POLYCITY Project

Energetic and Urban Regeneration
of the Arquata District
in the city of Torino
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The POLYCITY project

The objective of the urban development project supported by the EU-programme Concerto is to reduce the consumption of fossil fuel through energy-efficient buildings and the increased use of renewable energies. The scientific research conducted within the framework of the project focuses on innovative energy saving technologies. In that respect they employ simulation processes for the online optimization of the production of renewable energies on one hand and for the sustainable operation of the buildings on the other hand. The project respectively supports different aspects of urban development in three European cities: new buildings in locations which are still underdeveloped in the peripheral area of Barcelona, the renewal of an old city district in Turin and a mixture of re-development and new building in Schamhauser Park, a former military area close to Stuttgart. Each project is incorporated in a network of regional partners and further observer communities, which ensure an effective exploitation of the achieved results. Having completed the first half of the five-years project, we would like to present this leaflet to you which describes the preliminary results of the technical aspects thus far handled. For any other information, please contact the zafh.net, the coordination centre of POLYCITY.

Contact
zafh.net
M.Sc. Tobias Erhart, Dipl.-Ing.
Schellingstraße 24
70174 Stuttgart - Germany
Telephone: +49-711-8926-2601
tobias.erhart@hft-stuttgart.de
www.zafh.net | www.polycity.net

POLYCITY projects are located in Germany, Italy and Spain
Local Energy Supply in Arquata

District Heating & Cogeneration

A district heating network has been realized in order to supply space heating and sanitary hot water to the residential buildings as well as to the ATC building.

Bulk heat is supplied by a natural gas cogenerator:

<table>
<thead>
<tr>
<th>Electrical power</th>
<th>970 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Power</td>
<td>1166 kW</td>
</tr>
</tbody>
</table>

Peak demand is complemented by three high efficiency boilers:

<table>
<thead>
<tr>
<th>Thermal Power</th>
<th>1166 kW</th>
</tr>
</thead>
</table>

All the equipment was installed in the underground floor of the ATC building.

Heat is distributed by means of a 1.9km network of insulated pipes (delivery / return temperatures 75 / 62 °C).

At the beginning of 2008 a total amount of 489 dwellings were already served, corresponding to a heated volume of 73'000 m³ (67% of the total amount of 110'000 m³).

The remaining inhabitants (renters and/or owners) are expected as well to connect themselves to the district heating service.

In every single dwelling a satellite control module manages through a valve the inlet flow of hot district heating water, according to an environmental thermostat for space heating.

Sanitary hot water is produced by means of a dedicated heat exchanger inside the satellite module, with priority with respect to space heating.

A digital counter installed in the satellite module measures the heat consumed by the dwelling.
Solar power generation

In Arquata was realized one of the largest solar power generation installations in urban areas in Italy. Photovoltaic modules have been integrated on the roofs of the social housing buildings and on the façades of the ATC building. Mono-cristalline modules featuring 14.7% electrical efficiency were selected for all the installations.

Social housing buildings
Integration of photovoltaic modules was carried out on the roofs of 12 buildings. Installation and grid integration was completed in spring 2008.

<table>
<thead>
<tr>
<th>Total peak power</th>
<th>120 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly production</td>
<td>132 MWh/yr</td>
</tr>
</tbody>
</table>

ATC building
Integration of photovoltaic modules was carried out on the South-East and South-West facades. Installation and grid integration was completed in spring 2008. The modules have been installed such as to shade windows from direct solar radiation.

<table>
<thead>
<tr>
<th>Total peak power</th>
<th>50 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly production</td>
<td>55 MWh/yr</td>
</tr>
</tbody>
</table>

Solar modules on social housing buildings

Sun shading

<table>
<thead>
<tr>
<th>Cogeneration</th>
<th>Photovoltaic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Energy</td>
<td>4123 MWh</td>
</tr>
<tr>
<td>Thermal Energy</td>
<td>4956 MWh</td>
</tr>
</tbody>
</table>
Buildings refurbishment

Social Housing Buildings

Different refurbishments have been implemented to reduce the energy consumption of the district while keeping equal or increased quality of life for the inhabitants.

