

# ARCHITECTURE, PHOTOVOLTAIC SYSTEMS, RENEWABLE ENERGY ET ENERGY EFFICIENCY

*Feedback on the technical travel organised in the  
Netherlands in 2008*

## A CONCERTO- RENAISSANCE PUBLICATION





## What is CONCERTO ?



CONCERTO was launched and co-funded by the European Commission under the 6th and 7th Framework for Research and Technological Development of the Directorate-General for Transport and Energy (DG TREN).

**The main objective of CONCERTO is to join innovation and demonstration efforts in the fields of renewable energy, energy efficiency and the building sector.** CONCERTO focuses both on existing and new buildings, transforming them into high energy performance infrastructures in a **cost effective way** to offer **up to 80 percent in conventional energy savings** potential.

The CONCERTO initiative currently comprises 45 communities in 18 different projects in 18 European countries.

The CONCERTO project is often presented as a full-sized laboratory that is able to dare restrictive perspectives. **Capitalization and diffusion of contributions will be realized by CONCERTO PREMIUM**, an interdisciplinary team who conveys cities' recommendations to European Commission and national authorities.



## What is RENAISSANCE?



**RENAISSANCE** stands for : **Renewable ENergy Acting In SuStainable And Novel Community Enterprises**

RENAISSANCE was launched in 2003. It currently comprises the consortium formed by Saragossa's Municipality (Spain), Grand Lyon area (France) and the region of Lombardia (Italy) as observer.

**The project submitted by these cities stands for two exemplary urban operations** and has been graded first rank by experts. **Grand Lyon** is the project leader since 2006.

In Saragossa, 616 social housings the Sustainable Town Planning Centre have been constructed in *Valdespartera* and 196 social housings and a school refurbished in *El Picarral*. A *Centre for Sustainable Urbanism* has also been constructed as an exhibiton and training centre.

In Grand Lyon, 660 dwellings and 15,000 sqm of office have been constructed in La Confluence as part of an ambitious city-centre urban regeneration.

The Region of Lombardia is involved on research and development project activites.

- RENAISSANCE project duration: 7 years - October 2005 to October 2012
- **Total cost of project: 18 billions Euros, European contribution: 8,5 billions Euros**

To go further : [www.renaissance-project.eu](http://www.renaissance-project.eu)



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## I. Introduction

**As part of the CONCERTO-RENAISSANCE project, the association HESPUL organized on the 15<sup>th</sup> and 16<sup>th</sup> of May 2008 a technical tour in the Netherlands. Local authorities (representatives and technicians), developer contractor, real estate developers and energy experts related with CONCERTO attended this travel.**

**Thanks to this technical tour, participants discovered large scale urban photovoltaic projects and innovative design and integration of photovoltaics. These projects are innovated in terms of energy efficiency of the buildings, the rational use of energy and are strongly linked with some Grand Lyon urban projects such as Carré de Soie, Lyon Confluence,... This illustrated document presents the different sites and projects visited and the relevant information gained.**

CONCERTO is a programme launched and co-funded by the European Commission under the 6<sup>th</sup> and the 7<sup>th</sup> Framework Programmes (FP) that currently comprises 45 communities in 18 European countries. The CONCERTO initiative was created to promote the integration of energy efficiency measures and renewable energy systems and to encourage the development of sustainable cities.

The RENAISSANCE project was the laureate of the request for proposal of CONCERTO projects in 2003. RENAISSANCE supports an integrated urban project involving key stakeholders (local authority, developer contractor, energy experts, university, real estate developers) and combining research, training and dissemination activities. Three territorial authorities are engaged : Saragossa in Spain, Region of Lombardy in Italy and Grand Lyon in France, leader of the demonstration project located on the Lyon Confluence area.

HESPUL is a non-profit organisation specialised in renewable energy sources and rational use of energy. HESPUL is recognized thanks to the introduction in France of the first on grid-connected photovoltaic system since 1992 and the implementation of hundred systems via European projects under the 4<sup>th</sup> and 5<sup>th</sup> FP between 1993 and 2001.

