Housing Policies and Urban Economics – Vol. 5 (Dicembre 2016)

ISSN: 2385-1031 (print)
ISSN: 2385-0671 (online)

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Preface

In the current issue of HoPUE the section on the Historical Urban Landscape addresses the theme of port cities regeneration. In accordance with the Agenda 2030 guidelines for Sustainable Development, which reaffirm the importance of new approaches to increase prosperity and urban attractiveness, the contribution by Luigi Fusco Girard and Francesca Nocca specifically refers to the inclusive, safe, resilient and sustainable city. Giving an overview of the best practices and guidelines recently made at the international level, the authors underline the opportunity for waterfront regeneration, to redevelop existing buildings and infrastructure in a circular and multidimensional perspective. The role of ex-post evidence based evaluation is considered essential and strategic for monitoring public urban regeneration policies and to understand the actual progress achieved. The issue of sustainable development of port cities is fully embedded in the framework of the European directive for Maritime Spatial Planning expected by 2021: new institutional synergies and new approaches are required to combine environmental protection and economic growth, in a multidisciplinary and eco systemic view.

In the section on Building Quality and Energy Resources, Monica Cannaviello describes a case study for a school building, illustrating potentialities and limits of energy auditing for the building heritage. The following contribution by Antonella Della Cioppa and Rossella Ierardi addresses the theme of the use of renewable energy sources in the field of Design, pointing out that awareness about the environmental impacts of production can start from the knowledge of the current offer of ecodesign products for daily use. Antonella Violano and Carmen Rauccio describe an experimental teaching to plan a sustainable residential district in the province of Caserta, according to the principles of energy efficiency; the contribution highlights in particular the energy performance requirements for almost zero energy buildings (nZEBs), as well as the fundamental role of teaching to promote an appropriate environmental knowledge.

The section of Public space, Urban and Environmental Redevelopment includes two contributions: the first one, by Raffaella De Martino, Barbara di Vico and Rossella Frannchino, describes a regeneration project in the province of Caserta, highlighting the social, ecological and environmental aspects of the proposal; the second paper, by Antonella Trombadore, Dusan Rolovic and PierPaolo Congiatu, addresses the issue of sustainable tourism on the island of Asinara, offering some basic guidelines for the formulation of a Strategic Development Plan.

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In questo numero di HoPUE la sezione dedicata al Paesaggio Urbano Storico affronta il tema della rigenerazione delle città portuali. Il contributo di Luigi Fusco Girard e Francesca Nocca sottolinea come tali aree urbane rappresentino un complesso sistema di attività economiche, sociali e di scambio, aventi impatti sulla intera città, con ripercussioni sulla salvaguardia delle risorse ambientali ed

ecologiche e sulla conservazione del patrimonio culturale urbano. Coerentemente con quanto proposto dall'Agenda 2030 per lo Sviluppo Sostenibile che richiama la necessità di nuovi approcci per incrementare la produttività e l'attrattività urbana, il contributo fa specifico riferimento al tema della città inclusiva, sicura, resiliente e sostenibile, ravvisando nella rigenerazione dei waterfront il punto di partenza per ripensare lo sviluppo delle aree portuali. A tale riguardo, attraverso una panoramica sulle migliori pratiche e sulle indicazioni recentemente formulate in ambito internazionale, il contributo di Luigi Fusco Girard e Francesca Nocca sottolinea l'opportunità di riqualificare il patrimonio edilizio e le infrastrutture esistenti nelle aree portuali, in una prospettiva circolare e multidimensionale. Il ruolo della valutazione ex post (evidence based) per la misurazione delle varie categorie di impatto degli interventi proposti è ritenuto essenziale e strategico per il monitoraggio delle politiche pubbliche di rigenerazione urbana, al fine di comprendere gli effettivi progressi raggiunti. La questione dello sviluppo sostenibile delle città portuali si inserisce pienamente nel quadro della direttiva europea per la pianificazione dello spazio marittimo prevista entro il 2021: i temi del mare richiedono sinergie e nuovi approcci - multidisciplinari ed eco sistemici - per coniugare tutela ambientale e crescita economica, integrando politiche urbanistiche, infrastrutturali e portuali.

La sezione su Qualità edilizia e risorse energetiche è introdotta dal contributo di Monica Cannaviello che descrive un caso studio condotto per un edificio scolastico, illustrando potenzialità e limiti dell'energy audit ai fini della riqualificazione energetica del patrimonio edilizio. Il successivo contributo di Antonella Della Cioppa e Rossella Ierardi affronta il tema dell'impiego delle fonti energetiche rinnovabili al Design, sottolineando come la maggiore consapevolezza sugli impatti ambientali della produzione possa partire proprio dalla conoscenza dell'attuale offerta di prodotti di ecodesign destinati all'uso quotidiano. Nell'ambito della stessa sezione tematica, Antonella Violano e Carmen Rauccio descrivono una sperimentazione didattica sulla progettazione di un quartiere residenziale sostenibile in provincia di Caserta, pensato secondo i principi di efficienza energetica; il contributo evidenzia in particolare il riferimento ai requisiti di prestazione energetica previsti per gli edifici ad energia quasi zero (nZEB), nonché il ruolo fondamentale dell'insegnamento per promuovere una conoscenza ambientale appropriata.

La sezione su Spazio pubblico e riqualificazione urbana e ambientale comprende due contributi: il primo, a cura di Raffaella De Martino, Barbara di Vico e Rossella Frannchino, descrive un intervento di riqualificazione di un'area urbana in provincia di Caserta, evidenziando gli aspetti sociali, ecologici ed ambientali della proposta progettuale; il secondo articolo, a cura di Antonella Trombadore, Dusan Rolovic e PierPaolo Congiatu, affronta il tema del turismo sostenibile sull'isola dell'Asinara, proponendo alcune linee essenziali per la formulazione di un piano Strategico di sviluppo, compatibile con le caratteristiche di un'area particolarmente complessa.

Barbara Ferri

Housing Policies and Urban Economics Vol.5 (Dicembre 2016), pp. 3 - 22

The Circular Models for port city regeneration: port as "cyclifier"

Luigi Fusco Girard[1] Francesca Nocca[2]

Abstract: The 2030 Agenda for Sustainable Development framework calls for new models to increase urban productivity (economic, social, and environmental). This paper would propose a new approach for city regeneration, with particular reference to port cities.
Port areas can represent the entry point for the entire city regeneration, but the development of port system needs to become more sustainable. Port cities are place of strong development potential but, at the same time, the place where contradictions take place. The key issue is to transform the contradictions and problems into opportunities through a good government, management and planning. As required from the 2030 Agenda for Sustainable Development, it needs to move from principles to practice and thus to increase city productivity. So, new tools are required.

Keyword: circular economy, port-city system, urban productivity

1. Introduction

The 2030 Agenda for Sustainable Development has been defined as a plan of action for people, planet and prosperity (United Nations, 2015) and it is based on 17 Sustainable Development Goals (SDGs) and 169 targets (coming out from the Millennium Development Goals).

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The economic, social and environmental dimensions of sustainable development are addressed at a global institutional level in order to achieve prosperity and peace, gender equality, health and equal opportunities for people. These objectives are extremely challenging, and the monitoring of goals achievement through appropriate indicators is a priority.

All of them can be achieve in the space/city because all problems, as problems come from poverty or climate change, are concentrated in the city. This paper is particularly referred to the goal 11, "to make cities and human settlements inclusive, safe, resilient and sustainable" (United Nations, 2015).

In this period cities are facing three important challenges (related to economic, social and environmental crisis) referred to three great changes: demographic changes (population growth), structural changes (globalization) and environmental changes (climate change, pollution, etc.).

All these challenges are interdependent and thus they need systemic solutions. These interdependences are actualized in the space of cities.

These changes are evident in port cities because they are characterized by a particular complexity, i.e. the urbanization is concentrated along the coast, they are the place where there is the highest level of vulnerability. So they represent a good observation point to understand the dynamics of ongoing urban transformation.

Port cities are very different from each other: large ports of international/national importance, ports of local interest, river ports, military ports, etc. In each of them the coast continuously changes in order to adapt itself to needs of the society in a dynamic perspective.

Cities of XXI are complex and stratified; they are become a system of relationships, a complex of hybridization processes (Fusco Girard, 2014), where past and present coexist, cultural heritage combines with new forms of fruition and development.

Especially due to the economic crisis, lacking of resource and management difficulties, a lot of port areas are in a decline or abandoned state. Sometimes these areas represent a barrier between city and sea, producing negative impacts not only on the environmental system, but also on the economic and cultural one. They represent an

obstacle for the territorial management but, at the same time, they can represent the starting point of urban regeneration.

In port cities strong development potential and contradictions take place; in fact they are the place where the economic wealth is produced but, contemporaneously, negative environmental and social impacts are localized. They are the place where competitiveness, human capital and global appeal, population and migration processes are mainly concentrated.

At the same time, port cities offer a lot of opportunity for economic productivity, social cohesion and ecological resilience. The key issue is to transform the contradictions and problems into opportunities through a good government, management and planning.

There are a lot of good practices of well-known city regeneration projects, as Valparaiso, Rhodes, Oporto, Liverpool (Genovese, 2012), Baltimore and so on which show that regeneration of coastal cities starts just from the ports and waterfront regeneration.

The waterfront, unlike the coastline, cannot be considered a simple demarcation between city (land) and sea (water); it is a portion of land characterized by a strong relationship with the sea that man, during the centuries, has designed and shaped, building urban settlements and infrastructures.

Although its complexity, the waterfront importance, in terms of resources and potentialities, is evident. It represents the interaction space between city and sea, a boundary line between two different areas of the same urban area, the space of the relationships with the historic city and a landscape of great visibility. It is an attractive place in terms of businesses, activities, etc.

Today urban waterfront is characterized by local identity, but also globalization phenomena and intertwined urban and port flows (of goods and people),which have to be well organized and managed in order to create a unique entity.

Waterfront regeneration is a current topic that concerns big cities, but also small and medium size urban centres.

Waterfront regeneration is, in more and more cases, the starting point for regeneration of the city itself. It represents an opportunity for mending urban territory, where water can play a central role. It

represents a key topic in city transformation and involves themes related to the economic and social development, resources saving, and cultural heritage conservation.

In particular, port areas are focal points for port cities (also thanks to their central urban location): they are the area for trade exchange (import and export), for localization of industries and businesses and a source of attraction for tourism and cultural exchange. But, at the same time, they are also the place where many differences and conflicts are localized (i.e. they are the place of conflicts between economy and ecology). Some of them are related to negative environmental impacts caused by the high level of energy consumption, air and water pollution, or natural resource consumption. Other conflicts are due to the effort to conserve cultural landscape satisfying needs of economic development at the same time.

Port areas are the places where conflicts can be transformed into synergies through innovative approaches of governance, planning, management, etc.

In this perspective the port is not considered only as a transport hub, but also as a complex system of economic activities and relationships that have impacts on the entire city (Bruttomesso, 2007).

Port area is characterized by a particular landscape, which is the product of a complex system in which socio-cultural, economic and ecological systems are interconnected. Port area is the place of transformation but it is also the place of cultural heritage, identity and memorial conservation. It often represents the ancient city boundaries and, in many cases, it is recognized as UNESCO World Heritage Site (Naples, Venice, Liverpool, etc.).

In the historic cities it is important to create synergies between waterfront and city, generating symbiosis between waterfront development and cultural heritage/landscape conservation (Fusco Girard, 2013).

The "reconquest" of the relationship with sea and with cultural landscape, the port development, the enhancement of accessibility to the coastal area can be considered strategic actions to achieve the economic, environmental, social, cultural development of the entire city.

2. Waterfront regeneration

The concept of "boundary" is changed, losing its own significance: urban system is no longer a juxtaposition of functional spaces, but it is become intertwined relational spaces that are in relationship with each other through circular processes. The project of the interface land-water aims to generate relationships through flexible strategies, triggering virtuous circle.