Built at the beginning of the XX century, the Arquata buildings are subjected to several construction constraints, particularly on the decorated facades, in order to preserve their architectural value.

Cost/benefit evaluation was made to ensure return of investment costs from energy savings.

Refurbishment of roofs, facades and dwellings was made in the district regeneration programme.

Conventional glazing and window frames were replaced on North-East and North-West facades by low emitting components (Uw ≤ 1.6 W/m2K).

Induction lamps were installed in the courtyards.

Refurbishment will be completed in Summer 2008.

<table>
<thead>
<tr>
<th>Unit demand</th>
<th>Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>90 kWh/m2/yr</td>
</tr>
<tr>
<td>Electrical energy</td>
<td>17 kWh/m2/yr</td>
</tr>
</tbody>
</table>

(*) Savings are difficult to estimate. Expected reduction is substantial, especially on primary energy due to the substitution of electrical boilers for heating service in the apartments.
**ATC building**

Built in the 70’s the ATC building is a high storey commercial building with wide glazed facades.

Different measures have been implemented to reduce the energy demand of the building (electrical, thermal, cooling).

Conventional glazing and window frames were replaced on the North facades by low emitting components (Uw ≤ 1,65 W/m2K).

Thermal insulation was increased by the installation of wooden fibre panels and bituminous sheath to insulate thermal bridges.

Efficiency of the climatisation was improved by the installation of an absorption chiller.

Cooling is generated from the heat produced by the cogeneration unit (tri-generation).

Electrical demand for cooling is consequently lower.

<table>
<thead>
<tr>
<th></th>
<th>Cogeneration</th>
<th>Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>56,6 kWh/m2/yr</td>
<td>-25%</td>
</tr>
<tr>
<td>Electrical energy</td>
<td>58,4 kWh/m2/yr</td>
<td>-10%</td>
</tr>
<tr>
<td>Cooling</td>
<td>20 kWh/m2/yr</td>
<td>-25%</td>
</tr>
</tbody>
</table>
District Energy Management

The I-CEMS System

Energy management in Arquata is supported by the Integrated Energy Management System (I-CEMS), the most relevant innovation of POLYCITY.

Aim of the system is to enable the integration of the local energy demand with the local supply by means of an intelligent automated control suitable to the optimized governance of the service.

The operational perimeter of the I-CEMS network extends on 87,000 m² area, that includes 31 buildings and a population of nearly 2,000 persons.

Monitoring functions:
- electrical + heat consumption in district dwellings (1200 digital meters)
- electrical + heat + cooling consumption in ATC building (100 digital meters)
- environmental parameters (pollutant emissions, meteo, solar radiation)
- Photovoltaic power production on district buildings and ATC building
- Distribution of district heating network

Control functions:
- Power, heat, cooling production by tri-generation local plant

Implementation of the I-CEMS will be completed in Fall 2008.

I-CEMS concept

I-CEMS is constituted by:
- wireless communication infrastructure to control all the nodes within Arquata where energy is produced and/or consumed and/or exchanged with the electrical grid;
- automated control system to perform energy management of the whole district.

I-CEMS System Architecture
Impact on the Arquata district

Sustainability

Substantial impact is expected from POLYCITY with respect to previous situation in terms of primary energy saving and of CO2 emissions reduction.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Saving</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Energy</td>
<td>-7786 MWh/yr</td>
<td>-43%</td>
</tr>
<tr>
<td>CO2 Emissions</td>
<td>-1997 tCO2/yr</td>
<td>-52%</td>
</tr>
</tbody>
</table>

Other Impacts

The POLYCITY project is expected to produce economic and social benefits at different levels:

- Saving in energy costs (30-40% with respect to initial situation);
- Value increase of real estate due to the efficiency improvements;
- Improved quality of life and services for the inhabitants (space heating, sanitary hot water, roads illumination,…);
- Information and education regarding sustainable services and consuming behaviours.