HESPUL also participated in the IEA PVPS task 10<sup>[1]</sup>, dedicated to large urban scale and integrated photovoltaic applications. A book named "Photovoltaics in the Urban Environment" has been edited which gives an overview of case studies from a range of European cities and explains what did or didn't work in their PV projects.

Thanks to its unusual history, HESPUL established useful contacts for the organisation of this technical tour.

[1] International Energy Agency (IEA) Photovoltaic Power Systems Programme (PVPS) task 10/  
Programme sur les Systèmes Photovoltaïques de l'Agence Internationale de l'Energie tâche 10

## II. Energy Research Centre of the Netherlands (ECN) in Petten

**Located in Petten, a city at the north of Amsterdam, the Energy Research Centre of the Netherlands (Energieonderzoek Centrum Nederland, ECN), has a unit dedicated to the Energy in the Built Environment since the mid-90s.**

ECN develops concepts and products with the objective of the "environmental neutrality" in the built environment : new buildings which could balance the environmental impact of the existing buildings. The energy pyramid is a methodology used to design projects combining demand reduction, the use of renewable energy and the optimisation of devices working with fossil fuels. ECN is also the project manager of an interesting example of a refurbished building and a new one.

**Energy production systems are tested in real conditions thanks to passive house prototypes : heating pumps, earth tubes, co-generation, solar thermal panels, photovoltaic systems, hybrid solar panels (thermal and photovoltaic), solar cooling,...**

**Figure 1.1**

The « energy pyramid » methodology is used by ECN to reach the objective of the « environmental neutrality » in the built environment around 2050.



**Figure 1.2** South side of the building 31 before refurbishment (on the left) and after Building 31 (on the right).

**Figure 1.3**

The front of this building was renovated with insulated bricks to reduce thermal bridges which considerably reduces heating needs.

### A RETENIR

The Building 31 is a successful example of eco-refurbishment. The heating consumption decreased from 140 to 40 kWh/m<sup>2</sup>/year and the specific consumption of electricity from 80 to 50 kWh/m<sup>2</sup>/year.

On the south side of Building 31, the photovoltaic sun-shades improve the thermal comfort during the summer while producing renewable electricity.



**Figure 1.4**

Entrance hall of Building 42 whose glass roof is made of photovoltaic cells.

### KEY POINTS

In the entrance of Building 42, the roof is a mix of wood and photovoltaic panels. The result is a shiny hall and a pleasant atmosphere whilst the roof is producing energy.



**Figure 1.5**

Prototypes of passive houses used to simulate the energy efficiency of different insulating techniques.

**Figure 1.6**

Passive house on a rotary base in order to show the impact of the orientation on the energy needs.



**Figure 1.7**

Wall made of seashells which are taken from the beach located near the ECN centre. This is an example of the exploitation of local resources.



[www.ecn.nl](http://www.ecn.nl)





## III. RAU Agency in Amsterdam

**This architecture agency created in 1992 by Thomas RAU aims at designing buildings with a total respect of the Environment and Humans: resource saving, reuse of building wastes, users' comfort.**

The RAU agency get a large media coverage with the design, in 2006, of the WWF headquarter in the Netherlands. Numerous publication were made in specific journals in architecture on this CO<sub>2</sub> neutral building. In France, the RAU agency is designing the cooperation and ethical finance centre in Carré de Soie l'Îlot Touly in Vaulx-en-Velin (Grand Lyon).

The RAU agency aims at solving problems thanks to architecture and design to then simplify the energy systems and decrease the construction costs: a High-tech architecture for a Low-tech building !

All the energy available on the site such as human heat and solar energy, is used to reduce buildings energy consumption.

The RAU agency buildings are generally multipurpose, offices and dwellings for instance, in order to optimize energy consumption and the heat loads transfer.

The RAU agency buildings are designed to have different possible uses during their life and can be recycled with no major works.

RAU agency only works with the project owners who will be the final users of the building in order to know their needs and optimize the design.

**Figure 2.1**

The office of RAU agency is the first illustration of Thomas RAU's philosophy. This old port building was refurbished into an office building with a total economy of means. The employees only work 4 days a week to preserve their private life.