In order to regenerate the waterfront, it needs to take into account some key elements. These elements are, for example, summarized in the "10 Principles for a Sustainable Development of Urban Waterfront Areas". They are developed by Cities on Water in collaboration with Wasserstadt GmbH, Berlin, during the international seminars, and approved in the context of the initiatives for the Global Conference on the Urban Future (URBAN 21) held in Berlin in July 2000 and in the course of the EXPO 2000 World Exhibition. These principles are:

Principle 1 - Secure the quality of water and the environment. The quality of water in the system of streams, rivers, canals, lakes, bays and the sea is a prerequisite for all waterfront developments. The municipalities are responsible for the sustainable recovery of derelict banks and contaminated water.

Principle 2 - Waterfronts are part of the existing urban fabric. New waterfronts should be conceived as an integral part of the existing city and contribute to its vitality. Water is a part of the urban landscape and should be utilised for specific functions such as waterborne transport, entertainment and culture.

Principle 3 - The historic identity gives character. Collective heritage of water and city, of events, landmarks and nature should be utilised to give the waterfront redevelopment character and meaning. The preservation of the industrial past is an integral element of sustainable redevelopment.

Principle 4 - Mixed use is a priority. Waterfronts should celebrate the water by offering a diversity of cultural, commercial and housing uses. Those that require access to water should have priority. Housing neighbourhoods should be mixed both functionally and socially.

Principle 5 - Public access is a prerequisite. Waterfronts should be both physically and visually accessible for locals and tourists of all ages and income. Public spaces should be constructed in high quality to allow intensive use.

Principle 6 - Planning in public private partnerships speeds the process. New waterfront developments should be planned in public private partnerships. Public authorities must guarantee the quality of the design, supply infrastructure, and generate both a social equilibrium. Private developers should be involved from the start to insure knowledge of the markets and to speed the development. The coordinators of complex waterfront developments must guarantee their long-term economic, social and ecological success.

Principle 7 - Public participation is an element of sustainability. Cities should benefit from sustainable waterfront development not only in ecological and economical terms but also socially. The community should be informed and involved in discussions continuously from the start.

Principle 8 - Waterfronts are long-term projects. Waterfronts need to be redeveloped step by step so the entire city can benefit from their potentials. They are a challenge for more than one generation and need a variety of characters both in architecture, public space and art. Public administration must give impulses on a political level to ensure that the objectives are realised independently of economic cycles or short-term interests.

Principle 9 - Re-vitalisation is an ongoing process. All master planning must be based on the detailed analysis of the principle functions and meanings the waterfront concerned. Plans should be flexible, adapt to change and incorporate all relevant disciplines. To encourage a system of sustainable growth, the management and operation of waterfronts during the day and at night must have equal priority to building them.

Principle 10 - Waterfronts profit from international networking. The re-development of waterfronts is a highly complex task that involves professionals of many disciplines. The exchange of knowledge in an international network between contacts involved in waterfronts on

different levels offers both individual support and information about the most important projects completed or underway

One issue related to port-city ecosystem regeneration, to plan port cities, is referred to the spatial organization. The waterfront can provide land solutions shared between port and city. It needs to find the right balance between spatial and functional mix able to transform, in a productive way, the city-port interface and also the entire territory. It calls for solutions able to combine optimization of uses, efficiency and less environmental impact.

The different functions can be distributed both in horizontal, i.e. Amsterdam Port (Netherlands), and vertical, i.e. Marseille Port (France) (AIVP, 2015). The latter is not too use, but it is a good solution when there is no enough space. This functional mix makes port area more attractive both for businesses and for other stakeholders and community.

Other experiences show that another solution can be "to move the city towards the water", moving facilities on the water (floating restaurants, etc.). This solution, integrating port and city, represents an opportunity to preserve limited land space (AIVP, 2015). For example in Rotterdam (Netherlands) there are three "floating pavilions" functioning as exposition and reception area. They are become a symbol of the city, contributing to the identity of the place.

Temporary uses are a good strategy that allows the project to evolve over time, adapting to the city and port needs. The flexibility represents an opportunity, as in the case of Seville port (France), which makes cites more attractive and dynamic.

The functional mix contributes to the creation of a sustainable city-port. It is related to the necessity of new ways to plan the city with the port. It requires new collaborative approach, monitoring tools, community involvement.

"We need to plan incompletely. Since we don't know exactly what the future economy of the port city will be, we will need to plan for uncertain functions". In this way Peter Hall (a Canadian researcher) explains the necessity to make plans flexible. Urban planning should be "incomplete" (Hall, 2016). Space between port and city should be permanently unfinished. So it can adapt to dynamics and provide space

for experimenting. In this way, spatial planning can support the innovation required in port cities.

Accessibility should be optimized in a waterfront regeneration project, improving the connection between port and city. A good mobility plan (for goods and people) improves port competitiveness and contributes to reduce environmental impacts. A good mobility plan and alternative means of transportation (bicycle, shared transportation, water taxi, etc.) reduce road congestion in city/port territories, contributing to the environmental protection. For example, in Tangiers (Morocco) a cable car system is projected in order to connect the downtown area, the marinas, the new fishing port and the Kasbah (with a capacity of 2800 passengers per hour).

It is important to choose carefully the location of passenger terminals: it has to be localized in a place provided with the best access to the city center. The quality of connection between passenger terminal and the city center is decisive to promote tourism and generate added values. The city and port can be linked also through promenades having the role of connection and, at the same time, representing a means to revitalise spaces, introducing new visual perspectives too. In Malaga (Spain) for example, the topic of the links between the historic center and old port assumes a central role in the waterfront project: a promenade linking city center with the sea and high-quality public spaces are designed (Tuğçe and Yakup 2016).

Port cities have a particular identity that distinguishes them from other cities. This identity has to be conserve/preserve, integrating past and present in a synergistic way. Ports have also a particular heritage that links them to their history. The better solution for ports regeneration is to renovate existing architectural and port heritage. This is demonstrated comparing costs of renovating with costs of building entirely new constructions (AIVP, 2015). Adaptive re-use of cultural heritage can produce, in a circular perspective, a lot of multidimensional benefits (i.e. reducing land consumption) (Fusco Girard, 2015), both economic and ecological and social benefits.

In port areas we can find many answers to the climate change and rising sea level problems. Here we can find innovative solutions and measure able to reduce the environmental footprint and optimize

environmental performance. Planning the city with the port requires necessarily environmental considerations. It is fundamental, before practical steps, to identify and assess environmental impacts of ports, especially in city-port area interface (for example in Valencia, Spain, a carbon footprint measuring tool is adopted in order to draft the action plan).

Port and port activities are the main sources of negative environmental impacts and air pollution. It needs to identify innovative solutions to face climate change and improve energy performance of ports (and cities). A solution can be taken from the industrial ecology that, turning linear processes in circular ones, is able to optimize the resource cycles (Mat et al., 2014 a, b). In Rotterdam (Netherlands), for example, a pipeline is designed to collect the high-temperature industrial steam in order to produce heating for 20,000 homes and a hospital.

Other projects (23 projects) based on the industrial ecology model are drafted in Kalundborg (Denmark). They are based on the principle of circular economy related to industrial waste, re-using it as raw material for other industries or for power generation (Vadstrup Holm, 2013).

Lessons learnt from industrial ecology (and in general circular processes) can be transferred to the overall city organization, increasing productivity (in terms of economic, social, environmental dimension).

Two good practices of waterfront and port regeneration are Liverpool (UK) and Baltimore (USA).

Baltimore's Inner Harbor project has the aim to transform the port from a declining industrial area into a destination for tourists and residents. It is a good example of collaborative planning process, too.

The masterplan, in the wake of the previous dating back to 1970, offers new ideas related to the development of the port area: integrating green infrastructure systems, creating clear thresholds and entry points to the harbour, developing new civic spaces and pedestrian connections within the public realm, identifying new destinations and programs, balancing the need for service and parking, providing a flexible

framework which can accommodate changes in priorities, timing, and funding (AA.VV., 2013).

Data presented in the 2015 report (AA.VV., 2015) about benefits produced by the project demonstrate the success of the project. It produced a lot of benefits, both economic and social and environmental ones. It was able, in 2013 alone, to attract over 14 million people who visited, shopped, dined and enjoyed the Inner Harbour. In 2015 the waterfront hosted 41 private events, 39 public events, 19 running events, 18 filmings, 9 events series. The visibility of the city significantly increased, receiving 664 million media impressions in 2015.

Waterfront attracted new businesses, producing an increase in commercial square footage of 37%. Between the years 2000-2011 new job opportunities at the waterfront grew by 16%.

Commercial property value and property taxes jumped, as assessments rose by 50%. The residential demand increased by 49%.

There was a population boom in the Inner Harbor neighbourhood: growing well over 100% during the past decade (mellennials residing in waterfront in neighbourhoods increased over 56%). Waterfront neighbourhoods saw a 40% increase in number of the new-borns and toddlers living by the waterfront.

The port regeneration produced also environmental benefits; for example there are 1,673 homes powered by 224 tons of trash collected by the Water Wheel (224 tons of trash removed from the harbour) (AA.VV., 2015).

Liverpool Waters (www.liverpoolwaters.co.uk) is a project which aims at the regeneration of 60 hectares historic dockland site to create a world-class, high-quality, mixed-use waterfront quarter in Liverpool. The site extends 2km along the waterfront and part of the site interested by the project is situated within the Liverpool Mercantile City World Heritage Site (WHS 2004); the rest is within the WHS buffer zone. 42% of the Liverpool Waters site is within the World Heritage Site.

World Heritage Site has preserved and enhanced by Liverpool Waters proposal, through a symbiotic relation between port and city. The waterfront quarter is conceived and designed as an extension of the

city center with new buildings and public spaces. Heritage assets are included in a restoration programme including the former operational buildings, the dock boundary wall, historic surfacing and quayside artefacts. Integrating the site's cultural heritage with the development, the project creates a unique sense of place.

The project aims to accommodate new and existing residents, to increase the number of visitors and attract national and international businesses, significantly strengthening, at the same time, Liverpool's strong identity.

The project includes 9,000 apartments, hundreds of offices, hotels, bars and a new cruise terminal and 20,000 jobs.

Liverpool waterfront is an attractive place for businesses. In fact it provides 315,000 sqm of business space (in 88 plots).

There are 46,000 sqm of restaurant, bars and cafes, 33,000 sqm for leisure activities and 27,000 sqm designated to retail, (53,000 sqm) of floor space has been designated to hotel and conference facilities (Over 1,400 beds).

3. The role of port in city regeneration: port as a "cyclifier"

In these years it is increasingly necessary (for politicians, economic operators, citizens) to find new approaches to develop ports and city ports. The need is to create a sustainable city-port system. In port cities and waterfront regeneration, port areas assume a central role.

Port area can represent the entry point for the entire city regeneration (Fusco Girard, 2013). Port and city have different interests and priorities, so it needs to search for solutions able to create synergies between them. It needs to find solutions to increase port-city ecosystem productivity (in a multidimensional way).

To this end, more steps forward are required in planning field, decision-making processes, evaluation tools, collaborative approaches (able also to involve wider community).

Port can be a driver for city sustainable development; starting from local cultural resources, it is able to trigger creative processes, to

combine, in a synergistic approach, economic, logistic and industrial port activities with cultural heritage/landscape regeneration.

Port area is the places where flows are maximized; for example it is the place where many flows of the globalized economy arrive at and depart from, the focal point that connects every country in the world.

In port area commercial, industrial, logistic, tourist and fishing activities are concentrated, making it a driving force for economic wealth. The achievement of economic wealth often implies high social, ecological and cultural costs. So the net "economic benefits" (that is considering social, ecological and cultural costs, i.e. congestion, pollution, perception of insecurity, etc.) are lower than they seem. Furthermore, these benefits often are related only to some actors, i.e. trade, tourism, industry agents, and they are not distributed to the different stakeholders.

