technical report for the first year of operation)

	Phase I (3 x JGS 620 Engines) 2 x JGS 620 Engines 24 h/day – 7 days/week – 38 weeks/year 1 x JGS 620 Engines 14 h/day – 5 days/week – 52 weeks/year
Fuel Specification	Natural Gas
Fuel consumption	134 771 MWh/a (HHV)
Thermal Production from Exhaust Gases (170ºC)	22 215 MWh/a
Thermal Production from Hot Water (engines cooling water)	24 549 MWh/a
Electric output	54 528 MWh/a
Specific aux. energy demand (pumping)	293 MWh/a
Exhaust gas specifications	< 500 mg NOx/Nm^3

Total Energy demand for the whole Directional Centre

(according to the previsions of Directional Centre of Cerdanyola del Vallès)

Energy demand (MWh /year)	Electric	Heating	Cooling
Science & Technology Park	203400	92312	167800
Synchrotron	44600	3.800	30200
Residential Area	12270	17.650	2970
Commercial Area	20800	9760	13100

CO_2-Savings

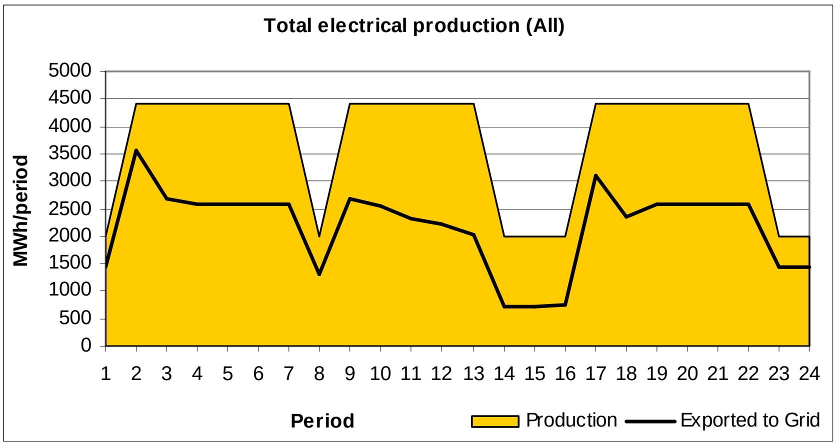
Stage of development	Primary energy savings	CO_2 savings
Initial stage (ST-4 Plant + Renewables)	38100 MWh/a	7500 t/a
Final stage (4 Plants)	109000 MWh/a	21400 t/a

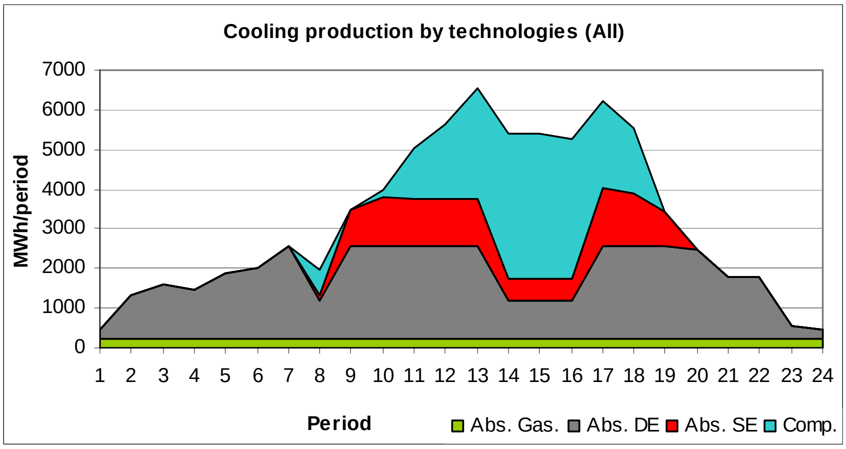
2.4.3 Simulation Results

Simulation results for ST4 Plant + Renewables (solar thermal and biomass gasification plant) according to the Lonjas technical specifications and the information available from the Directional Centre.

Performance prediction for ST-4 Plant + Renewables

(1 Period= 15days)





2.4.4 Conclusions

The implementation of this high efficiency polygeneration system in Cerdanyola del Vallès increases the district's energy efficiency. The distributed electricity production reduces losses through transportation, and the transformation of residual heat from the cogeneration engines into useful thermal energy provides a major saving in primary energy consumption and, therefore, a reduction in the emissions of greenhouse gases. Additionally, it contributes to the energy supply safety and diversification.

2.5 District Heating Network

Parc de l'Alba, Cerdanyola del Vallès, Spain

2.5.1 General description

The Cerdanyola del Vallès Parc de l'Alba project includes providing the area with a heating and cooling distribution network that will supply hot and cold water to the buildings in the Science and Technology park, including the Synchrotron building as well as commercial and public buildings. This is a 4-pipe network (2 pipes for hot water and 2 pipes for cold water) that interconnects the 4 polygeneration plants. For safety reasons, the Synchrotron has a direct connection to the ST-4 Plant.

2.5.2 System design specification

General information

System characteristics	Total length	31 km
	Tube dimensions	4- Pipe Network Pipes ST.37 steel pre-insulated with injected polyurethane, aluminium diffusion layer and a high-density polyethylene external protection layer. Diameters from DN 100 (200mm ext) to DN 800 (1000mm ext)
	Fluid	water

Specifications

	Chilled water	**Hot water**
Temperatures	6 (feed) / 13 (return)	95 (feed) / 78 (return)
Pressure	(feed) / (return)	(feed) / (return)
Flow to Synchrotron (m^3/h)	858	73
Flow to Science and Technology Park (m^3/h)	4910	1026
Number of pumps	2 x 858 m^3/h for Synchrotron (1 backup pump) 4 x 1613 m^3/h for Science and Technology Park (1 backup pump)	2 x 73 m^3/h for Synchrotron (1 backup pump) 3 x 513 m^3/h for Science and Technology Park (1 backup pump)

2.5.3 Conclusions

The district heating and cooling network represents a good opportunity for implementing the polygeneration plant because it expands the pool of potential users of recovered thermal energy beyond the industrial sector to include other sectors, like commercial. With the implementation of the DHC another alternative to the conventional system, where each building purchases the electricity from the grid and covers its own heating and cooling demand locally, is given. It also has benefits to the community, including avoided costs of energy, through the use of surplus and wasted heat energy, and reduced investment in individual building heating equipment.