**Figure 2.2**

The WWF headquarter in Zeist (Netherlands), delivered in 2006, is an example of the eco-refurbishment of an agro-lab in offices. The building is now self-sufficient and produces no CO<sub>2</sub> at all. The renovation costs were equal to those of a "standard" refurbishment.

**Figure 2.3**

Block Touly: the cooperation and ethical finance centre in the Carré de Soie area (in Vaulx-en-Velin - Grand Lyon). It consists of 21 000 m<sup>2</sup> of offices and social housing and has been designed to produce the equivalent of the annual energy consumption of the building.



**Figure 2.4**

The municipal building of Middelburg in the Netherlands is a good example to show the possibilities to recycle a building. If necessary, this building made of 4 blocks built on a base could be turned into a shopping centre and a hotel without major works.

**Figure 2.5**

The headquarters of the ethical bank Triodos in Zeist have been extended in 2006. Its energy consumption is lower than the regulatory threshold of energy consumption for building offices in the Netherlands.



RAU

[www.rau.nl](http://www.rau.nl)

## IV. The « City of the Sun » in Heerhugowaard

**Heerhugowaard is a municipality of 50 000 inhabitants located in the north of Amsterdam. In association with 2 others cities, Alkmaar and Langedijk, the city of Heerhugowaard drew up the project to build 3 000 low CO<sub>2</sub> emission houses compared to standard operation.**

After the analysis of energetic solutions, the municipality of Heerhugowaard defined 2 priorities : the large scale use of photovoltaics and the decrease of energy consumption of the houses. This operation, named « City of the Sun » (Stad van de Zon), has been co-funded by the European Union through the programme SunCities. 5 MW of photovoltaic panels have been implanted into the three municipalities : 1 MW in Alkmaar, 400 kW in Langedijk and 3,6 MW in Heerhugowaard.

The municipality of Heerhugowaard has been involved since 10 years in this world wide project : the construction of a district of 3 000 high-performance buildings, the « City of the Sun ».

Although Heerhugowaard is a quite small city of 50 000 inhabitants, this operation has been the most ambitious in the world concerning the use of photovoltaic panels in urban areas..

Photovoltaic panels are a strong visual elements in Heerhugowaard but the roofs are not yet full of. An average of 10 m<sup>2</sup> of solar panels per house (1 kW) have been installed.

Meetings have been held with the architects to improve the architectural and visual integration of the photovoltaic panels. It was excluded to use building integrated photovoltaic products (BIPV) in order for the real estate developers not to face problems related to water damage.

According to the municipality of Heerhugowaard, the benefits of its participation in a European programme have been superior to the inconvenience encountered thanks to the exchange of experiences and the communication done in the project.

**Figure 3.1**

Aerial view of the « City of the Sun », urban extension of the City of Heerhugowaard on 120 hectares and named "The Square".







**Figure 3.2**

The information centre is situated in the centre of the district, it has been created by the city of Heerhugowaard to welcome visitors.



**Figure 3.3**

Different house designs form the « City of the Sun » : single family detached homes, terraced houses, blocks of flats. It's a mono-functional area only dedicated to residential uses.



[www.heerhugowaard.nl](http://www.heerhugowaard.nl)



## V. Parkrand Building in Amsterdam

**The Parkrand building, named Buurt Ne9en and located in a district in the west of Amsterdam, was designed by MVRDV and the interior designer Richard Hutten et également nommé buurt Buurt Ne9en.**

With the collaboration of real estate developers and social landlords, the municipality of Amsterdam initiated a urban renewal project at a large scale to change the bad reputation of the district. The result is an "opened" building in order not to feel isolated from the rest of the district.

This building was designed by MVRDV which is also part of the architect team in charge of the Monolithe in Lyon Confluence (Grand- Lyon).

The size and the design are similar to the Monolithe, in construction in Lyon Confluence.

The Buurt Ne9en is not an efficient building and does not use renewable energy sources.

