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Architecture, urban design, energetic systems

Design of eco-sustainable industrial parks
with very low environmental impact, reduced use of water
and energy resources and optimized waste management

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Preface

This book summarises the outcomes of the ASIA PRO-ECO European research, “Design of eco-sustainable industrial parks with very low environmental impact, reduced use of water and energy resources and optimized waste management, feasibility study for implementation of a demonstration project to be realized in Asia”, developed by the local unit in Perugia¹, in collaboration with the Malardalen University in Västerås (Sweden), the Institute of Engineering Thermophysics of the Chinese Academy of Science in Peking and the Dongguan University of Technology. The principal objectives of this research concerned the elaboration of a feasibility study finalised to the realisation of two Industrial Parks in China: the first for 15,000 people situated in the South, in the region of Guangdong (close to the city of Dongguan); the second for 2,000 people, situated in the North, in the Shandong region (close to the city of Dezhou)².

The general objectives of the project, pursued through an interdisciplinary approach involving urban design, architecture and energy systems engineering, are four: 1. To reduce energy consumption through the study of adequate typological aggregations integrated with advanced systems for the production of renewable energies; 2. To reduce pollution and emis-

sion of greenhouse gases by integrating energy systems with infrastructures for mobility and solid and urban waste disposal; 3. To improve workers’ life conditions by the adoption of more comfortable building typologies, connected to green areas and to the open space system; 4. To improve buildings’ performances through adequate technical/constructive solutions (natural ventilation) and through the self-production of renewable energies. The design proposals (though at a preliminary project level) represent the first step of the ASIAPROECO European research; the second step will therefore be the realisation (demonstration) of the prototypes in order to experiment and verify the validity of solutions directly on field.

In practice, this book is organised in three parts: in the first one, methodological questions and global strategy issues are presented for the reduction of greenhouse gases from large residential and industrial estates. Both historical references and relevant standards, as well as aspects of renewable energy production and operation of the main structures for solid and urban waste disposal are included. In the second part, the technical description of the proposed solution is considered, both in qualitative and in numerical terms, with particular attention to the infrastructures for the production of renewable energies and the reduction of greenhouse gases emission. In the third part, you can read

about two projects developed in the occasion of two international competitions, which were deemed significant to go deeper into some of the themes approached in the Industrial Park research³. Finally, in the apparatuses section, a synthesis is offered of the numerous initiatives, conferences, workshops organised by the research group in the period going from 2006 to 2009. The projects have been publicly presented indeed to the Chinese press (and to a se-

lected representation of the academic, political, financial and industrial world) through a series of workshops and conferences, organised between 24th November and 2nd December 2006 among Peking, Shenzhen and Dongguan and also to the Italian press and scientific community through an international conference "China and sustainability: compared experiences", held in Perugia on Friday 22nd June 2007, in the Sala dei Notari of Palazzo dei Priori⁴.



Shanghai Urban Planning Exhibition Hall

Notes

1. The research group, coordinated by the undersigned, is formed by the engineers Livia Arcioni, Luca Cesaretti, Daniela Leonardi, Stefania Proietti, Nicola Sorbi, Francesco Zepparelli and by the architect Maria Luisa Zeppa.
2. A first synthesis of the research has been published in 2011 in: 'Verducci P., Energie rinnovabili e ricerca progettuale. Due casi studio: i progetti di fattibilità per la realizzazione di due parchi industriali in Cina, in "Il progetto di architettura tra ricerca e didattica", Bari, 4-6 May 2011, pp. 693-702, (edited by Claudio D'Amato Guerrieri).
3. The projects concern two International competitions: the first concerning the realisation of the first Solar Tower in China (in Badaling) and concluded in May 2008 (the team is formed by Paolo Verducci (architect and team leader) Umberto Desideri mechanical engineer; Jinyue (Jerry) Yan mechanical engineer, Marco Mezzi civil engineer; Mauro Savelli civil engineer; Kala Liu Xinyan architect, Matteo Benvenuti junior civil engineer); the second concerns the requalification through the realisation of a renewable energy park in a portion of the motorway between Salerno and Reggio Calabria and concluded in July 2010 (Paolo Verducci (architect and team leader), Umberto Desideri mechanical engineer, Matteo Minciotti civil engineer).
4. The conference, which was a part of the events for the Seventh Centenary of the foundation of University of Perugia, represented an occasion of study and comparison to introduce the projects and the most innovative research in the field of sustainability and energy control, with particular reference to the realisation of new towns in China. The conference, after the greet-