3. Arquata

3.1 ATC Building

Corso Dante 14, Turin, Italy

Type: Office Building

3.1.1 General Description

Application of High Efficiency Glazing:

ATC office building has been built at the beginning of the 70's.

The main structure is made of concrete and the building is characterized by wide glazed facades. This kind of structure provokes thermal losses which have been dramatically reduced replacing, on all facades, conventional windows with low emittance glazing.

The U-value of windows decreased from 3.8 to less than 1.45 W/m2K.

Thermal Bridges:

Insulation of walls and balconies has been carried out with panels of mineralised wood fibres (thickness 25 – 35 mm, U-value 2,5 – 1,8 W/m^{2}K) protected by a bituminous sheath.

Photovoltaic System (50 kWp):

Photovoltaic polycrystalline modules are integrated in the south-west and south-east facades of ATC building (total peak power 50 kW).

Weather Station on ATC Building 's Roof:

Measured quantities:

- Humidity
- Temperature
- Wind speed and direction

– Solar Radiation
– Air pressure
– Rain collector

All data are collected by wire and sent via Web Services to the CEMS control central .

Tri-generation System:

An heating thermal plant is placed in the second floor underground of ATC building which includes:

- three gas boilers: two with a 2600 kW thermal power and one with a 978kW power;
- a Combined Heat and Power (CHP) unit (1 MWe, 1,2 MWt),;
- an absorption chiller (190kWc), thermally coupled with the gas co-generator, produces refrigerated water for the cooling system of ATC building..

In normal conditions, the co-generator plant works in parallel with the local electric energy distribution network. The electric energy produced by the cogenerator partly supplies the ATC building's demand and partly is sold to the National Managing Authority.

3.1.2 Building specification

General information			
Building characteristics	Heated building volume	337 095 m^3	
	Total envelop area	11 350 m^2	
Envelope construction			
Element of building envelope	**National regulation***	**CONCERTO specification**	**As Built**
	NBE-CT-79 (Now already substituted by CTE)		
	U-Value [W/m²K]	**U-Value [W/m²K]**	**U-Value [W/m²K]**
Façades/wall		0.8	0.65
Roof		0.4	0.4
Ground floor		0.4	0.4
Windows		3.1 to 1.0	1.45
Ventilation Rate		0.5	0.5
Energy consumption			

	National Regulation [kWh/m² a]	CONCERTO specification [kWh/m² a]
Total Space Heating	74	50
Electricity	28	24
Lighting	28	26
Cooling	58.8	30.6

*In the Italian regulation Legge 10/1992, UNI 10349 and DPR 412/93 only the volume related heat loss is regulated (C_d value for transmission and an effective heat loss FEN_{lim} which includes ventilation loss and effective solar gains);U-Value is not regulated

3.1.3 Electric Consumption

The ATC building is supplied by the CHP (P_{elt} = 970 kW) and by the AEM grid. The CHP is on between Monday and Saturday and it is off during the Sunday and at night-time. When the CHP doesn't work the ATC building is supplied by the grid.

Electrical data are obtained from I-CEMS (Communal Energy Management System) and from communications of AEM Distribuzione . I-CEMS gives real-time data but the electric consumption of the ATC building is not yet available.

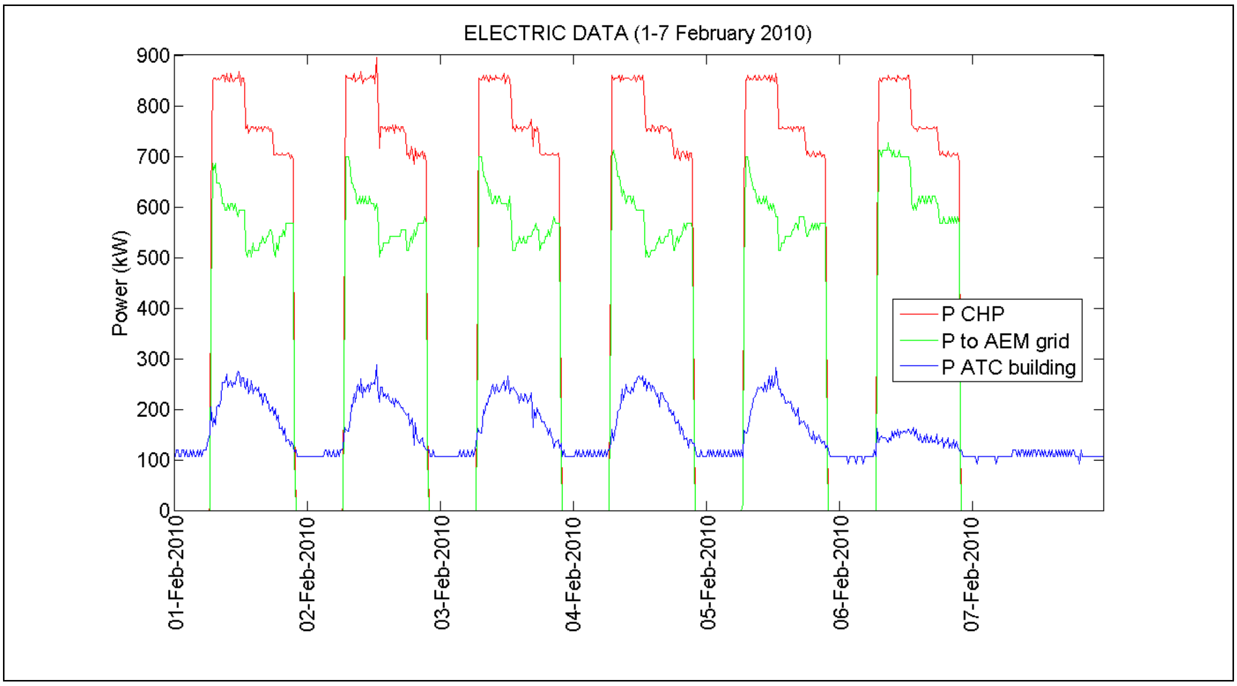
On the contrary from AEM we get the waveforms of the power exchanged with the grid but these data are available with a time delay longer than one month.