The development of port system needs to become more sustainable. Port cities, but cities in general too, should learn from nature wise, organizing their processes as natural ones: from linear to circular processes.

The sustainable development of port cities should be based on synergy and circularization principles (goal 12 of SDG's, about the necessity to ensure sustainable consumption and production, introduces a circular economy approach).

The first one is referred to the relationship (synergistic relationship) between different actors and systems, while the second one is referred to re-use, recycle and regeneration, in analogy to the natural system organization.

Port area can be considering the starting point for a new economic city organization able to reduce waste, energy consumption, materials input. It needs to find new models able to increase urban productivity (economic, social, and environmental).

4. A circular economic model

A circular model of productivity, where nothing is considered a "waste" but a "resource", is the way to make sustainable development operational (Angrisano et al., 2016).

Port and city have to search for new circular business models, finding concrete solutions.

New collaborations/cooperations among local communities, entrepreneurs, port businesses and public bodies offer great opportunities for actions and innovations.

An approach is offered from the industrial ecology. It can improve the productivity of urban system, focusing on the impacts of urban organizations.

The industrial ecology represents a field from which to learn in order to move from linear to circular processes, closing the loops. It needs to consider not only actors individually, but all relationships among them too.

This approach should be transferred from the industrial sector into the city comprehensive organization. We need to move towards a more virtuous economic model; at the moment, we are only at the beginning of this way. Port cities offer a lot of opportunities to make circular economy concrete, through recycling, sharing, re-using, designing.

Thanks to circular economy processes, inputs are minimized and, at the same time, outputs are maximized, preserving as long as possible the value of the produced resources(Preston, 2012). It is more efficient and productive than traditional linear economy.

Developing the circular economy is a key component of a city development; it means close the loops, to suppress useless flows, to implement new flows. We can consider the productive city as a city of flows (material and not). This flow-city (Fusco Girard et al., 2014) is characterized by circular processes that are able to structure the entire city organization. It is able to transform diversity into complementary, identifying and fostering synergic relationships between different elements.

The flow-city, therefore, is not a simple combination of programs and elements, but the result of hybridization processes (Fusco Girard et

al., 2014; Fusco Girard, 2014) in which different elements are not in a conflict relation with each other but, sharing intensity, drawing strength and mutual benefits.

Circular economy offers a great opportunity to increase urban productivity. It is not only referred to waste cycle (European Commission, 2015), but it is the economy of synergies and symbiosis between different industrial activities, city and industrial system, etc. It is the re-generative economy of materials, but also of natural, cultural and social resources, energy, water, etc.

Port city should be organized according to circular models. In this perspective, in the productive flow-city, port can be become a "cyclifier" for the entire city, a trigger point of flows (Fusco Girard et al., 2014).

Cyclifiers are technically elements that send resource flows in a circuit; they are connectors between waste streams and demand for resources (www.cyclifier.org).

Inspired by nature and industrial ecology, and borrowing and translating the concept of cyclifier to a wider level, we can consider port as a cyclifier place able to activate and trigger flows, generating a "continuous flow" of material (and not) resources.

The cyclifiers are connectors which, by relating different elements of a system, and different systems with each other, are able to close the circuits. Thereby they are able to increase the efficiency of the system (city and city-port).

Port area processes should be organized in analogy to the organization of natural systems, where "nothing is waste". This new economy greatly contributes to make city more inclusive, sustainable, safe and resilient. In this model, technologies assume a central role; they are the nervous infrastructure of the system; they support decision-making processes.

Port cities become city of symbiosis: symbiosis between industrial/logistic economy and touristic economy, industrial system and urban system, cultural heritage/landscape conservation and economic development, etc. (Fusco Girard, 2013).

5. The need of tools

The 2030 Agenda for Sustainable Development focuses on the need to move from principles to action and then the tools to do it. This issue is highlighted by the existing of a group of paragraphs related to the "means of implementation" § 126-160 (United Nations, 2015).

To increase urban productivity and so to achieve the goal 11 of Sustainable Development Goals, tools are required. It needs to move from theory to practice.

Urban planning represents one tool to move in this direction.

The key role of urban planning is highlighted in 14-15-44-51-96 paragraphs of the 2030 Agenda for Sustainable Development. Here, the importance of urban planning to improve urban productivity is stressed. In particular, the integrated planning, as paragraph 94 introduces, aims "to balance short-term needs with long-term desired outcomes of a competitive economy, high quality of life and sustainable environment".

The transition towards a new urban paradigm (§15) readdresses, for example, the way to plan, to govern, to manage cities "recognizing sustainable urban and territorial development as essential to the achievement of sustainable development and prosperity for all".

The above mentioned paragraphs highlight the role of national governments in the implementing "inclusive and effective urban policies and legislation for sustainable urban development. Integrated approaches to urban and territorial development are required, by implementing policies, strategies, capacity development and actions at all levels, based on fundamental drivers of change, including: developing and implementing urban policies including in local–national and multi-stakeholder partnerships and promoting cooperation among all levels of government; strengthening urban governance to enable social inclusion, sustained, inclusive and sustainable economic growth, and environmental protection; reinvigorating long-term and integrated urban and territorial planning and design in order to optimize the spatial dimension of the urban form and deliver the positive outcomes of urbanization; supporting effective, innovative and sustainable financing frameworks and instruments" (§15).

The 2030 Agenda for Sustainable Development encourages "the implementation of sustainable urban and territorial planning, including city-region and metropolitan plans, to encourage synergies and interactions among urban areas of all sizes and their peri-urban and rural surroundings" (§96). It supports projects related to the development of sustainable regional infrastructure that stimulate sustainable economic productivity, promoting equitable growth of regions across the urban–rural continuum. To this end, Agenda 2030 "promoted urban–rural partnerships and inter-municipal cooperation mechanisms"(§96).

The success of the urban transformation process depends on the ability to produce not only added income, but also social and human capital; this is closely tied to the intensity of the relationships activated.

In port areas we can find many answers to today challenges, climate change issues and rising sea level problems. Here we can find innovative solutions and measure able to increase overall city productivity, to reduce the environmental footprint and optimize environmental performance.

The crossover between port and city (15th World Conference Cities and Ports "Crossovers", 5-7 October 2016) is a place for economic and social innovations fuelled by new technologies, innovative businesses and new planning strategies between city and port.

Port areas can represent the starting point for city regeneration. It is connected with the capacity to trigger circular processes. In this regeneration process, port is considered not only a logistic machine, transport hub detached from city, but it is a "cyclifier". It can stimulate new economic growth and job creation, promoting synergies and partnerships.

Great knowledge production is necessary. The knowledge represents the feed of these processes. It is necessary the improvement "in data collection, mapping, analysis and dissemination, and in promoting evidence-based governance, building on a shared knowledge" (§ 159).

To start this route depends on us (Gunter Pauli, 2014): first of all we need to start a "cultural revolution" in order to move man from the logic and mechanisms that have characterized his actions towards the logic of nature.

Planners have to work in a synergistic way with communities. A better knowledge, awareness and interconnectivity have a key role. Community has an increasingly active role in development. It plays a key role in the success of port-city project. It can be useful to adopt approaches able to involve community, consulting and informing citizens.

People come first of technologies. So smart technologies need smart people and cooperation always is the key success factor. Social Innovation accounts for 75% of successful innovation, technology only 25% (Daamen and Isabelle, 2016). Port Cities should draw up a Human Capital Agenda (Daamen and Isabelle, 2016)with a long-term strategy in order to create a resilient working community ready for the future.

6. The key role of evaluation processes to increase systemic productivity

Port areas can represent the entry point for the entire city regeneration, but the development of port system needs to become more sustainable. Port cities are place of strong development potential but, at the same time, the place where contradictions take place.

It needs to demonstrate economic benefits of the proposed circular economy in order to convince companies, but also all stakeholders, that a project based on circular economy is economically (but also socially and ecologically) profitable.

Knowledge production about impacts (direct, indirect, induced, short, medium and long-term, quantitative and qualitative, economic, ecological, social) is necessary. Without this evaluation we are not able to solve in a win-win perspective the symbiotic relationship between port and city.

The circular economy model here proposed is referred not only to waste management but, more in general, as development model for city regeneration, in particular for port city regeneration. In this perspective, adequate evaluation tools are required. The 2030 Agenda for Sustainable Development dwells on this necessity. In fact, it highlights the central role of evaluation processes in order to achieve all goals. In

particular 80, 94, 104, 115, 136, 138, 147, 158, 159, 161, 172 paragraphs deal with the evaluation tools.

They highlight the importance of medium-long term impact evaluation (§80) and stress the importance of improving the transparency of data (§104, 136, 138) to ensure equity and spatial integration. Monitoring and evaluating public policies is fundamental for sustainable urban development. The evaluation process is today based on ex-ante assessments. Instead, public policies need ex-post assessments, based on the critical analysis of concrete experience. In this way, we are able to gauge again the intervention policies and understand, for example, if we closed the loops.

To strengthen data and "statistical capacities is important to monitor progress achieved in the implementation of sustainable urban development policies and strategies, and to inform decision-making" (§158).

The 2030 Agenda refers also to the necessity of evidence-based assessment; impacts assessment is necessary in order to track the progress and ensure the Agenda's effective and implementation (§161, 172). The 2030 Agenda refers to the necessity of implementing and systematically evaluating plans, while making efforts to leverage innovations in technology and to produce a better living environment.

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Housing Policies and Urban Economics Vol.5 (Dicembre 2016), pp. 23 - 32

Energy audit of a school building: potentialities and limits to improve energy quality

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Sunto. L'audit energetico rappresenta uno strumento fondamentale per affrontare la riqualificazione energetica del patrimonio edilizio scolastico. Costituisce infatti un efficace supporto nell'individuazione delle carenze prestazionali più rilevanti, e nella scleta degli interventi di retrofit più appropriati.

Parole Chiave: Edifici scolastici, diagnosi energetica, riqualificazione energetica.

Abstract. The energy audit represents an essential tool to face the energy rehabilitation of the school building. In fact, it is an efficient support in both identifying the most relevant performance deficiencies and choosing the interventions of more appropriate retrofit.

Keyword: School buildings, energy audit, retrofit..

1. School buildings: need for a consistent path of rehabilitation

In Italy, school buildings have been in a real emergency for years, in terms of comfort, functional equipment, energy and environmental quality. In particular, school buildings built between 1950 and 1980 are characterized by low standard of quality, especially in southern Italy [1]. We wish to globally face all aspects related to its rehabilitation, by

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intervening synergically on its performance deficiencies that disrupt its structural, energy and functional quality.

In order to achieve this aim, we need to identify appropriate tools of knowledge of the initial conditions of the good to set up an organic and efficient rehabilitation project.

2. Energy audit of a school in the province of Naples to interpret the energy quality of the building

With regard to the energy aspects, the audit represents the most suitable tool to interpret the energy quality of the building by identifying criticality and potentiality.

The Directive 2012/27/EU[1] has strengthened the role of this tool, making it compulsory for industry, and suggesting it for the civil sector and, as a consequence, for buildings.

The Legislative Decree 102/2014, implementing the Directive 2012/27, focuses on the energy rehabilitation of the public heritage-listed building that, characterized mainly by highly energy-consuming buildings, is a strategic aim, not only in terms of reducing consumption, but also in terms of exemplarity. At the same time, it reiterates the importance of the "Energy audit" [2].

The public body is, in fact, called upon to making appropriate proposals of interventions for the energy rehabilitation of properties occupied by him/her, formulated on appropriate energy audit. The energy audit of the Padre Rossi Primary School situated in the Municipality of Scisciano, in the province of Naples, belongs to this context, which is in climate zone C.

The building was built between the late 1950s and early 1960s and is made up of a single building with two floors above ground. The vertical bearing structure is made of calc-tufa.

[1] Directive 2012/27/EU of the European Parliament and of the Council, of 25th October 2012, on energy efficiency.

Fig.1 Padre Rossi School in Scisciano (Naples)

The external vertical walls of the building are made of calc-tufa blocks, plastered on both sides, with an average total thickness of about 54 cm.