ings of the authorities, has been articulated in two parts. In the first part, the Italy/China relation is examined with particular reference to the themes relative to energy control and to the quality of building interventions. The speeches, after the greetings of Town Councillor Wladimiro Boccali, current Mayor of Perugia City Council, and of professor Fabio Radicioni, Director of the Department of Civil and Environmental Engineering of University of Perugia, have been introduced by professor Umberto Desideri; other speeches were given by professor Hongguang Jin, Director Institute of Engineering Thermophysics, of Chinese Academy of Science; professor Jianzhong Xu, Chancellor of Dongguan University; Gianluigi Angelantoni, CEO of AI, company involved in the development of thermodynamic solar in Italy and with a long history of investments in China and by professor Roberto Battiston, the coordinator of some important ongoing research with the Scientific Research Department of China. In the second part, two projects for two Chinese cities have been presented: the industrial city of Dongguan and Peking's Sieeb; the projects, introduced by professor Paolo Verducci, have been presented by the Unipg research group and by the architect Giulio Altieri of the studio Cucinella of Bologna.

First part

The methodology to design
eco-sustainable buildings in industrial parks

1.1 Introduction

The design of an ecosustainable industrial park in China has required a number of definition and the development of some concepts that were not clear at the beginning of the project. The social and economic structure of China differs so much from that in Europe that the simple application of EU standards to a Chinese case of study was not possible. China economy is now developing at a strong and sustained rate and the attitudes and opinions towards the work and the social structures are also a subject of discussion and improvement. Positive and negative aspects of the way of life are considered and implemented in the Chinese society causing deep changes in the expectations from the future and from the economic changes. This can make the results of this project applicable sooner than we could expect at the beginning of it and could provide improvements in the energy efficiency that could not be reached in the EU with a similar approach.

The first issue that has been discussed is the definition of an industrial park in China. The European and in general the Western concept of industrial park is a location where some industrial buildings are located together with general services that are necessary for the daily operation of the industrial activities and of the

workers. Industrial parks may include commercial services, mainly for restoration and goods used in the industries and shipping companies for rapid delivery and pick-up of goods. Industrial parks in the Western countries are generally empty at night when all the workers go home. This is a reason why many residential areas are empty during the day and industrial areas are empty during the night, making it difficult to integrate the services and the infrastructures for both the industrial and the residential areas. Another characteristic of industrial parks in the Western countries is their position with respect to the cities: industrial and commercial activities are generally separated from urban areas, to avoid pollution and heavy traffic near the places where people live. This has some benefits, if we consider the most polluting and heaviest industries, such as steel, plastic, oil refineries, but it also creates logistic problems to transport workers and goods from different places to a single area, to concentrate all the infrastructure for energy and solid and liquid wastes in a small area, and making it necessary to duplicate it in the urban areas.

Industrial parks in China are not different from small cities, where workers residential areas are next to the industrial activities: within the same compound, people live and work and this has a number of benefits and disadvantages that will be examined and addressed in

this project. Building the residences next to the factories, has the following advantages:

1. there is no need to travel long distances to get from home to work -> less traffic and congestion in peak hours and less pollution from transportation means;
2. industrial and residential infrastructure can be integrated making it possible to provide the basic services to the residences as part of the industrial services -> production of thermal and electric energy for both users, collection and treatment of industrial and urban wastes together, utilization of optimized transportation systems from/to the residences;
3. services are accessible at all the hours of day and night and all the types are present, with the creation of business opportunities within the park;
4. pollution mitigation systems are on a scale that can be applied to both industrial and residential users.