From the available data it is possible to calculate the electric load of the ATC building P_{ATC} as :

$$P_{ATC} = P_{CHP} - P_{GRID}$$

where P_{CHP} is the electric power produced by the CHP (data from I-CEMS) and P_{GRID} is the power that goes to the grid (data from AEM Distribuzione).

Season	**2007-2008**	**2008-2009**
Electric consumption (kWh)	**1446860.63**	**1277366.12**


ELECTRIC DATA (1-7 February 2010)
Power (kW)
900
800
700
600
500
400
300
200
100
0
01-Feb-2010
02-Feb-2010
03-Feb-2010
04-Feb-2010
05-Feb-2010
06-Feb-2010
07-Feb-2010
P CHP
P to AEM grid
P ATC building

3.1.4 Thermal Consumption

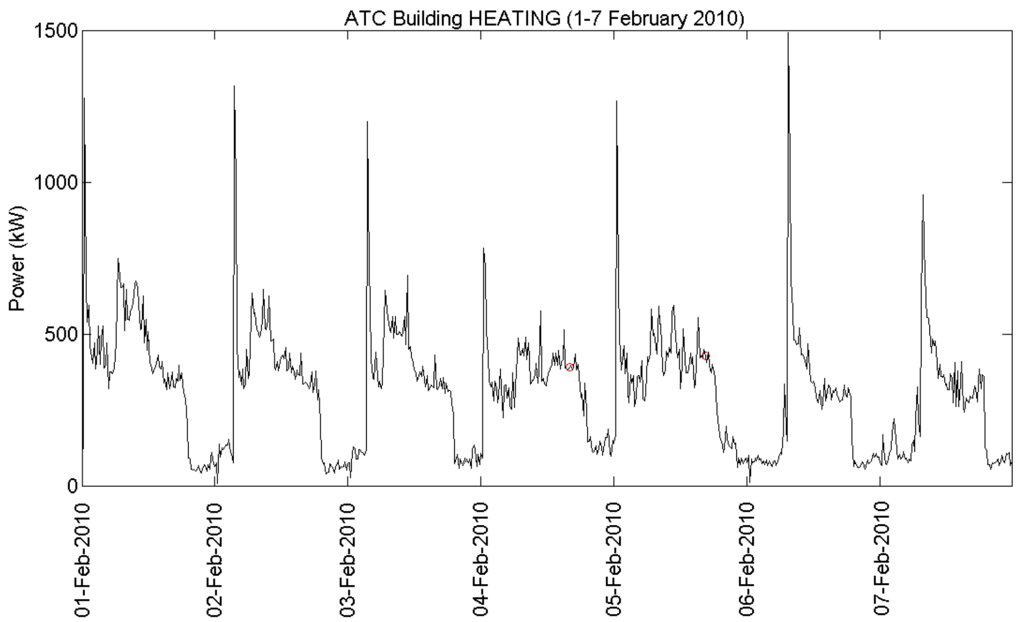
Heating:

To meet the overall thermal load of the ATC building there are the CHP (P_{th} = 1166 kW) and three boilers (2 x 2600 kW + 1 x 895 kW).

The boilers are used when the CHP is off and everyday to meet the peak load.

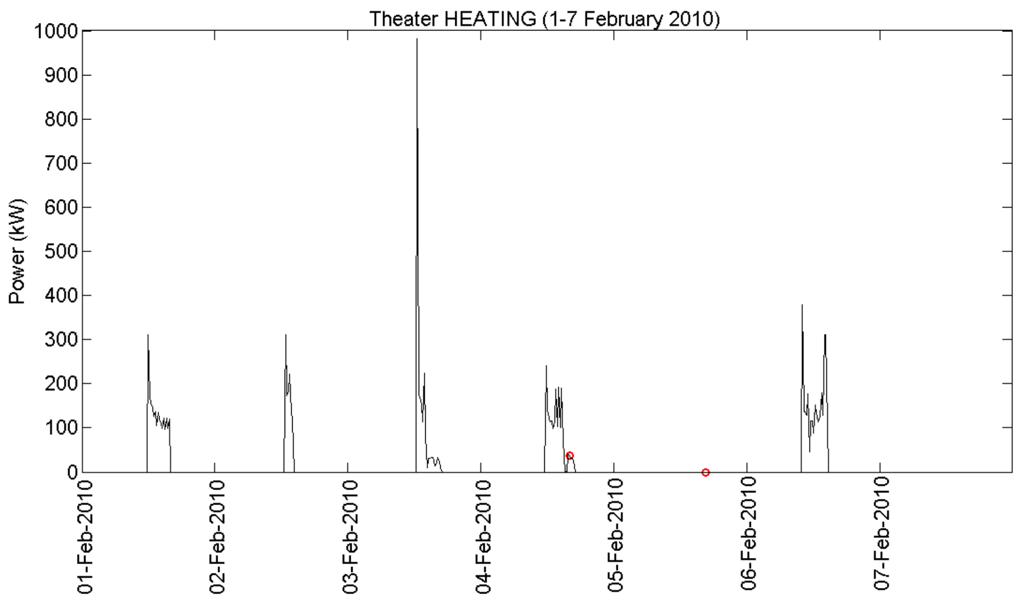
In the I-CEMS data about the ATC thermal load are available.

Season	2007-2008	2008-2009
Heating consumption (kWh)	966 660	1 026 190



The thermal station supplies also the theatre that it is in the second floor underground of the ATC building. In the I-CEMS data for the heating and the cooling of the theatre are also available.

The theatre is not used everyday and so in some days the power is equal to zero because the heating (or the cooling) is off.