The roof is flat, made up of bricks and cement, on which the screed of the slopes and the waterproofing sheath are placed. The other floors are of the same type, too. The original fixtures with iron frame and single glass were mostly replaced with aluminium frames and double glazing. They are equipped with non-isolated and night screening systems dumpster, while there are no solar shading systems.

The heating system of the building is a water type radiator. There are also four electric water heaters, for the production of sanitary hot water. There are no other installations for summer air conditioning or for controlled mechanical ventilation.

At first, the energy audit foresaw a phase of standardized assessment, essential to evaluate the energy quality of the building regardless of its use. Then the energy model has been refined through a tailored assessment defined by UNI EN 13790 that is suited to the user, which allowed quantifying the energy requirements of the building

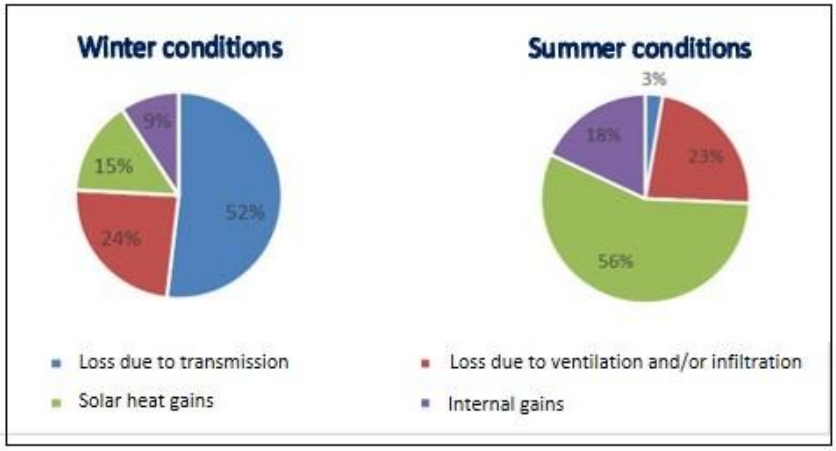
under actual conditions of use. This step is necessary to validate the built energy model, through a comparison of the alleged consumption with the real ones.

The fairness factor[1], resulted to be equal to 1.06, corresponding to a high level of fairness. So the energy behaviour of the built model can be considered as conforming to the real building.

Through the analysis of the thermal energy need for heating and cooling[2], the elements that most influence the energy balance have been assessed.

The following graphics shows the percentage of loss due to transmission and ventilation and the gains to the requirement of thermal energy to be used for heating.

As you can see from the graphics 1, the loss due to transmission (nearly 52%), which prevails over the one for ventilation (24%), represents the most significant item in the energy balance and the one where it would be appropriate to intervene through rehabilitation.



Graphics 1 - Incidence of heat loss and gains in winter and summer conditions

[1] defined as a relationship between the real energy consumption, derived from the bill, and the energy consumption computed with the semi-stationary process

[2] calculated in accordance with the standard UNI/TS 11300: 2014. Energy performance of buildings. Part 1: Evaluation of energy need for space heating and cooling

In summer conditions, as shown in the graphics 1, the loss is much lower than the gain. Particularly solar heat gains represent the most significant item of the balance. About the loss, the one due to transmission is not so significant, almost negligible (3%). The loss due to ventilation (23%), although higher than the one due to transmission, has little impact on the balance anyway.

Therefore, it is clear that in the summertime the only really efficient strategy concerns the solar control of both transparent and opaque surfaces.

3. The main criticality of building-plant system through the comparison with the new standards

The energy quality of a building cannot be expressed only through the annual energy consumption, but it should be made clear through an appropriate set of indicators.

The energy audit has selected some indicators in order to compare the building performance with the reference building[1] one in 2019 (nZEB). This is in order to verify how far the building analysed is from the new performance requirements (tab.1), established at legislative level not only for the new construction, but also for significant renovation of the first level.

In winter conditions, comparing the energy performance index for heating ($\mathbf{EP_{H,nd}}$) of the real building with the reference building one allows an early assessment of the energy quality of the building envelope. Within this indicator, both the ability to control the loss due to transmission and ventilation and the ability to harness solar gains are considered. The other significant indicator is represented by the overall heat transfer coefficient due to transmission $\mathbf{H'}_T$ expressed in W/m^2K, which expresses the average thermal insulation level of the building

[1] The reference building is defined by the Law 90/2013 and its implementing decrees as an identical building in terms of geometry (shape, volume, floor space, surfaces of building elements and components), orientation, geographical location, intended use and surroundings, and having thermal characteristics and predetermined energy parameters.

and, consequently, the building envelope ability to control the loss due to transmission.

The envelope performances are very poor when compared with the performance limit introduced by D.M. 26/06/2015.

Particularly, the analyzed energy performance index for heating the building exceeds of approximately 120% the limit value (**$EP_{H,nd\ Lim_NZEB}$**) established by the regulator as a function of the S/V ratio of the building and the climate zone. The overall heat transfer coefficient for the analyzed building exceeds of approximately 116%, the limit value (**$H'_{T\ Lim_NZEB}$**).

In summer conditions, instead, the envelope energy quality mustn't be evaluated through the energy performance index for cooling the building, but through two indicators:

• equivalent summer solar area per unit area ($A_{sol,est}$/ $A_{sup\ utile}$), which expresses the ability to control the entering solar radiation

• opaque envelope periodic thermal transmittance (Y_{IE}), which expresses the thermal inertia of the opaque envelope.

The energy performance index for cooling the building is even lower, though only slightly (2.6%) than the limit index. The equivalent summer solar area per unit area is lower than the limit value too.

The highest criticality concerns, instead, the periodic thermal transmittance, which is 85% higher than the limit value.

Performance indicator in winter conditions	Real building	Reference building	Deviation percentage
$EP_{H,nd}$ - Energy performance index for heating [kWh/m^2]	76,04	34,66	+120%
H'_T - Overall heat transfer coefficient [W/m^{2}K]	1,30	0,60	+116%
Performance indicator in summer conditions			
$EP_{C,nd}$ - Energy performance index for cooling [kWh/m^2]	44,60	45,82	-2,6%
$A_{sol,est}$/ $A_{sup\ utile}$ equivalent summer solar area per unit area	0,0060	< 0,040	-85%
Y_{IE} – opaque envelope periodic thermal transmittance [W/m^{2}K]	0,26	≤ 0,14	+85%

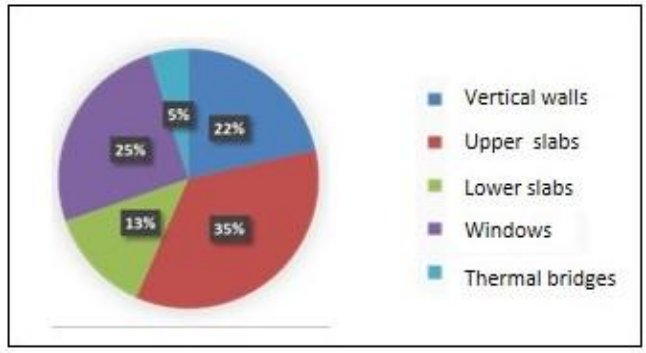
Tab. 1 - Energy quality of the building envelope

4. Analysis of criticality and identification of the types of intervention

The energy analyses carried out have shown that the energy performances of Padre Rossi School in Scisciano are mediocre and the comparison made between the energy performance of the real building and the one of the reference building has highlighted a huge gap compared to the values required by the actual law for the nearly zero energy buildings, both for the building envelope and for the heating system. The criticality is mainly related to the winter conditions, even if there are problems for the summer conditions too.

In wintertime, in order to improve performances, the goal consists in reducing the loss due to transmission and ventilation. In the standardized evaluation, in order to reduce the requirement for thermal energy to be used, being unable to intervene on the air-flow rate, which is established by the standard UNI 10339:1995, depending on the intended use, you should first intervene on transmission loss.

The analysis of the energy needs has shown that, with regard to transmission loss in winter season (graphics 2), the predominant rate is attributable to the upper slabs, whose incidence is for about 35%. The transparent components incidence is for 25.4%, the vertical walls for 21.5%, while the lower slab - for nearly 13%. Finally the thermal bridges, as it is a load bearing masonry structure free from thermal insulation, have a limited incidence, equal to nearly 5%.



Graphics 2 - Incidence of heat loss attributable to the various dispersants

It is evident that the upper slab, while representing only 19% of the overall dispersible surface, is the one that mostly affects the requirement for thermal energy to be used (35%).

The transparent components affect the overall dispersions for nearly 25%, compared with an incidence on the overall dispersible area of nearly 35%.

The analysis of thermal energy requirement to be used for heating shows that the component on which action is most needed to reduce consumptions is coverage. It has also considered the appropriateness of intervening on fixtures and external vertical walls, as they have very poor energy performance, much lower than the limit value established by the new standards.

For the opaque envelope it is, therefore, necessary first of all to intervene in order to reduce the thermal Transmittance, which is much higher than the reference values.

For coverage, the intervention of insulation cannot be only aimed at reducing the instantaneous thermal flux exchanged for transmission, but also at improving the component performance in a dynamic condition. Therefore, it is better the isolation from the outside and the use of insulating materials with a low diffusivity. This is also in order to intervene on both the attenuation phenomena, and thermal wave phase-shift and the periodic thermal Transmittance. It is also important to control the performances of the surface finish, favouring the use of materials that have a solar reflectance not lower than 0.65.

5. Technical and economic feasibilities of energy rehabilitation interventions

The choice of rehabilitation interventions must derive not only from a technical but also from an economic assessment of the feasibility [3]. The latter was more difficult to be satisfied.

The technical feasibility has to deal with energy efficiency standards, established by D.M. 26/06/2015, depending on the type of intervention (significant renovation of the first and second level, energy rehabilitation).

Identifying technological solutions and materials able to adapt the existing building to the new energy standards, for example in terms of thermal insulation, is an aim that can be surely achieved.

The hypothesis of intervention on the building envelope has been aimed at ensuring both thermal transmittance and periodic thermal transmittance, foreseen for nZEB buildings. For the opaque components analyzed, it has been possible to achieve such an aim by adding an insulating layer of about 10 cm (obviously a variable thickness depending on the conductivity of the material).

The major problems arise, unfortunately, from the analysis of the payback period for the investments done.

In the absence of incentives, for the insulation of external walls and replacement of the fixtures, the payback period exceed 20 years, while for the coverage insulation the payback period is nearly 15 years.

The intervention on the heating system has been more interesting: the installation of thermostatic valves has a payback period of nearly 2 years and the replacement of the existing boiler with a condensing one has a payback period of nearly 10 years.

This critical aspect, relating above all to the interventions on the envelope, is generally observed in the mildest climate zones (A, B and C) and in buildings, such as schools, that have a rather limited period of use (in terms of both days and hours).

For these buildings, the annual economic savings after the interventions are extremely reduced and make the implementation not so convenient in most cases.

6. Existing School nZEB Buildings: an unbridgeable gap?

The made energy audit allowed highlighting the performance deficiencies of the building analysed, also in comparison with the National and European targets for energy efficiency in buildings.

The energy balance has also highlighted the most critical aspects, on which it would be appropriate to intervene.

However, the economic assessment of the proposed interventions has shown that the payback period of the investment is too long and so hard to be sustained by a public administration.

Moreover, this quite frequent situation, especially in the least cold climate zones, is likely to result in a total stop of the rehabilitation interventions of public buildings.

The tools used up to now, in terms of incentives, haven't been properly exploited and haven't been sufficient to push the public body towards a structured process of rehabilitation of his/her own heritage-listed buildings.

The gap between the existing school building and new nZEB standards could then be filled, but there are difficulties not so much in terms of technology, but especially from the economic point of view and at cultural level as well. Local governments must do their part, but it is absolutely necessary a national control, which individualizes tools and strategies to address and support the public body towards such an ambitious aim.