There are however disadvantages in this concept that can be partially solved in this project:

1. the workers consist mainly of singles in their early working age (17-24) and families are generally not included: this creates a great exchange of workers but it is generally impossible to keep the best workers long after they create their own families. This continuous variation of workers also requires high level formation and very good recruitment procedures

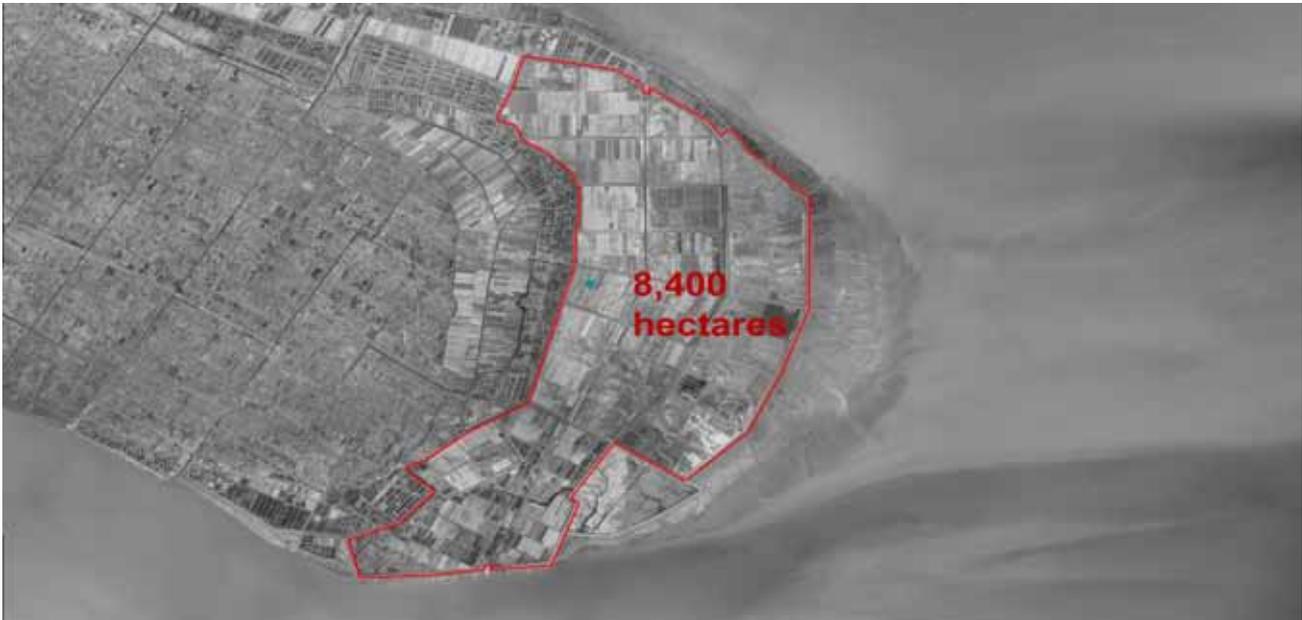
and also requires a change in the salary because new workers may ask a higher wage;

2. sources of pollution are close to the residences;
3. each industrial park has to offer all the necessary services to all the workers with obvious duplication of activities;
4. workers cannot choose their home but are required to live in the park.

All the above characteristics make the concept of industrial park in China very different from what is the Western concept. However, China is developing fast and the people may ask different living conditions in the near future. This is possible without the need of deep changes in the Chinese society, offering better living and working conditions: this is the concept of sustainable industrial park where the environment is considered, the standard of living of people is raised at the European levels and the working place is safer and healthier. This concept can be created in an economical and feasible way. A better living and working condition becomes necessary when the basic needs are already satisfied and the people look for more. China is approaching this point very quickly and the anticipation of this can be beneficial for those companies that are willing to improve their situation.