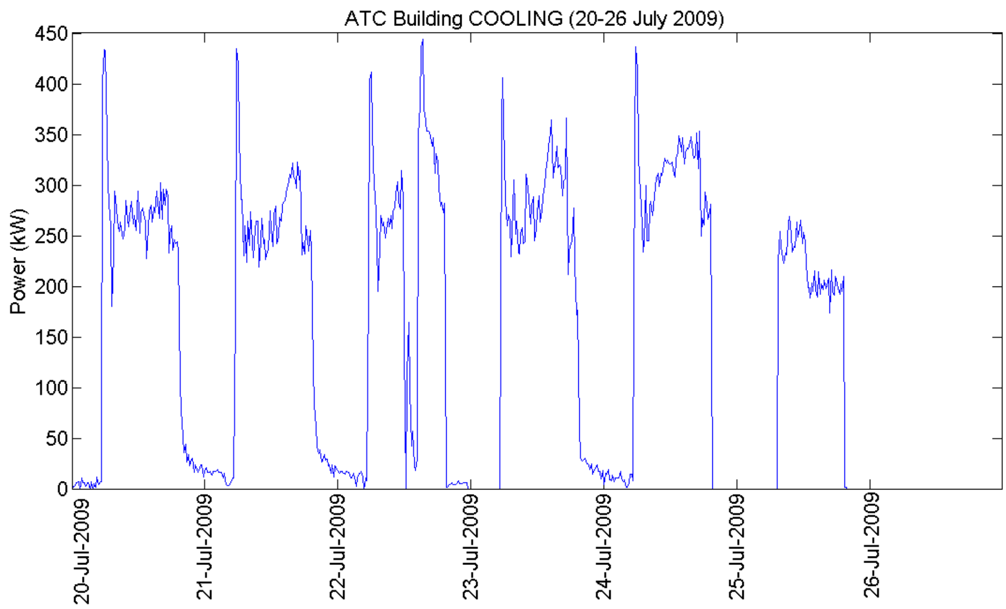


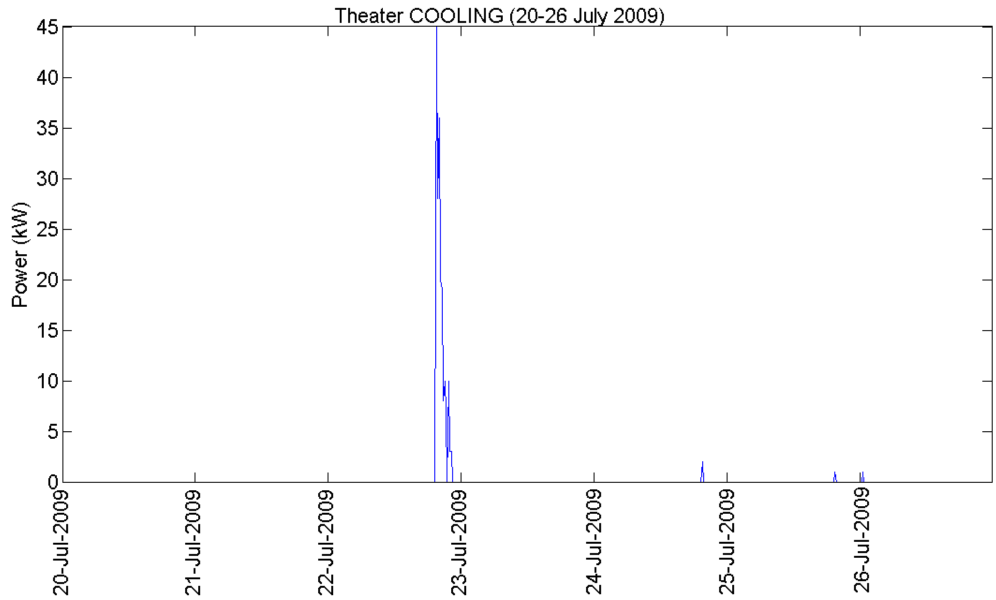
3.1.5 Cooling System

Two chillers produce the cold for the ATC building and for the theatre in the summer period: an electric compressor chiller (476 kW) and an absorption chiller (190 kW).

We have data for the overall production of the cooling system for the season 2007-2008 and 2008-2009 and data from I-CEMS for the ATC building and for the theatre separately.

Season	2007-2008	2008-2009
Cooling production (kWh)	272 360	378 570





3.1.6 PV Systems

ATC Building

Overall power installed: 50 kW

Panels Features:

