Bairro do Padre Cruz, Lisbon, Portugal

1. Introduction

Bairro do Padre Cruz is a neighbourhood located in the northeast side of Lisbon; in the parish of Carnide. It is the biggest low-income residential neighbourhood in Portugal and one of the biggest of the Iberian Peninsula. This neighbourhood has its roots in the late 50’s, when its first construction phase occurred to give a quick response to re-housing needs. The newly constructed neighbourhood had a temporary nature and as such relied on simple construction methods and rustic materials seldom used in vernacular residential architecture. Also, the social housing being provided was expected to be short lived. Nonetheless, that premise did not hold up true and the neighbourhood continued expanding in addition to this initial urbanisation, suffering still three more phases of urbanization.

The rehabilitation plan of the Bairro do Padre Cruz neighbourhood was coordinated by the Municipality of Lisbon by following a priority action plan to be undertaken due to the state of the area. The plan took into consideration several assumptions, namely the need to eliminate the negative image of re-housing neighbourhoods and revitalize the urban tissue; create reallocation and youth-oriented housing with urban coherence and constructive quality; and, within this line create endogenous living spaces in the neighbourhood. The plan also introduces the valorisation of the blocks’ inner-halls with leisure spaces and the introduction of equipments and commercial spaces. Mobility is an issue taken into account. The plan is designed to discipline the traffic access to the neighbourhood and to promote pedestrian mobility for which careful design of pedestrian routes is pursued. The area of intervention is 111.943 m2 and 1619 homes are to be constructed in 18 lots with a total area of 50.764 m2. 10% of this area is allocated to commercial purposes.
2. The Lisbon Ideas Challenge

The Lisbon Ideas Challenge is an international design competition initiated by PV Portuguese experts from the Centre for Innovation, Technology and Policy Research, IN+, at Instituto Superior Técnico, Technical University of Lisbon involved in the IEA-PVPS-Task 10 which aims at fostering and promoting PV deployment in urban areas. Following a first edition of the competition, which called for ideas for urban structures integrating PV, the organizers of the competition decided to turn this initiative into a more inclusive project for Lisbon and promote the integration of PV in one of the most relevant low-income neighbourhoods in Portugal. The motivation was to ally PV dissemination with the possibility to create the first solar neighbourhood in Lisbon.

The 2nd Lisbon Ideas Challenge aimed at promoting the presentation of ideas of well integrated and well-designed urban renovation/rehabilitation plans for the transformation of a low-income residential neighbourhood of Lisbon into a Solar Neighbourhood.

This Solar Neighbourhood’s intent is to serve the triple purpose of technological demonstration site, pro-active dissemination and education, targeting several stakeholders, from the local community to public authorities, passing through energy services companies.

As Portugal is one of the European countries with lowest PV capacity installed, mainly due to lack of proper governmental incentives and complex administrative procedures, the most important question was to get the attention and cooperation of the Lisbon Municipality. For this, the first step was to involve National Energy Agency, ADENE, who supported the project from the very beginning, as well as the Lisbon's Municipal Energy-Environment Agency, Lisboa E-Nova, who is the direct link to the Lisbon Municipality.

Finally, from the already existing plan developed by the Empresa Pública de Urbanização de Lisboa (EPUL), the Municipality of Lisbon assisted by several organisms, decided to boost this renovation project and invited the international community of architects, designers and engineers to present proposals of integrated renovation/rehabilitation programmes of urban intervention that valorise the area and transform this neighbourhood into a 1 MWp solar neighbourhood. the Centre for Innovation, Technology and Policy Research, IN+, at Instituto Superior Técnico,
Technical University of Lisbon in straight cooperation with the National Energy Agency, ADENE and the Lisbon's Municipal Energy-Environment Agency, Lisboa E-Nova, Competitors were requested to present intervention ideas for urban renovation and rehabilitation plans for one commercial building, a kindergarten and a social housing apartment block of the low-income residential neighbourhood of Lisbon, Bairro do Padre Cruz, Carnide. They were asked to take into account the three following factors:

- **Integration**: PV materials should be adequately integrated in the urban-scale design concept, both physically and aesthetically. The level of integration should be explicitly stated in the design description, as well as the identification of functional added values of the PV materials,

- **New applications or technological concepts**: Entries should attempt to make use of PV materials in innovative ways, both regarding conventional and new technological concepts,

- **Communication**: The use of well-integrated PV materials should be explicit and therefore easily communicate with the general public

The objective of the **2nd Lisbon Ideas Challenge** was to turn transformation of a low-income residential neighbourhood of Lisbon into a **1 MWp Solar Neighbourhood**.

Competitors were requested to present intervention ideas for urban renovation and rehabilitation plans for:

- one commercial building
- a kindergarten
- a social housing apartment block

The Lisbon Municipality hopes to adopt and effectively implement the winning entries.

**Commercial Building**

The commercial building is a shopping centre with a rectangular shape and an open space in the middle. The commercial building can integrate PV materials in the South, East and West facades and also in the flat roof cover. Solutions combining PV properties of shadowing effects and natural lightning functions were presented both for the roof and the facades.