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Housing Policies and Urban Economics Vol.5 (Dicembre 2016), pp. 33 - 46

Green Energy Design

Antonella Della Cioppa[1] Rossella Ierardi[2]

Sunto. La sensibilizzazione della società civile all'utilità e alla eco-compatibilità delle fonti energetiche rinnovabili deve partire dal basso, dal mercato. La diffusione di oggetti di uso quotidiano che utilizzano energia solare o altre fonti rinnovabili porta all'innovazione non solo di prodotto ma anche di comportamento. Il contributo analizza l'attuale offerta di mercato e il valore aggiunto della diffusione di questi prodotti di design attraverso l'utilizzo del catalogo .

Parole chiave: energie rinnovabili, design, sviluppo sostenibile, innovazione.

Abstract. Society awareness about usefulness and eco-campatibility of renewable energy sources has to begin from the market. Everyday-use objects' diffusion that use solar energy or other renewable sources bring to innovation not only of the product but also of the use.
This research analyzes the market offer at the moment and the surplus value of the diffusion of this design products through the use of the catalogue.

Keywords: renewable energy, design, sustainable development, innovation

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1. Introduction (by R. Ierardi)

According to the new Renewable Energy Policy Network for the 21th Century (REN21), 2015 was a very important year for the renewable sources; the investments in renewable sources have been more than fossil ones for the sixth year in a row.

As shown in Fig.1, developing countries invest more and more, while the European countries' investments have decreased. Nowadays, the countries that invest more are China, USA, India and Japan.

Photovoltaic and Aeolian investments have been important to attract more other investments, disregarding evidently other energy sources. It is evident that more promotion of the renewable sources is needed through energy products' innovation, use and design.

To promote environmental awareness for the use of the renewable sources, it is needed to modify the habits of people and their orientation in markets towards particular types of products.

The right fusion between design and renewable sources can represent the most tempting answer. According to the concept of awareness, it is possible to analyse other two key-concepts as the base of design. The first is the concept of "need", that is to say the ability to satisfy every need, the second is the "limit", that is to say, the right correlation between what is possible and the good intentions.

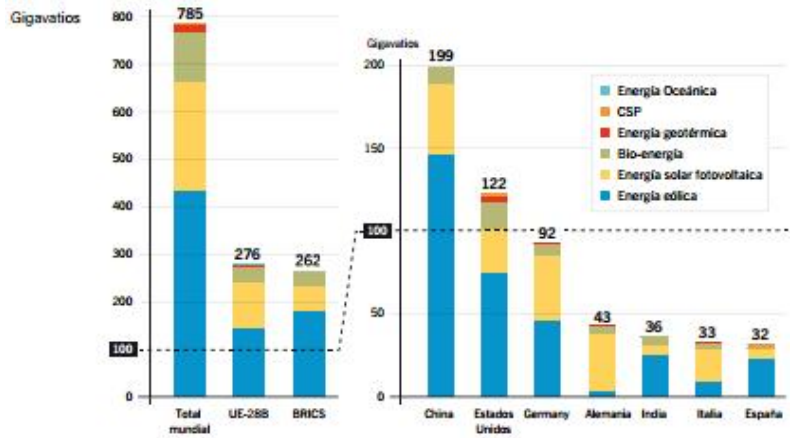


Fig.1 Renewable power capacities in the world. Source: www.ren21.net

The Green Energy utopia has three main points:

1. Production: The Green Energy approach is strictly based on the use of renewable energy;
2. Use: Green Energy means efficiency and energy saving;
3. Environmental impact: Green Energy implies less pollution.

Considering these three main features, the Green Energy Design Catalogue, structured during a research activity in collaboration with the Technological research group of the Department of Architecture and Industrial Design of the University of Campania, is now available, where there are many products examples where energy sensitivity plays the main role.

The aim of the catalogue is to show the efficiency of the products that have very often the role to fascinate the user and then to but the product (Fig. 2).

The surplus value of all this is the diffusion of the energy awareness and the demonstration that the use of the renewable sources isn't just for experts and designers, but it can be a technology of common and every-day use.

Fig. I Patchwork products of the Green Energy Design (Image edited by R. Ierardi)

2. The technological innovation to improve environmental consciousness (by R. Ierardi)

The Green Energy Design (GED) can be considered as a concept design with the aim to reduce the environmental impact during the whole product's life. According to "The project management life cycle: a complete step-by-step methodology for initiating, planning, executing & closing a project successfully" [1], the phases of a life cycle of the project are four:

1. Project initiation
2. Project planning
3. Project execution
4. Project closure.

The product is a system where it is necessary to consider every element that is needed to develop its work and its design.

"The transforming process towards a new kind of society has the aim to examine the objectives and needs thanks to new way of interventions that are linked to the eight "Rs" decreasing concepts:

- Reassess (a new system of values);
- Reconceptualise (a different vision of the world)
- Restore (updating production and social relationship for new values)
- Redistribute (obtaining a new division of the natural patrimony based on restoring social relationship)
- Relocate (Restarting producing, when possible, the necessary products to satisfy the needs of people);
- Reduce (Reducing the impact on the biosphere of our way to produce and to consume, eliminating wastefulness and over use);
- Reuse (Reusing products still usable till it is possible);
- Recycle (Dividing the part of the products to recycle them)." [2]

It is evident that the technological innovation has an important role for our future in terms of sustainability, in particular the energy one.

When designing a new product it is important to orient the production and the consumption of the products from an environmental point of view and to set and define new settings in the relation between needs and comfort.

In 1875 Nicolaj Kondratiev, a Russian economist, showed the theory of the waves of the technological innovation (Fig.3), constituted on the regular cycle of the capitalism. He observed long-term economic fluctuations in cycles of 40 to 60 years. These cycles begin with technological innovations. Most of the scholars of the innovation waves agree with the "Schumpeter-Freeman-Perez" theory that states five existing waves since the Industrial Revolution. These waves are related to the phases of development of the world economy. As time progressed, the lapse between each wave got shorter. This reflects a growing potential for innovation and the capacity of economic systems to derive commercial opportunities from an innovation once it has been adopted. According to the theory of Kondratiev, we are in the sixth wave [3].

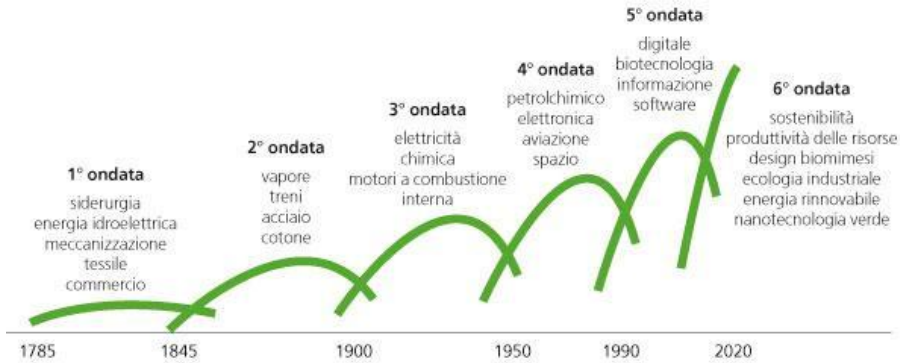


Fig. 3 The six innovative waves (Source: Hargroves, Smith, 2005)

Every product life can be divided into phases and for each phase; it is possible to evaluate input and output, environmental charge and economic and social benefit.

The product innovation has to be careful to all factors that can reduce energy and materials employed in the different phases of the cycle of life. Therefore, there is a new technological process as Life Cycle Thinking, which aims to evaluate all the environmental impacts connected to the cycle of life in every phase (designing, producing and managing the product).

The final result analyses the several factors involved and it is evident the attention to the products and service from the users' point of view. The designer can face the energy problems from the use, consumption and request's point of view, so not only from the formal and energy point of view.

As shown in market researches, the introduction of the environmental values in business brings to an innovation of the business models that determines more positive effects on competitiveness.

MIT Sloan and Boston Consulting Group research shows companies can obtain best economic results from their sustainability projects that can innovate their model of business. A radical change of the operating model is given thanks to the decision to put the sustainability research at the centre of the strategic orientation.

According to the General Electric research, new challenges are given by the globalization, economic and environmental crisis, that induce to a new innovative approach. Sustainability doesn't need innovation, innovation needs sustainability.

3. A catalogue for the Green Energy Design (by A. Della Cioppa)

With the Directive 2009/125/CE of the 21st October 2009 (GUCE 31/10/2009) and the Italian Legislative Decree of the 16th February 2011, n°15 about a table to elaborate the specific eco-compatibility design of the products linked to the energy based on the directive about energy efficiency, the EU pays attention on ERP production (Energy Related Products). That is to say doors and windows, isolating materials, bathroom fixture, taps and fittings, that don't use energy but have a relation with the energy consumption of the EuP (Energy Using Products).

Form a technical point of view, the new Directive does not modify any product but it establishes the rules for the definition of technical requirements to follow, to improve energy efficiency and reduce the negative environmental impact of the products during their cycle of life (production → use→ end of life).

To evaluate comparing performances, technological features and technical requirements of the products produced according to the Green Energy Design principles, it is needed to consider technological, energy and working data of the objects. As a result, we have data sheets the permit to have an immediate and complete analysis of the market.

Starting from their features, it is possible to find strengths but also critical issues of performances and of the real sustainability in order to define possible actions to correct and improve how they work, their use and their sustainability.

The data sheet (Fig.4) has several sections. The first section is about product's data as a sort of ID.

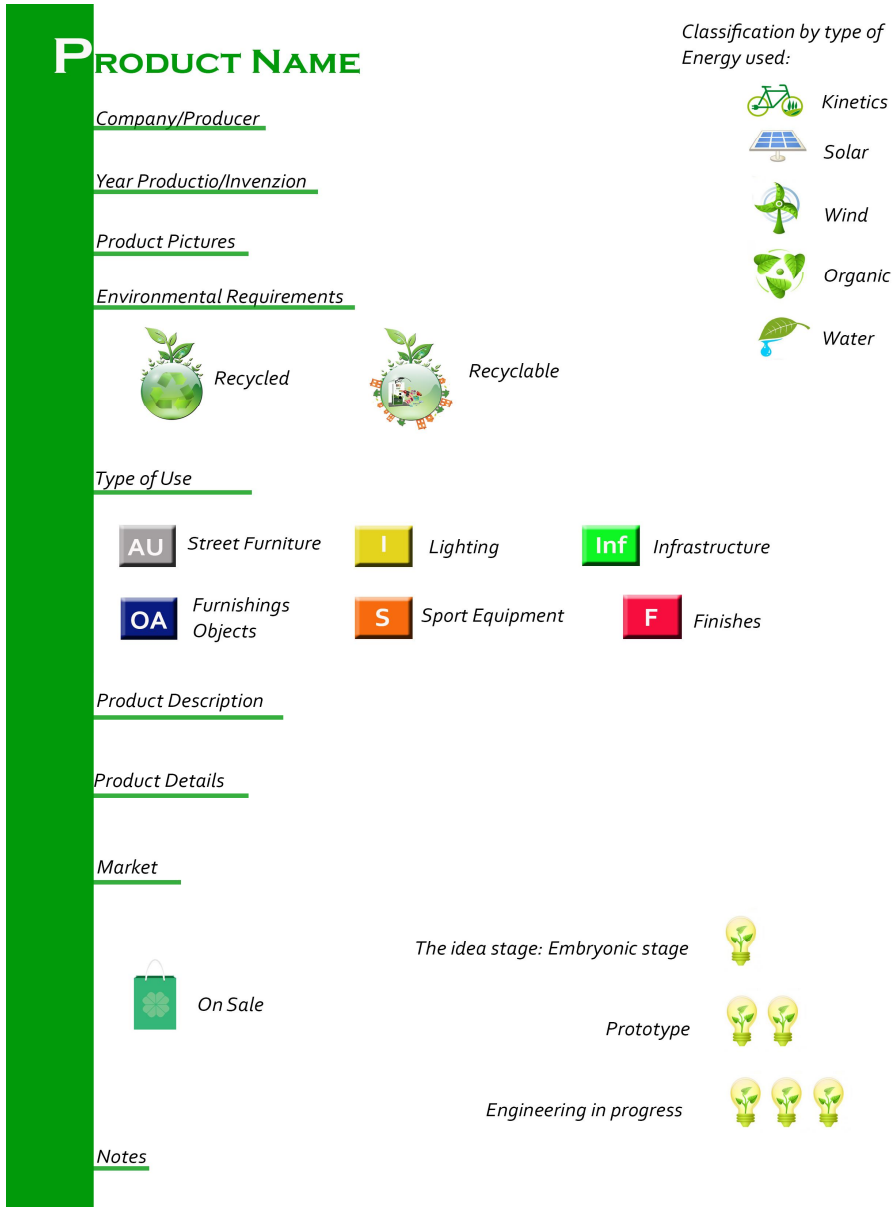


Fig. 4 Product data sheet example (edited by R. Ierardi in collaboration with A. Della Cioppa).