Nominal Power: 215 Wp

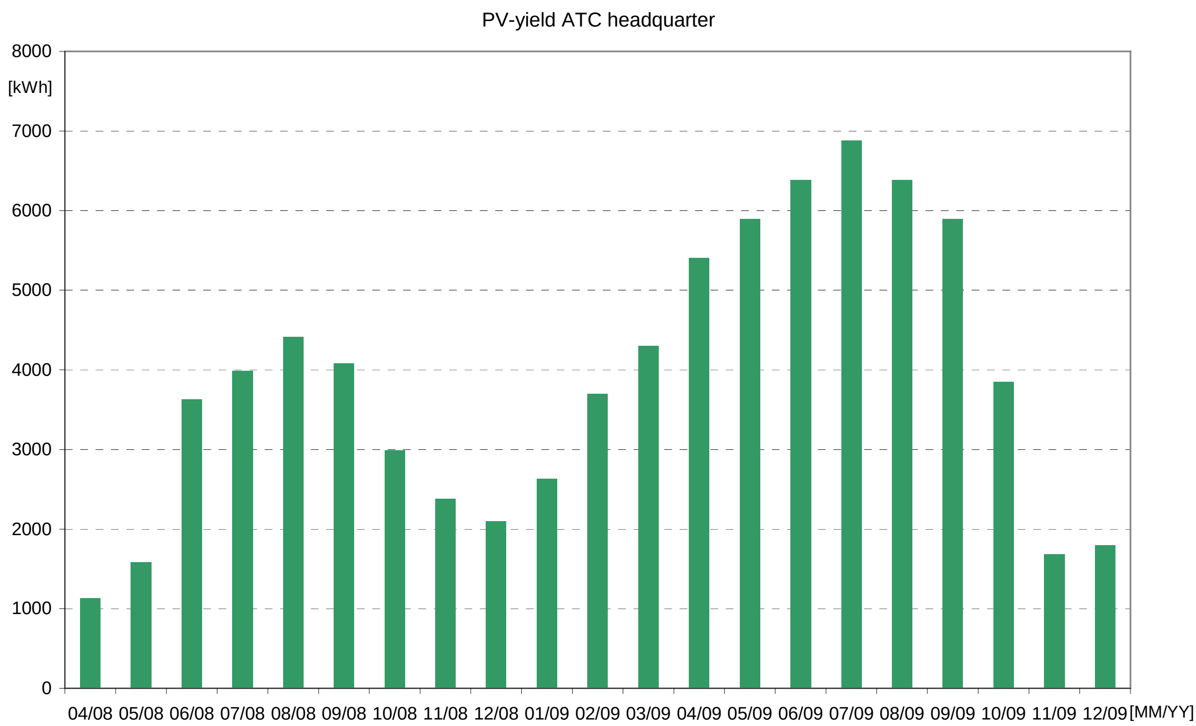
Efficiency: up to 14.7 %

Tilt Angle: 35°

Energy production ATC building from April 2008 to December 2009

Months	**kWh**	**Feed**	**€**
April 08	1134.00	0.4853	550.33
May 08	1585.00	0.4853	769.20
June 08	3628.00	0.4853	1760.67
July 08	3990.00	0.4853	1936.35
August 08	4417.00	0.4853	2143.57
September 08	4085.00	0.4853	1982.45
October 08	2992.00	0.4853	1452.02
November 08	2379.00	0.4853	1154.53

December 08	2101.00	0.4853	1019.62
January 09	2631.00	0.5008	1317.60
February 09	3702.00	0.5008	1853.96
March 09	4304.00	0.5008	2155.44
April 09	5405.00	0.5008	2706.82
May 09	5897.00	0.5008	2953.22
June 09	6388.00	0.5008	3199.11
July 09	6880.00	0.5008	3445.50
August 09	6388.00	0.5008	3199.11
September 09	5897.00	0.5008	2953.22
October 09	3852.00	0.5008	1929.08
November 09	1688.00	0.5008	845.35
December 09	1800.00	0.5008	901.44
Total energy	**81143.00**		**40228.59**



Arquata District

Overall power installed: 120 kW

Panels Features:	
Nominal Power:	215 Wp
Type:	Polycrystalline
Efficiency:	up to 14.7 %
Tilt angle:	27°

3.2 Council buildings

Turin, Italy

Type: Residential Buildings

3.2.1 General Description

Arquata district was built at the beginning of the XX century.

The retrofitting of the council buildings is subjected to several constraints, given the valuable and historical kinds of decoration of their facades.

The thermal insulation of the 30 council buildings has been applied to the floor of the garrets using a layer made of sintered expanded polystyrene. The insulating materials that has been used is a product called “BITUROLL AE 20/G2V”

The original project included the substitution of lamps (about 100) in the internal courtyards of the council buildings with induction lamps that would have assured a good level of energetic efficiency and a much greater duration, without any variation in the lighting level’s quality. The old lighting system project included two typologies of lamps:

Internal streets: mercury vapour lamps with 125 W power posed on 4.2 m high poles

Walking ways and court gardens: mercury vapour lamps with 80W power posed on 2.5 m high poles

In a further stage of the project, it has been decided not to change the lighting system because it has been the result of a recent substitution financed with Public funding (Contratti di Quartiere II).

The budget for this substitution (20,000 euros) has been shifted toward the demand side of the project.

Application of High Efficiency Glazing

The conventional glazing system has been substituted with a low emittance one (1 W/m^2K vs. actual 3.2).

500 conventional windows have been replaced with low emittance glazing and window frames (U_w = 1.6 W/m^2K instead of ~4).

Photovoltaic Plants

Photovoltaic plants for an overall peak power of 120 kW have been installed on the roofs of 12 district buildings.

Panels features:

Nominal Power:	200 - 215 W
Type:	Polycrystalline
Efficiency:	up to 14.7 %
Tilt angle:	27°

Water Telemeters in Council Buildings

We have already installed 214 water telemeters.

Features:

Nominal Flow	1.5 m^3/h
Maximum Flow	3.0 m^3/h
Pressure drop	0.1 bar

District Heating Network

Through the District Heating Network the energy produced by the Combined Heat and Power provides the heating and hot sanitary water to the Arquata district.

3.2.2 Building Specification

General information

Building characteristics	Heated building volume	90 828 m^3
	Total envelop area	30 276 m^2

Envelope construction

Element of building envelope	**National regulation***	**CONCERTO specification**	**As Built**
	NBE-CT-79 (Now already substituted by CTE)		
	U-Value [W/m²K]	**U-Value [W/m²K]**	**U-Value [W/m²K]**
Façades/wall		Not modifiable (due to constraints as historical buildings)	-
Roof		0.8 to 0.16	1.167
Ground floor		1.02 to 0.17	Not modified
Windows		3.1 to 1.0	1.45
Ventilation Rate		0.5	0.5

Energy consumption

	National Regulation [kWh/m² a]	**CONCERTO specification [kWh/m² a]**
Total Space Heating	110/85	70
Electricity	12	12
Lighting	10	10
Cooling	0	0