The commercial building that won the 2nd Lisbon Ideas Challenge 1st prize was Shopping Delight. The concept follows an orthogonal grid plan similar to downtown Lisbon where blocks become shops and streets circulation space. A glass facade interrupts the shops allowing natural light in and views out. PV materials constitute the commercial building rooftops; a non-innovative approach that allies natural light with shadowing effects, forming shopping galleries. The North façade is covered with vegetation, hanging gardens, allying the PV integration strategy with other forms of expressing sustainability issues and possibilities.
Public Spaces: Kindergarten
The kindergarten is the most important public outdoor space in this block. It is intended to be a leisure area with special attention given to the possibility of integrating urban art aimed at increasing awareness of the technology among the community. In this public space the solutions presented covered a wide variety of structures from esplanades that ally PV panels with shadowing panels, to kiosks and lamps and innovative playgrounds integrating PV materials.
an energy dependency. Besides the electricity generation, PV –Flowers develop more functions in the urban space, working like parasols. Technically the panels green color might be satisfied using thin film technology, semi transparent, dealing with both energy production and shadowing effects. Being a self-standing structure, possible vandalism issues would also have to be considered, as well as the connection to the main network. Even so, the structures are designed to close themselves in conditions of darkness or bad weather. Considering all the kindergarten area, 78 m2 of PV surface would be installed.

Social Housing
The social housing apartment blocks under consideration were to be sustainable mass-production houses, including PV as part of a wider strategy. The block facing south is the best-oriented building in the whole intervention area. The building front faces one of the neighbourhood’s main streets, while the rear faces the kinder garden. The blocks will be 6-storeys high, providing 10 or 28 apartments. Being the best south oriented building under competition this housing block presents the possibility to integrate PV in the facades, covering balconies, shadowing devices to protect windows, or covering whole facades to provide natural light, same happening in the block’s flat roof, where it can be used as a skylight.

Solution to the residential block

The winning project for the social housing was PV Tile. The main idea is to create an object that can be applied to existing buildings, renovations, or to new constructions. The Urban Tile is a photovoltaic object inspired by Portuguese tiles where a three dimensional component has been added. Designed to be facing the best solar orientation optimizing solar gains and electricity production, the Urban Tile is designed to be 0.2 m2, a smaller PV surface breaking down the scale of standard PV panels, therefore becoming more versatile to integrate in buildings. The social housing building under competition is to integrate 118 PV Tile units, 5,400 m2 Urban Tile in the building South façade.
This project, housing PV tile, effectively responds to the purpose of the competition. Aimed at new housing concepts and refurbished buildings, the piece design is presented as an innovative and feasible product, considering the built environment for which is aimed at. Technically some issues have to be dealt with, namely the wiring system that might be complex, involving electrical losses and high installation costs. Also the overall maintenance cost of the building, the insulation of the building envelope and the vandalism constraints must be analyzed when considering the product development. Regarding the building conception, and not the piece itself, the achieved result evidences a good integration, despite the fact that the tile density on the top of the building is high and could cause shadowing effects between tiles.

3. Summary of problems, barriers, solutions and recommendations

How to get local decision makers to study the possibility of building a solar district?
Portugal is one of the European countries with the lowest PV capacity installed, mainly due to lack of proper governmental incentives and complex administrative procedures. Thus, PV is generally not seen as an energy option for buildings or for cities. Making international teams study the possibility to design a solar district in Portugal with the support of the Lisbon Municipality was therefore seen as hardly possible!

In order to get the attention and cooperation of the Lisbon Municipality, Portuguese PV experts benefited from the technical support of a programme of the International Energy Agency, the Photovoltaic Power Systems Programme, to initiate an international competition to design a 1MWp solar district in Lisbon, the 2nd Lisbon Ideas Challenge. This initiative was so successful that the Lisbon Municipality claimed to be willing to adopt and effectively implement the winning entries of this competition.

How to finance the construction of a 1 MWp solar district without any proper national incentives?
The project overall costs and business models have still not been developed. Despite that, several options are open and available for discussion, namely the ownership and maintenance responsibility of the systems and the legal framework to apply.

One of the possibilities is that the over cost caused by the integration of the PV panels in the neighbourhood is supported by the municipality in partnership with the utilities and regional and local energy agencies, in a clear action of enhancing, setting the example and fostering a new energy market that is beginning to rise. Being the owner of the system the municipality would also be the entity benefiting from the actual feed in tariff incentive scheme offered by the Portuguese legislation, what would allow the possibility to promote and set the example as an early investor in the green electricity market.

One other option is for the construction company to provide the investment and be the owner of the system and the responsible entity for its production and maintenance, exploring the system during its lifetime.

The development of this project can thus be an added value in both directions, the PV sector through the possibility to enter the independent power producer market in a more appealing way and the city by the sustainability and innovation image associated to the municipality.
4. Sources of further information

- [www.iea-pyps-task10.org](http://www.iea-pyps-task10.org)

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