Building characteristics :

- Ground coverage: 4 590 m<sup>2</sup> (135 m x 34 m)
- Surface area: 35 300 m<sup>2</sup> with 560 m<sup>2</sup> for the crèche
- Height: 34 m (10 floors)
- 223 rented dwellings with 30 social dwellings
- Construction costs: around 1 300 €/m<sup>2</sup>

**Figure 4.1**

South and East sides of the Parkrand building : the front side of the two arches are different from the inside ones.





**Figure 4.2**

East side of the Parkrand building.

**Figure 4.3**

South side of the Monolithe (ING Real Estate) in Lyon Confluence. This building is made of 5 different types of facade with one made by MVRDV. The heating needs of this building are low, around 40 kWh/m<sup>2</sup>. PV panels, solar thermal panels and a wood fuel boiler will be installed.



**MVRDV**  
[www.mvrdiv.nl](http://www.mvrdiv.nl)





## VI. Nieuwland, solar city in Amersfoort

**Nieuwland is a district of Amersfoort city in the centre of the Netherlands. The construction of this sustainable district lasted from 1995 to 2002. Here was experienced the concept of solar city (1MW), the first project of this magnitude in the world. Nine teams of architects were selected to design the houses of various plots of this residential area.**

This district was a great opportunity to make experimentations on the use of photovoltaics through the diversity of the techniques used and the conditions of exploitability (collaboration with tenants, social landlords, homeowners,...). Some of the buildings include :

- 2 energy efficient schools,
- 500 private dwellings,
- 50 social dwellings,
- 19 energy self-sufficient owner-occupied dwellings,
- 2 semi-detached houses using solar panels and the rational use of energy.

Two blocks were designed by Bouwfonds, the real estate developer of the block B-Lyon Islands in Lyon Confluence.

Even if PV panels are very present, the roofs' potential is not saturated.

Different solutions have been found for the physical integration of the PV modules : integration to the roof, to the facades, to porches,...

One of the schools has more than 192 solar panels.

The most of the photovoltaic projects have been developed to face the maximum of problems in order to gain technical and administrative experience.

The houses orientation has been modified from the previous urban plan : the East/West orientation of a numerous number of streets has been corrected for a North/South orientation, more favourable to solar panels productivity.

**Figure 5.1**

Aerial view of Nieuwland district in the North-West of Amersfoort.





**Figure 5.2**

The houses orientation has been modified from the previous urban plan : the East/West orientation of a lot of streets (picture on the left) has been corrected for a North/South orientation (picture on the right), more favourable to solar panels productivity.



**Figure 5.3**

Entrance of the sports hall. The roof of the bicycle parking is made of photovoltaic cells.

**Figure 5.4**

South side of a building : example of photovoltaic panels integrated into the facade.





**Figure 5.5**

Family single detached houses with photovoltaic panels. The panels can be integrated to the roof or be the roof.



**Figure 5.6**

Porch made of photovoltaic modules.



**Figure 5.7**

Semi-detached houses with a roof made of solar thermal and photovoltaic panels. The roof looks like to be uniform besides the different solar modules used : standard, multicrystalline, single-crystal, semitransparent, double-glazing,...

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[www.rencom.nl](http://www.rencom.nl)



## VII. Annexe - List of participants

### Grand Lyon



### La Ville de Lyon



[www.lyon.fr](http://www.lyon.fr)

### SPLA Lyon Confluence



[www.lyon-confluence.fr](http://www.lyon-confluence.fr)

### ALE du Grand Lyon



[www.ale-lyon.org](http://www.ale-lyon.org)

### Nexity-Apollonia



[www.nexity.fr](http://www.nexity.fr)

### Bouwfonds-Marignan



[www.boufinds-marignan.com](http://www.boufinds-marignan.com)



**ATEMI**

[atemi-immobilier.com](http://atemi-immobilier.com)

### SIGERLY



[www.sigerly.fr](http://www.sigerly.fr)

### INSA-Cethil



[www.insa-lyon.fr/cethil](http://www.insa-lyon.fr/cethil)

### HESPUL



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## Executive Summary

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