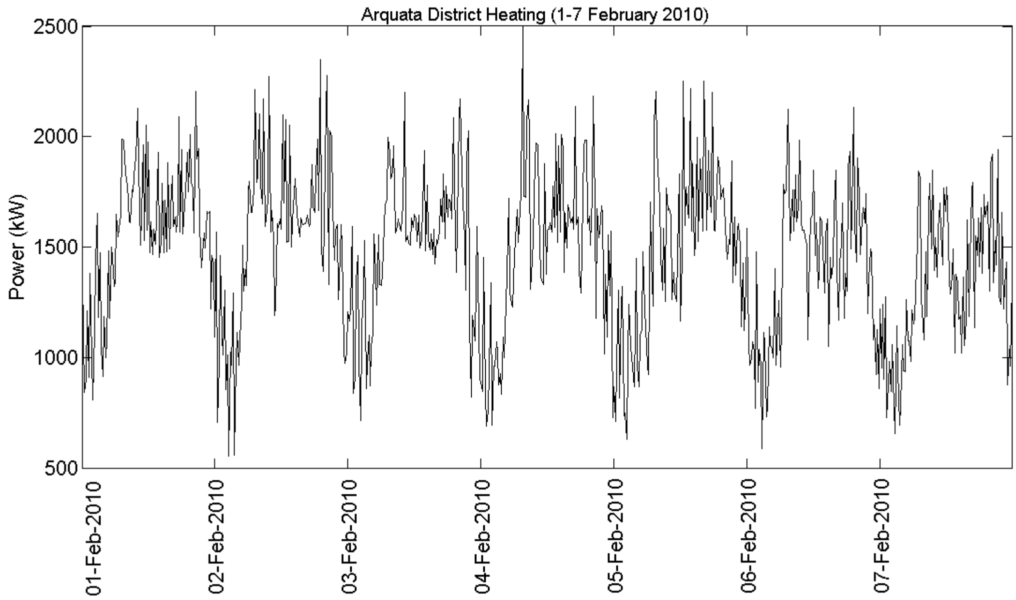
*In the Italian regulation Legge 10/1992, UNI 10349 and DPR 412/93 only the volume related heat loss is regulated (C_d value for transmission and an effective heat loss FEN_{lim} which includes ventilation loss and effective solar gains);U-Value is not regulated.

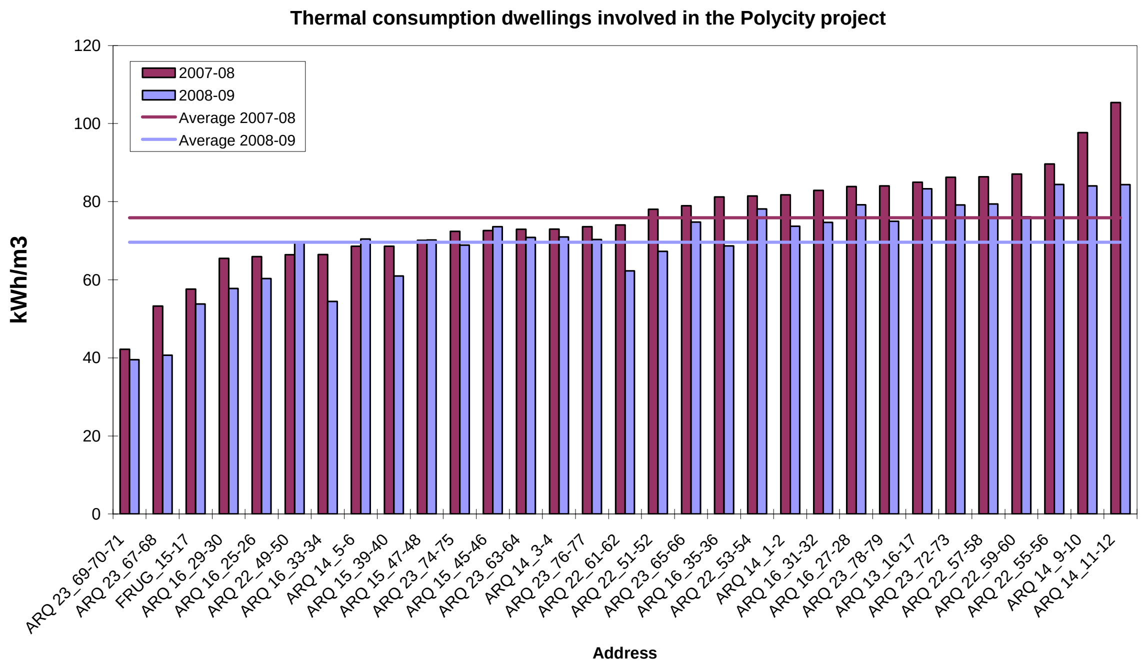
3.2.3 Thermal Consumption

The heat produced by the CHP provides the heating and the hot sanitary water to the Arquata district (through the district heating network).

We have data for the overall space heating consumption for the seasons 2007/2008 and 2008/2009 and the time trend from the I-CEMS data.

Season	2007-2008	2008-2009
Space heating consumption (kWh)	6 640 700	5 973 800





3.2.4 Electric Consumption

Electricity in Arquata is supplied by AEM by means of two substations (P_{n1} = 400 kW and P_{n2} = 250 kW).

In the month of January 2010 two additional meters were installed to get data about the aggregate consumption of the district.

The data provided from AEM at the moment are:

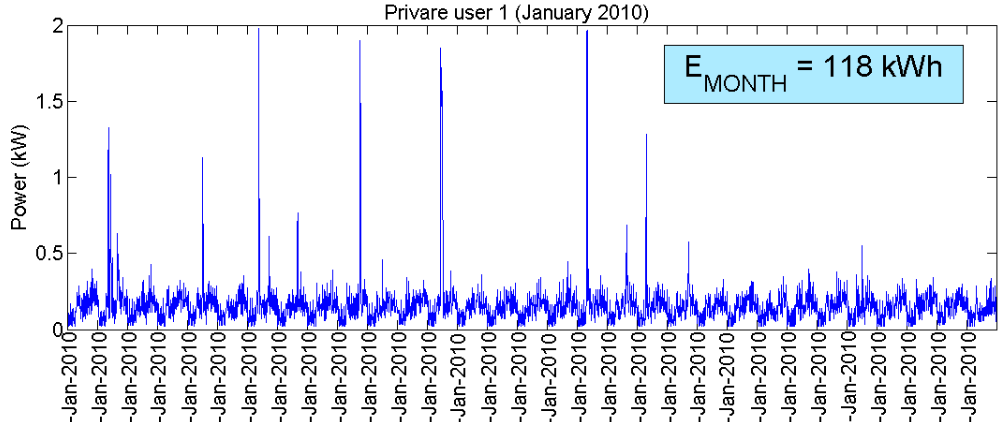
real power of some private users (fiscal data);