Then there is the renewable energy source, and the recyclable components.

The product is classified according to its use/function considering six subsets:

- Street Furniture;
- Lightening;
- Infrastructures;
- Furniture Objects;
- Sports equipment;
- Finishing.

A short technical description and building details, and production follows to understand the product innovation.

Useful information for the users is how the product is placed on the market. The data sheet shows if the object is on sale or is still a prototype.

From a visual point of view, each category has a quality symbol (1, 2 or 3 bulbs according to the developing level of the project).

The only quantity symbol is represented by the category "on sale" that is represented in a different way.

Thanks to the data sheet, it is possible to obtain clear and immediate data about the condition of the productive process and the offer for these elements.

Moreover, it is possible to evaluate the real usefulness and the possible energy saving, defining also the real sustainability of these objects.

The catalogue of all these products can help the user to choose when buying but it can also help the companies to improve products' features and performances.

As the data sheets show (Fig. 5, 6 and 7), the information is clear and immediate.

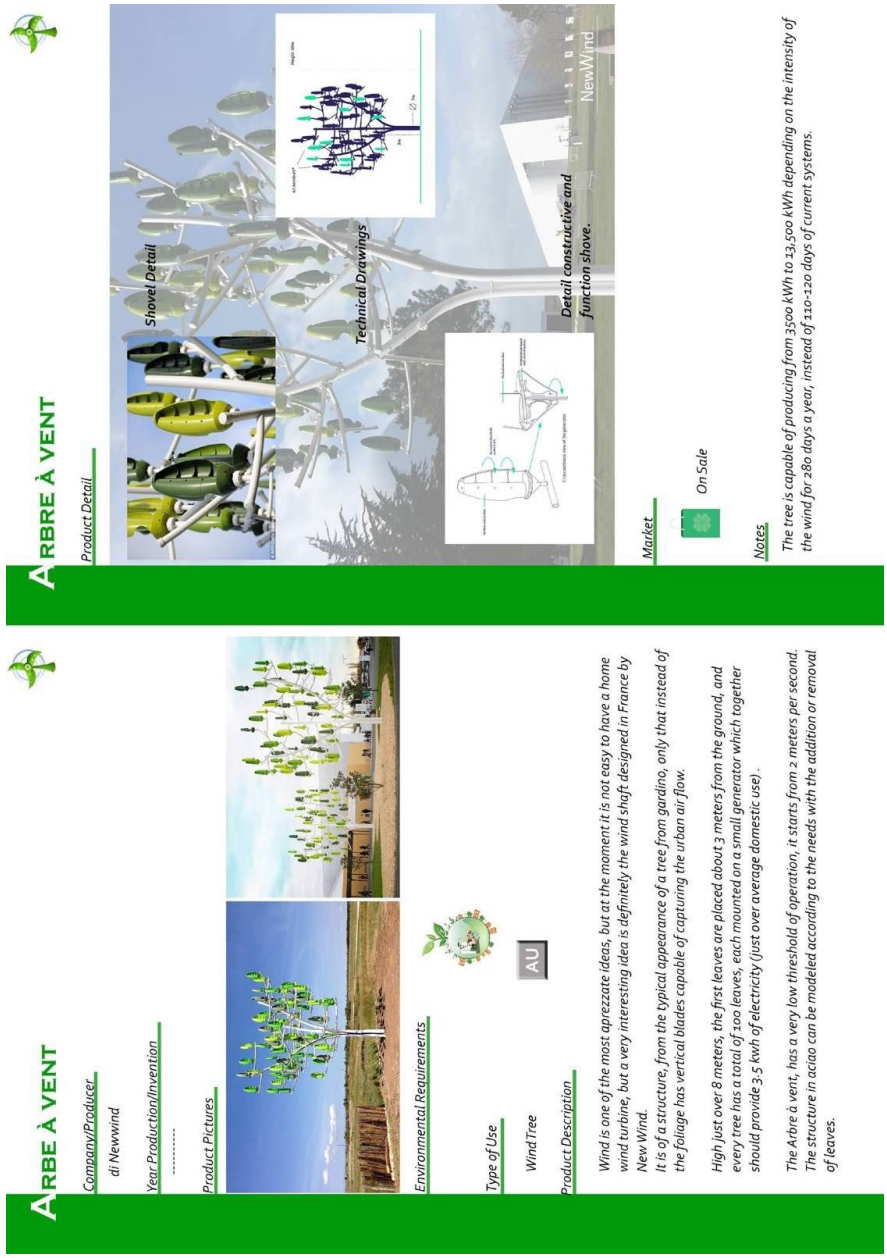
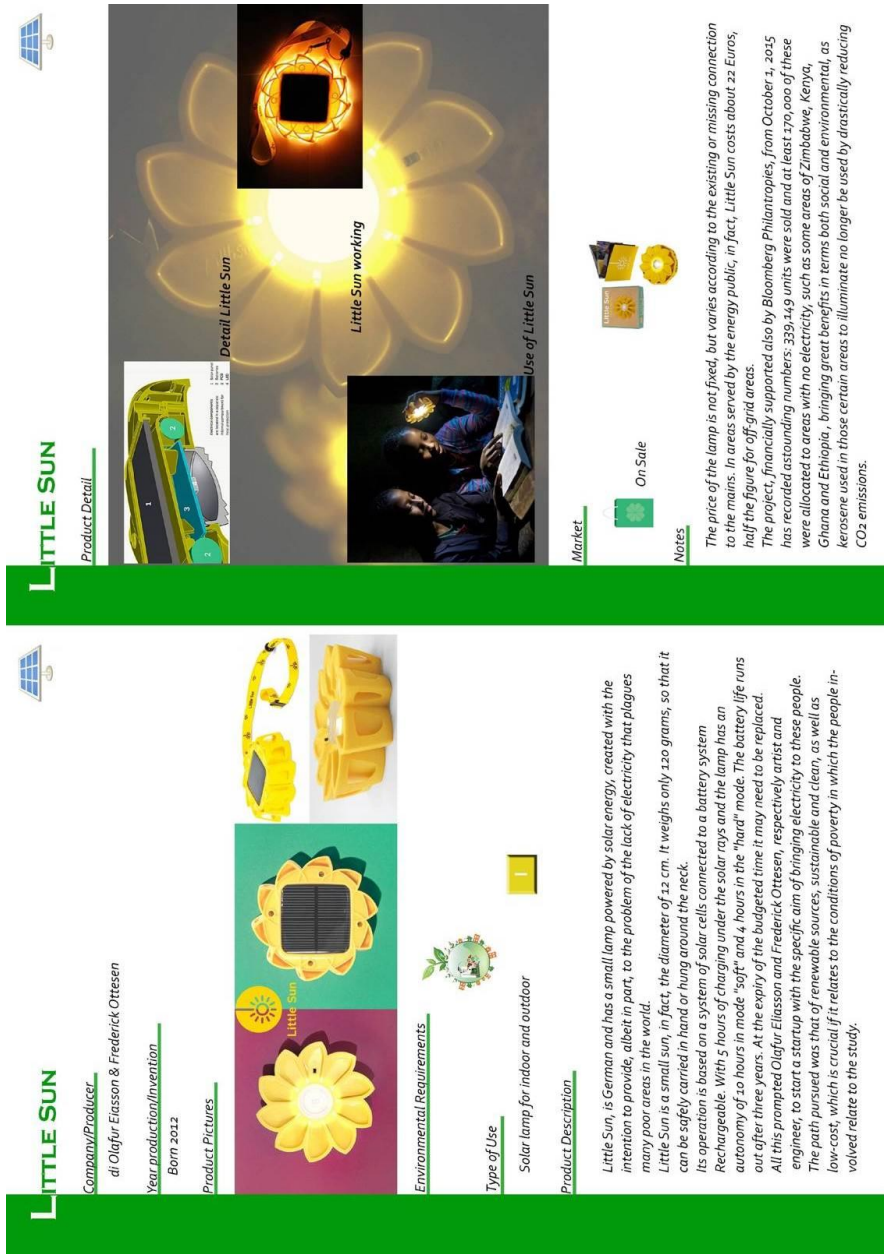


Fig. 5 “Arbre à vent” product data sheet (edited by R. Ierardi in collaboration with A. Della Cioppa)

Fig. 6 "Gaon Street Light" product data sheet (edited by R. Ierardi in collaboration with A. Della Cioppa)



LITTLE SUN

Company/Producer

di Olafur Eiasson & Frederick Ottesen

Year production/Invention

Born 2012

Product Pictures

Little Sun

Environmental Requirements

Type of Use

Solar lamp for indoor and outdoor

Product Description

Little Sun, is German and has a small lamp powered by solar energy, created with the intention to provide, albeit in part, to the problem of the lack of electricity that plagues many poor areas in the world.
Little Sun is a small sun, in fact, the diameter of 12 cm. It weighs only 120 grams, so that it can be safely carried in hand or hung around the neck.
Its operation is based on a system of solar cells connected to a battery system Rechargeable. With 5 hours of charging under the solar rays and the lamp has an autonomy of 10 hours in mode "soft" and 4 hours in the "hard" mode. The battery life runs out after three years. At the expiry of the budgeted time it may need to be replaced.
All this prompted Olafur Eliasson and Frederick Ottesen, respectively artist and engineer, to start a startup with the specific aim of bringing electricity to these people.
The path pursued was that of renewable sources, sustainable and clean, as well as low-cost, which is crucial if it relates to the conditions of poverty in which the people involved relate to the study.

LITTLE SUN

Product Detail

Detail Little Sun

Little Sun working

Use of Little Sun

Market

On Sale

Notes

The price of the lamp is not fixed, but varies according to the existing or missing connection to the mains. In areas served by the energy public, in fact, Little Sun costs about 22 Euros, half the figure for off-grid areas.
The project, financially supported also by Bloomberg Philantropies, from October 1, 2015 has recorded astounding numbers: 339,149 units were sold and at least 170,000 of these were allocated to areas with no electricity, such as some areas of Zimbabwe, Kenya, Ghana and Ethiopia, bringing great benefits in terms both social and environmental, as kerosene used in those certain areas to illuminate no longer be used by drastically reducing CO_2 emissions.

Fig. 7 "Little Sun" product data sheet (edited by R. Ierardi in collaboration with A. Della Cioppa)

4. Conclusions (by A. Della Cioppa)

Here it is the turning point: "Fossil sources era is ending. A new energy use able to lead civilization towards a radically new way is growing." [12]

In the following years, the products based on renewable sources are growing, giving an important contribution of every single industrialized country GNP.

To permit a more rapid diffusion of these innovative systems it is possible strategically, to liberalise the intellectual property of these products. In this way, every company is able to use these new technologies in their products.

Industries will have the main role to transform the need to substitute the conventional fossil sources and the nuclear energy with the renewable energy.

Universities and research institutes have been playing an important role for a long time showing their results.