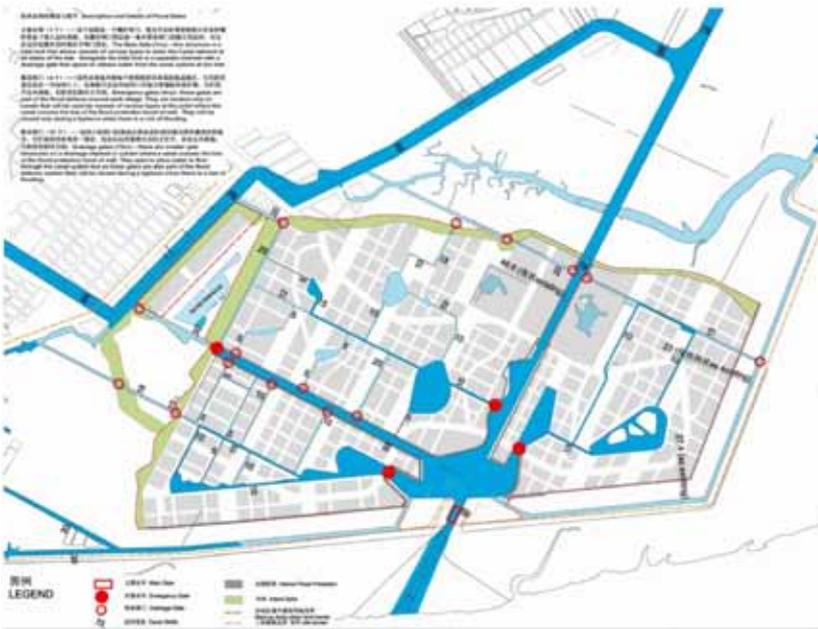


2-3. Dongtan eco city - Ove Arup and Partners.

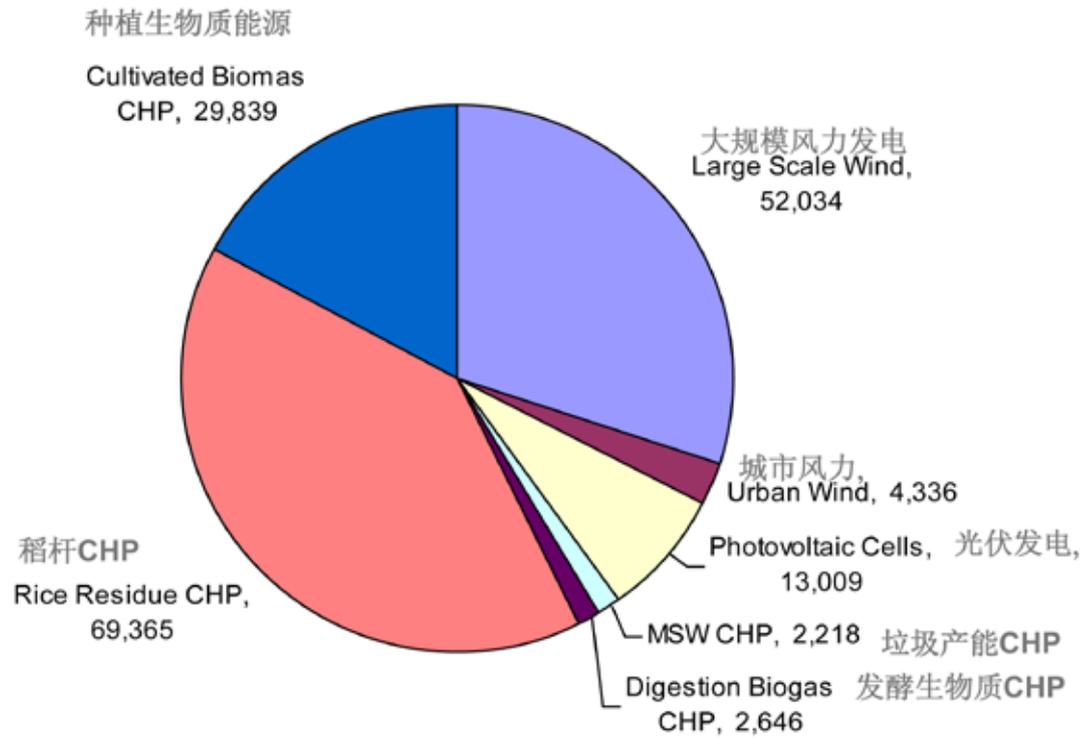


4-5. Dongtan eco city - Ove Arup and Partners.





6-7. Master plan of Dongtan eco city.



8. Eco Demonstrator – Sources of electrical generation (MWh per annum)



9-10. Dongtan eco city - Ove Arup and Partners.