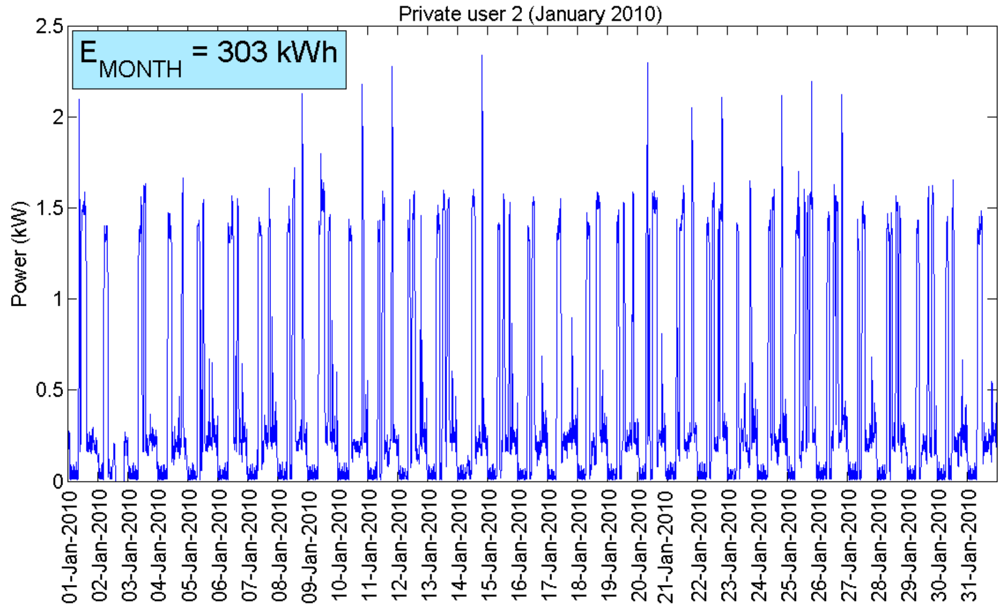
reactive power of some private users (fiscal data);

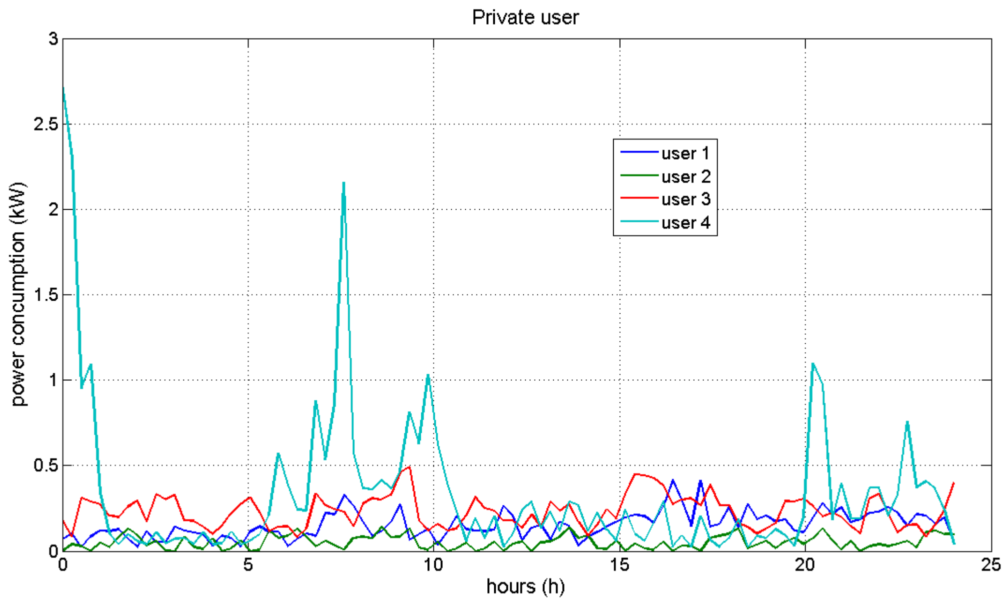
aggregate consumption of the district (fiscal data).

All the electricity AEM meters are not yet directly connected to I-CEMS, so AEM information are not “real time data”.

AEM provide data for 10 private users with a contractual power of 3 kW. The monthly and daily trends of users were compared. From the analysis of these trends it is possible to observe different behaviors of the users as shown in the following figures.

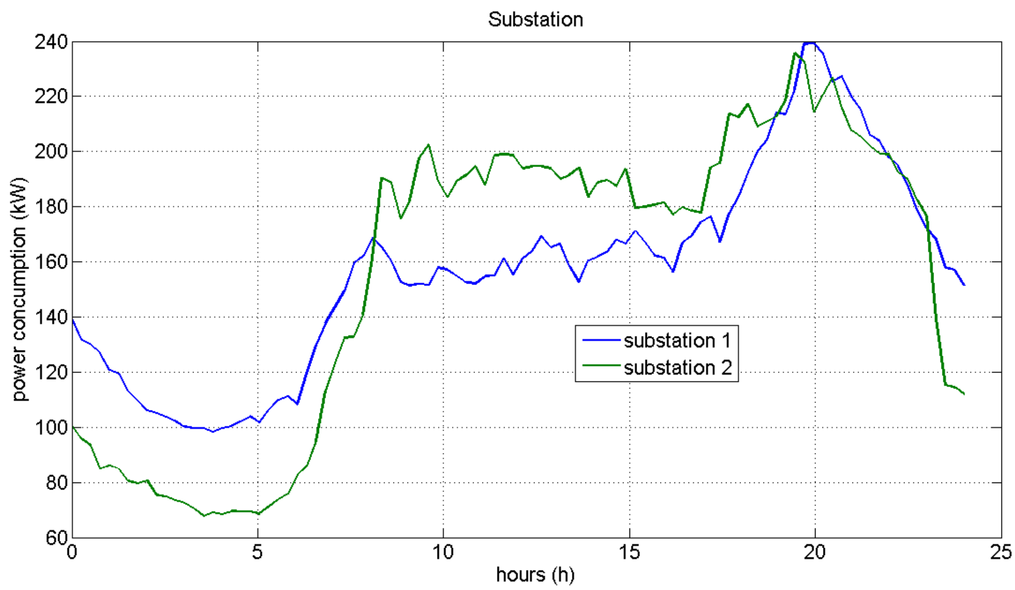

Privare user 1 (January 2010)
E_MONTH = 118 kWh
Power (kW)