Green Energy Design objects aim to surprise and intrigue users through their up to date technologies, even if they have a high social surplus value: promoting and spreading environmental sensitivity.

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Housing Policies and Urban Economics Vol.5 (Dicembre 2016), pp. 47 - 59

Zero Energy Building DISTRICT

Antonella Violano[1] Carmen Rauccio[2]

Sunto.
Il contributo presenta gli esiti di una sperimentazione didattica: il progetto di un quartiere residenziale sostenibile concepito in linea con i requisiti degli edifici ad Energia quasi Zero e di tutte le altre variabili ambientali significative. Gli edifici, inseriti all'interno di un sistema di viabilità sostenibile, sono progettati con alte prestazioni energetico-ambientali e un consumo di 80.2 KWh/m^{2}anno. Un risultato che ci proietta verso un cambiamento normativo già in atto, alle porte del 2020.

Parole Chiave: Edificio ad Energia Quasi Zero, Prestazioni energetiche, Architettura bioclimatica

Abstract.
This paper presents the results of a didactic experimentation: the design of a sustainable residential district which addresses the requirements of nearly Zero Energy buildings, combined with all other significant environmental variables. The buildings, inserted into a sustainable road system, are designed with high energy-environmental performance and a consumption of 80.2kWh/m^2/year.
An achievement that propels us towards a regulatory change already under way, almost in 2020.

Keyword: nearly Zero Energy Building, Energy performance, Bioclimatic architecture

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1. Introduction (by A. Violano)

"*The mind does not need to be filled such as vases, but a spark that turns it on*" (Plutarch)[1].

An educational experience that stimulates creativity and follows the fields of knowledge based on the approach of the "possible quality" and the pragmatic approach, aimed at professional practice, shows us that the technician must be able to do, rather than just knowing.

Creating a relationship between didactic contents and pursuing concrete goals, learning activity is perceived as interesting, stimulating and correlated to the professional context. Spontaneously a push to be engaged arises, that is represented by the motivation linked with the possibility to use educational contents to purse a professional concrete goal.

In this sense, a degree thesis is perhaps the last chance for a student to follow a design process with the supervision of a tutor who helps him making decisions on a proper and scientifically supported methodology.

The contribution illustrates one of these educational paths aimed at a Technological Design of a Zero Energy Building District: a residential area for students developed according regulatory criteria for energy efficiency and environmental compatibility, in line with the current laws. The district, localized in San Prisco (Caserta) is an experimental proposal of low energy design, which addresses the technological aspects in multiscale way: urban, architectural and technological point of view.

The opportunity to design a residential area, almost exclusively for a target of young people (university students), has given the opportunity to interact effectively with the knowledge of other disciplines which, as claimed by Eduardo Vittoria, "*contribute to reaffirming that kind of experimental project, necessary to the production of physical objects, conceived, designed, engineered, and especially intended for a more comfortable and balanced existential space of everyday life*" [8].

The key words, in fact, were *balance* and *comfort*: the residential complexes is designed according to the rules of energy efficiency (nZEB standard) and environmentally compatible bioclimatic design,

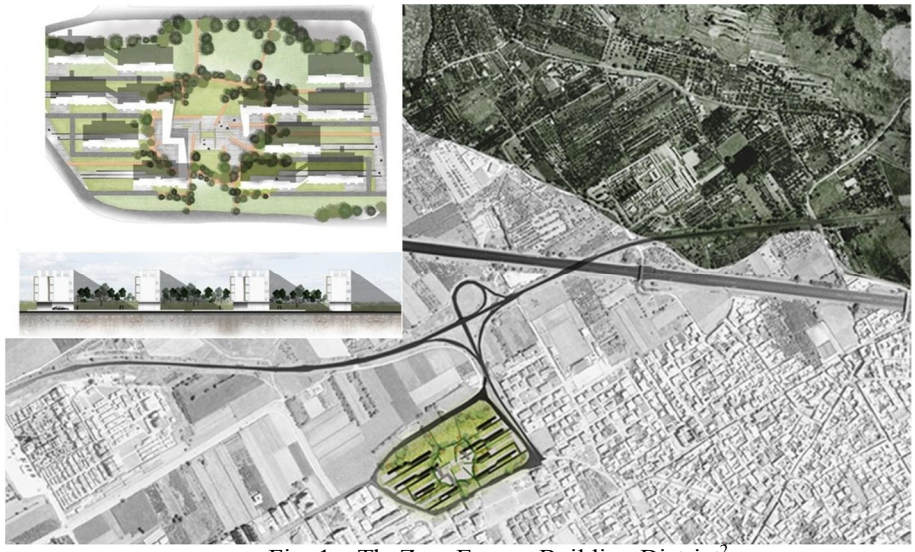


Fig. 1 – TheZero Energy Building District[2]

connected by a sustainable road network, within a context of alternating large public and private green spaces.

The buildings are developed mainly along the east-west axis and the windows are both on south and north facades, in order to ensure adequate natural ventilation. Furthermore, the planimetric location of each building has been designed in such a way that none of them creates shadows on the other, maximizing the amount of natural direct light.

2. Methodology approach and concept design (by A. Violano)

A responsible use of resources and materials lead rethinking the design process. Designing and innovating mean "Choose wisely" and the mechanisms of complex development of design ideas must be able to answer a question, which in the meantime has evolved / renewed towards ever-higher standards of performance.

The architect shall be responsible for interpreting the relationship between not only environment and building, but also potential offer of building systems and direct users' demand, according to a rationality motivated by the comfort's needs .

In fact, the Technological Design, before being a transformation instrument, is a knowledge instrument.

Moreover, the design requires the creative interpretation of direct users' needs: a wise balance between technological innovation, research and a "Possible /Feasible Quality" [2].

Teaching the "Possible Quality" means to give to the students, who are the future architects, technical tools for the wise and appropriate control of the built environment. Students must acquire design competences and skills in order to give a new quality to the built environment on which they will be called to work in the future.

In fact, awareness, knowledge, sensitivity and control of regulatory and technological tools is the objective to which we must aim during undergraduate learning process.

The project can not be considered a "product": it is instead the "place" where concur several peer, multi-scale, interdisciplinary instances, whose specialist inputs are integrated contributions.

The Meta-Design is the first awkward phase, in which students make the methodological choices: they choose the purposes, define needs and identify regulatory requirements.

From the design viewpoint, the aggregation of residential units follows the rules of modularity, prefabrication, flexibility and eco-sustainability. In particular, the relationship between the building and the external environmental components makes the rules for the control of factors: sun, wind, water and green, ...

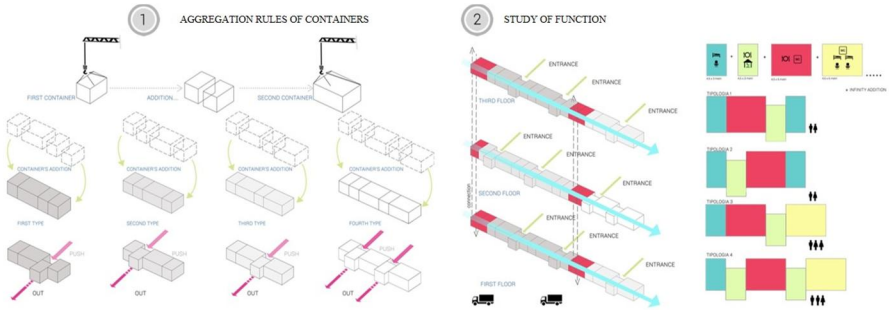


Fig. 2 – The aggregation of residential units[2]

Then, in the Design Phase, the energy and environmental performances respect all the minimum legal requirements [2]:

- Average global heat transfer coefficient for transmission by unit of dispersing surface (H'T);
- Thermal Performance Index useful for Heating (EPH, nd), Cooling (EPC,nd) and Global (EPgl,tot);
- Efficiencies for heating, cooling and production of sanitary hot water system;
- Transmittance less than 0.38 W/m^{2}K for the C climate zone[3];
- Attenuation of the thermal flow equal to about 0.15;
- Phase Shift of the thermal flow more than 12 hours;
- cross ventilation and architectural bioclimatic integration;
- integration of renewable energy source, considering outdoor climatic conditions and economic effectiveness (Costs / Benefits);
- use of eco-friendly materials.

The balance of the energy needs must be supplied by integrated renewable technologies, which have to meet the standard requirements that first must be minimized by appropriate design and technological choices.

However, it is not sufficient to make the architectural design; it is important to verify their own choices and be able to assess the possible need changing solutions, too.

The use of specific software helps the student in this evaluation and they make easy the verification of technological choices.

Fig. 3 – The winter behavior of northern and southern fronts[2]

Fig. 4 – The design process … step by step[2]

For the transparent envelope, the evaluation of some important parameters is been taught:

-transmitted light through the glass (in percentage in comparison with the incident light);

-heat transmitted through the glass (in percentage in comparison with the incident radiation);

-transmittance (in W/m^2K)

-solar factor g (a percentage that value ranges between 0 and 1),

- Summer Equivalent Solar Area for usable area ($A_{sol,est}$ /$A_{suputile}$).

It is important that students make their own choice considering the thermal component is not the only variable: conditions of light, comfort and fruition of the confined space need a different quantity of natural light in relationship with both the intended use, and exposition and characteristics of the environmental surroundings (presence of obstructions close to the glass front and their shadows).

In the following paragraphs, the design solutions are described.

3. The building- scale design proposal (by C. Rauccio)

The residential district, not very far from San Prisco town, near Caserta, has been conceived to host 252 students in 12 well-ordered buildings in the plot. Every residential building is able to host a maximum of 21 students and is conceived as a prefabricated modular stick, whose constitutive elements are conceived according to the modular approach of the container. It is a set of flexible house cells, prefabricated and repeatable to infinity, easy to carry and to assemble.

Composing planimetrically the containers, two types of buildings will be identified: two for two students at unit and two for three students at unit.

Projected according to the bioclimatic and passive project rules [6]and, so, to the external climatic conditions of hanging out to dry and ventilation, each house unit has a position studied to enjoy the best orientation possible.[4]

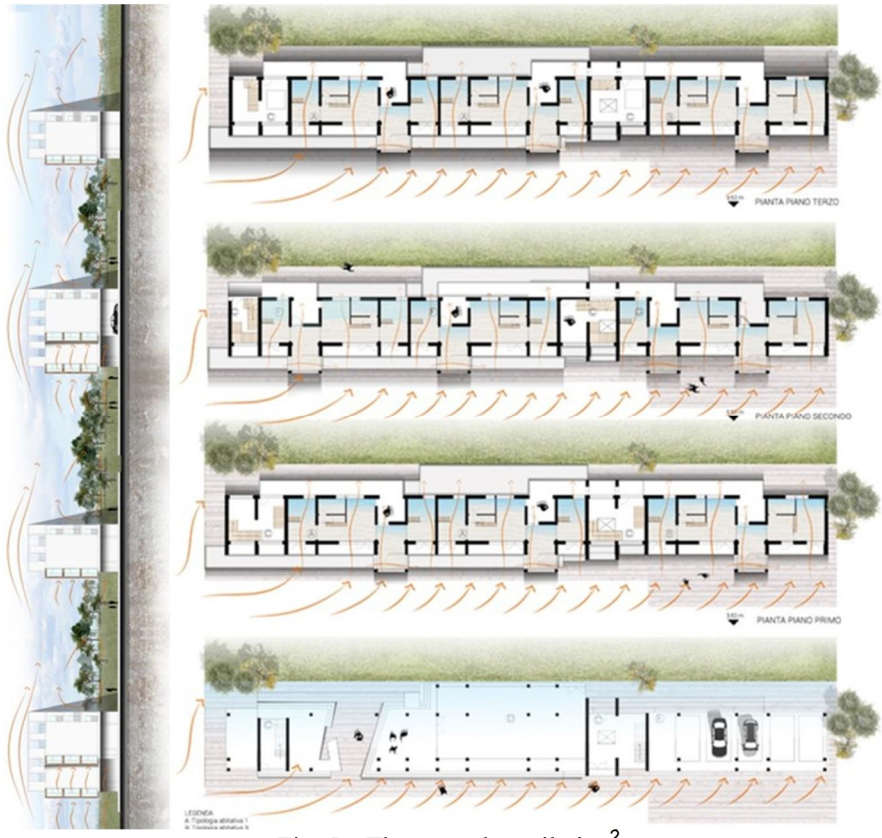


Fig. 5 – The natural ventilation[2]

From a functional point of view, every stick is projected as a spatial organization, which provides:

- on the ground floor: study/ common space rooms, small business activities and garages, connected to higher floors thanks to stairs and lifts;
- on the first three floors out of earth: the house units.