Legend

- Natural Gas
- El Energy
- Heat
- Cold Water

Energy Balance of Arquata (in MWh/yr)
Socio-economic research

User Centred Design

Final aim of the socio-economic research in Arquata is to assess if and how much the measures introduced by POLYCITY had positive impact on the district. The overall research is based on the user-centred design approach, a consolidated methodology used in the ergonomic field.

A multi-competence CRF team developed the methodology that was applied, involving experts in ergonomics, psychology, statistics, marketing, engineers.

All the stakeholders in Arquata (inhabitants, public administration, real estate owner, energy supplier) are involved at every stage of the project in order to adapt the design to the real needs.

Stakeholders involvement

A communication strategy was developed and applied in order to involve, train and inform all the relevant local actors.

As a first step of the coordinated communication plan a corporate image and a POLYCITY mascot were created in order to better communicate with the inhabitants in collaboration with the Arquata Agency for social accompaniment.

Agency Centre & mascot

Different instruments were created for each category of final users (information leaflets, info days for Arquata inhabitants, experts and for the public).

Info days and leaflets

Handbooks, guides and training days were organized for Arquata inhabitants. Aim is to maximize the rational use of the implemented energy efficiency measures.

Training days and handbooks
Evaluation Methodology

The Evaluation Methodology was developed as a comprehensive monitoring system suitable to assess the environmental, economic and social impacts of sustainable energy measures such those of POLYCITY.

Perceived and objective qualities are monitored in order to assess the value added created.

First step of the methodology has been the definition of the social, economic and environmental indicators suitable to monitor the performance of the project and the quality of life aspects in the district.

Subjective Assessment

Arquata inhabitants were directly involved. A sample of 100 families was interviewed and filled a two weeks diary regarding use of home appliances, expectations, personal attitudes, satisfaction, usability of energy systems and services.

Objective Assessment

A comprehensive set of economic, environmental and energetic parameters have been selected as quality and performance indicators.

Common parameters with German and Spanish regional projects were adopted.

Data collection in Arquata is made by means of direct measurement and/or integrated by simulation models.

Modelling

Statistical analysis of the collected data was carried out.

Correlation of subjective-objective indicators was analyzed in order to define quantitative measures for subjective aspects and qualities.

As a result an integrated evaluation framework was created to assess the overall socio-economic impact of POLYCITY.

The same methodology could be applied also in different contexts and situations (partially applied in Ostfildern and Cerdanyola sites).

Tracking

The evaluation framework was applied in 2006 in order to assess the situation in Arquata before the POLYCITY implementations.

The assessment will be replicated after the implementations (in winter 2008) in order to compare results, to verify compliance with the project expectations and finally to assess the impact effectively perceived by the inhabitants.

The participation of the inhabitants demonstrated to be a real asset for the POLYCITY project to achieve the ambitious results so far.
Contacts

Scientific Coordination, Energy Management, Socio-economic

Centro Ricerche Fiat
Ing. Pasquale Campanile – strada Torino, 50 – 10043 Orbassano - Italy
Telephone: +39-011-9083 977 – pasquale.campanile@crf.it
www.crf.it

Buildings Refurbishment, Energy Supply

Agenzia Territoriale per la Casa della Provincia di Torino
Ing. Luigi Fazari – corso Dante, 14 – 10134 Torino - Italy
Telephone: +39-011-3130 468 – l.fazari@atc.torino.it
http://portale.atc.torino.it/

Energy Supply

Azienda Energetica Municipale - Distribuzione
Ing. Marco Cerchio – Corso Svizzera 95 - 10143 Torino - Italy
Telephone: +39-011-19562579 – Marco.Cerchio@aemdistribuzione.torino.it
www.iride-energia.it

Energy Management

Politecnico di Torino
Prof. Michele Tartaglia – corso Duca degli Abruzzi, 24 – 10129 Torino - Italy
Telephone: +39-011-562 5234 – michele.tartaglia@polito.it
www.polito.it

Socio-economic

Comune di Torino - Settore Rigenerazione Urbana e Sviluppo
Dr. Francesco Maltese – Via Corte d'Appello, 16 - 10122 Torino
Telephone: +39-011-4432519 – francesco.maltese@comune.torino.it
www.comune.torino.it