Private user 2 (January 2010)
E_MONTH = 303 kWh
Power (kW)


Private user
user 1
user 2
user 3
user 4
power concumption (kW)
hours (h)

The two substations supply all the district, so the overall consumption of the district (including also some dwellings not involved in the Polycity project) can be calculated from data obtained by the new two meters. The average district electric consumption has been evaluated. And the time behavior of electric consumption in both substations is also shown in the following figure.

Average district consumption	2 232 MWh/a



3.2.5 Thermal Station

CHP

The CHP main features are:

Engine: DEUTZ TCG 2020 V12 K

Electrical power: 968 kW

Thermal power coming from hot water recovery on the engine block: 474 kW

Thermal power coming from hot exhaust gas recovery: 692 kW

η_{el} (guaranteed minimum at full load in ISO 3046 conditions): 0.386

η_{th} (guaranteed minimum at full load in ISO 3046 conditions): 0.464

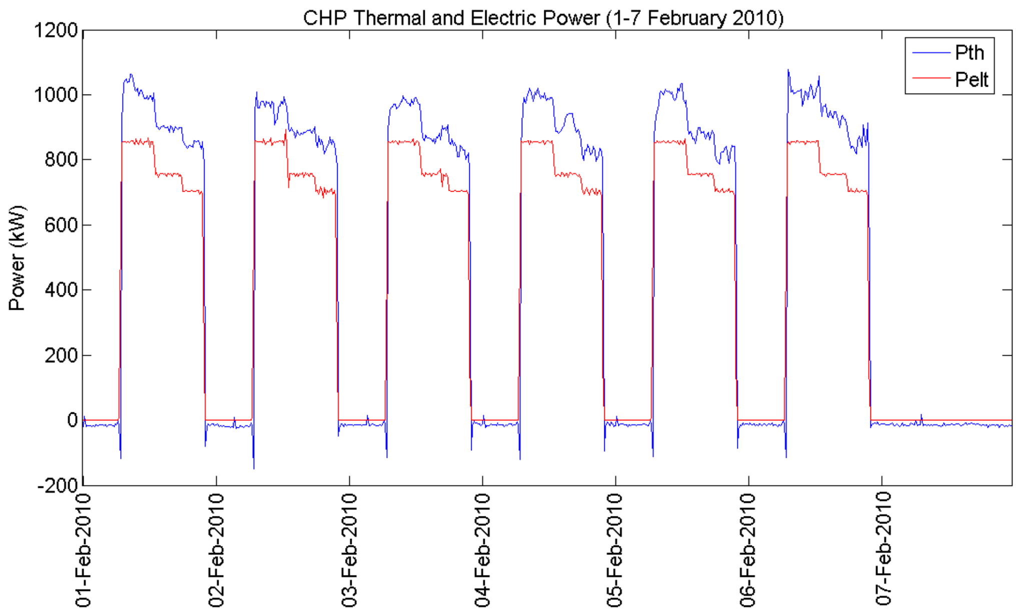
Overall efficiency: 0.85

Estimated maximum methane gas consumption: ~ 263 Sm^3/h

The thermal station is placed in the second floor underground of ATC building.

Season	2007-2008	2008-2009

CHP gas consumption (m3)	1 219 582.80	947 631.50
CHP electric production (kWh)	4 588 690	3 506 490
CHP thermal production (kWh)	4 249 016	3 465 692



3.2.6 Cooling System

The cooling system consists of:

a Lithium-Bromude absorption chiller TRANE RTWB 214, thermally coupled to the CHP unit (190 kW);

an electric compressor chiller TRANE RTWB 214 (476 kW).

Season	2007-2008	2008-2009
Electric consumption cooling system (kWh)	78 738.35	114 656.80
Thermal consumption absorption chiller (kWh)	116 900.00	190 800.00

3.2.7 Energy production Arquata district

Nr	Contract Number	Address	Period	kWh	Feed	€
1	30468478	Via Arquata 15 int. 40	Aug 08- dec 09	14284.00	0.42	5999.28
2	30468442	Via Arquata 15 int. 46	Aug 08- dec 09	14322.00	0.42	6015.24
3	30247244	Via Arquata 15 int. 47	Aug 08- dec 09	16998.00	0.42	7139.16
4	30247222	Via Arquata 16 int. 25	Aug 08- dec 09	14568.00	0.42	6118.56
5	30247237	Via Arquata 16 int. 33	Jan 09	11408.00	0.42	4791.36
6	30468566	Via Arquata 22 int. 49	Aug 08- dec 09	14284.00	0.42	5999.28
7	30468446	Via Arquata 22 int. 51	Aug 08- dec 09	17048.00	0.42	7160.16
8	30247211	Via Arquata 22 int. 53	Jan 09	11408.00	0.412	4700.10
9	30497010	Via Arquata 22 int. 57	Jan 09	12659.00	0.451	5709.21
10	30247224	Via Arquata 23 int. 76	Aug 08- dec 09	16959.00	0.42	7122.78
11	30468442	Via Arquata 23 int. 78	Aug 08- dec 09	17090.00	0.42	7177.80
12		Via Arquata 16 int. 35	Aug 08- dec 09	12950.00	0.42	5439.00
				173978.00		73371.93

3.2.8 PV-yield residential buildings