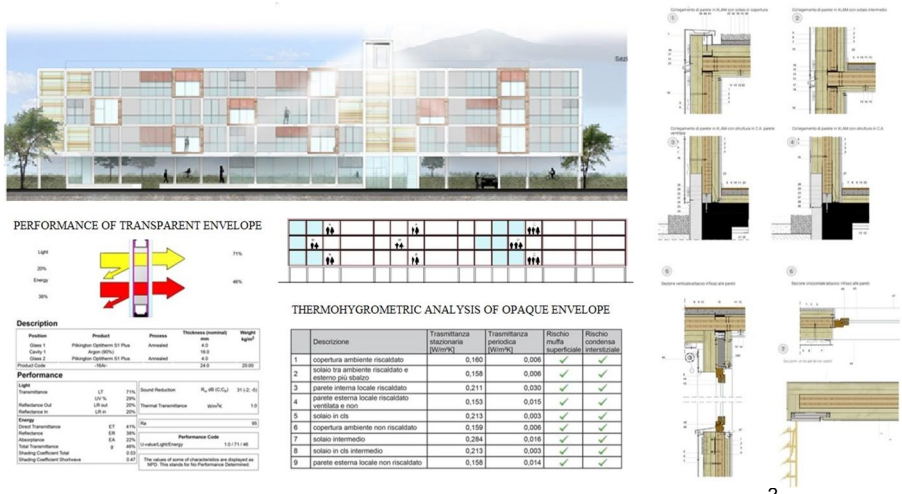
From a technological point of view, the southern front, that houses the “subtracted modules” for service areas such as stairs, lift and bicycle

parking, is shaded by mobile and colorful brise-soleil. By modulating the panels' inclination, it is possible to control the quantity of solar radiation allowed to filter inside the building.

The modules dedicated to living purposes are illuminated by wide windows and it is possible to read their geometric development on the front.

The glazed greenhouse module, covered in wood, breaks the linearity of the stick as it has slipped forward, giving us the chance to appreciate the green inside decorations from the outside.

The northern front is made "inward-looking" for climatic reasons, given the lower windowed surface in comparison to the southern front, with small, higher-placed, window fixtures.



	Descrizione	Trasmittanza stazionaria [W/m²K]	Trasmittanza periodica [W/m²K]	Rischio muffa superficiale	Rischio condensa interstiziale
1	copertura ambiente riscaldato	0,160	0,006	✓	✓
2	solaio tra ambiente riscaldato e esterno più sbalzo	0,158	0,006	✓	✓
3	parete interna locale riscaldato	0,211	0,030	✓	✓
4	parete esterna locale riscaldato ventilata e non	0,153	0,015	✓	✓
5	solaio in cls	0,213	0,003	✓	✓
6	copertura ambiente non riscaldato	0,159	0,006	✓	✓
7	solaio intermedio	0,284	0,016	✓	✓
8	solaio in cls intermedio	0,213	0,003	✓	✓
9	parete esterna locale non riscaldato	0,158	0,014	✓	✓

Fig. 6 – Performances of transparent and opaque envelope [2]

Once again, the architectural element that adds movement to the front is the greenhouse, which however, given the different exposure, is subtracted and in this case is covered in irregular panels made of laminated timber, which cover the walkways and create more complex games on the front.

From a bioclimatic point of view, the winter behaviour of the building allows sunlight to fully penetrate the residential units, thus

maximising the free solar gain and minimizing the energy consumption for warming.

In summertime, instead, the comfort conditions are managed through the selective behaviour of the technological solutions we adopted: three types of mobile shading systems (projecting roofs for the openings, brise-soleil for the stair bodies and rolling blinds for the greenhouses and all the glazed components). These systems are designed to prevent incoming of direct solar radiation during the hottest months and, on the contrary, allow for the free solar gain in the coldest ones. [1]

Furthermore, an appropriate direct natural ventilation assures the comfort conditions; in fact, the windows are positioned in a way that allows the southern front to receive the predominant summer wind; this generates cross ventilation.

The bioclimatic greenhouse is the passive structure projected as buffer space with the task of tapping the thermal energy through the surfaces of store and releasing it in a controlled way when it needs. The kind of window employed is composed of a wooden covered frame at thermal cut and double-glazing with a 4-12-4 structure and interspace filled at 90% with argon, limiting, this way, the dispersions during wintertime.

In wintertime, it is completely let exposed to maximize the solar gain, in summer it is ventilated and screened through external roller curtains. Even the choice of color is not accidental: the choice of the warm tints of earth drawn on the typical color of the building tradition of Campania in general and particularly of Caserta.

The carrying structure of the house units has been projected with X-LAM technology, characterized by low emission of CO2, recyclability and eco-friendliness.

The thermo hygrometric analysis of the opaque envelope, verified with PAN 7.0 software of ANIT in accordance with the limit requirements imposed by DD.MM. 26/06/2015, confirms the adequacy

of the technological choices as regards the parameters of Transmittance, Attenuation, Phase Displacement, Periodic Thermal Transmittance and Interstitial Condensation.

	Technological Element	**Transmittance (W/m^2K)**	**Periodic Transmittance (W/m^2K)**	**Surface mold Risk**	**Interstitial condensation Risk**
1	Roof	0.160	0.006	NO	NO
2	Floor on open spaces	0.158	0.006	NO	NO
3	Vertical perimeter wall	0.153	0.015	NO	NO
4	Ground floor	0.213	0.003	NO	NO

Tab. 1 – Value verified with PAN 7.0 software

By the Energy Performance Certificate, drawn up for a single housing unit with NAMIRIAL TERMO software it has emerged that the housing unit taken into consideration is in class A2, with an annual consumption of 80.2 KWh/m^2/year.

Finally, the Energy Performance Certificate not only certifies the validity of the choices, but also provides the right guidelines to improve them with a view to a future regulatory change.

Fig. 7 – Performances of transparent and opaque envelope [2]

4. Conclusion (by A. Violano)

Designing and innovating require "knowing how to choose"; in the meantime the complex mechanisms of development of project ideas have to respond to a question renewed towards ever-higher standards of performance. Renovated design methodology redefine the powers of the technology industry for innovation. However, my invitation is always the same: let us change the designing method, so, we will contribute to improve the Quality of Habitat not transforming the things, but the way to use them.

Notes

[1] Plutarch, The art of listening, II A.D.

[2] The image is produced in collaboration with Carmen Rauccio

[3] This value will be 0.34 W/m^2K after the 1st of January, 2019, for public buildings and public use and after 1st of January, 2021 for all other buildings, according to the Appendix A (Annex 1, Chapter 3) "Description of reference building and parameters of verification" of MM DD 26.06.2015

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Housing Policies and Urban Economics Vol.5 (Dicembre 2016), pp. 61 - 74

The renewed balance of highly urbanized contexts: ecological and environmental aspects

Raffaela De Martino[1] Barbara di Vico[2] Rossella Franchino[3]

Abstract. To requalify abandoned urban green areas means planning a variety of interventions, which would lead to the creation of many green areas that connected to each other would eliminate infrastructural barriers caused by urban expansion, so that there would also be a growth in the quality of the living in the city.

Keyword: environmental requalification, ecological network, environmental education, urban farm.

1. The environmental regeneration of anthropized contexts

Over the last few decades, environmental issues have had priority among the major concerns of contemporary man. They have significantly affected the study, implementation and management of new technologies, both innovative as well as simply evolutionary. For this reason, the analysis of convenience, oriented only by the need to save resources, has become a compatibility analysis that has added to

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the aim of saving that of mitigating the environmental impact, both seen in their effect on the remaining availability of resource for future generations and the ability to enjoy a habitat not completely degraded, despite having undergone repeated transformations. Currently, one of the main environmental issues is that of the environmental balance of urbanized areas, where the environmental water, air and soil components are, in some cases in emergency conditions.

The analysis and design technologies that can be used in environmental restoration interventions differ from the traditional ones used for a single building or in building contexts, since being applied to the environment, they have to consider a complexity of variously interrelated factors.

The environmental transformations are dynamic and depend essentially on how the moving systems are inserted and possibly alter the static systems, such as, for example, the morphological and landscape ones. Among the dynamic systems, it is worth mentioning the energetic and service ones as well as those that regulate mobility. Precisely due to this specificity, an appropriate analysis method could be the matrix, where the environmental characteristics given to the rows are associated to the factors that have an influence on them through a gradual assessment reported in the intersection element. This system, based on the matrix representation, despite its schematic nature, can represent a methodology that allows to approach the complexity of the object under analysis.

This methodology also allows to observe the environment in its uniqueness and unrepeatability since everywhere physical and biological transformation processes can be configured according to their basic characteristics.

In addition, from the analysis, the transition to the project still has a particular typicality when the object of the design is the protection of the local environmental conditions from the impact of development and anthropization. Thus, the project must be run by a unified multidisciplinary professionalism through a coordination that always takes into consideration the goals of the design as well as the factors that it has to review and change as they evolve.

The technology of the redevelopment project is, therefore, complex and coordinated and based on an integrated set of interventions on the mobility and viability, the green and furniture, plant and infrastructure systems, relationship spaces, the building envelopes. The objectives are to qualify life, protect health, enhance safety, facilitate the relationships among the inhabitants.

The aspects that need to be controlled within the urban redevelopment include:

• energy quality, in order to control energy flows and encourage the use of renewable energy as well as reduce exhaustible fuels;

• water quality, including the control of a correct water cycle management;

• quality of the waste management, intended as a correct collection and treatment of waste;

• quality of green, intended as identifying the changes that the plant system can have on the urban environment;

• quality of the structures, intended as valorisation of the typological and constructive characteristics of the building heritage, also on the basis of the bioclimatic aspects;

• quality of mobility, as a restriction of vehicular traffic flows and promotion of alternative transport systems;

• quality of information, intended as the management of activities related to relational data streams;

• quality of safety, intended as the controlling of physical and personal risks.

An approach to the planning of activities for the environmental rebalancing of urbanized territories requires we carefully identify the possible interference between the natural and anthropized aspects with the issues related to the sustainability of urbanization, conservation of biodiversity, control of the land use and territorial fragmentation.

The redevelopment interventions of the territory have to move with particular interest, among other aspects, towards the ecological conservation of biodiversity in order to safeguard the natural processes that form the basic survival of ecosystems.

Particular attention should, therefore, be given to ecological networks that represent the tool that allows to carry out redevelopment interventions on the natural spaces as part of the contexts transformed by man.

2. The ecological network for the redevelopment of anthropized environments

The requalification project described below has given particular attention to the ecological and environmental aspects.

This is in line with the trends that have developed over recent years in the field of territorial planning/management practices, according to which, the application of the ecological network concept, is used for the environmental requalification of heavily anthropized contexts. It allows to initiate a process of regeneration of the area starting from the management of conflicts between the anthropized and natural flows.

The uncontrolled growth of cities, with the resulting settlement, infrastructure and production phenomena, has determined profound alterations to the territorial ecological structure, intensely transforming the natural and semi-natural areas, often reduced to isolated fragments, poorly connected and with severely compromised green features.

Ecological networks represent the locus of the requalification of natural spaces in the anthropized contexts, both in urban areas as well as on a larger territorial scale.

From an ecological/environmental point of view, the territory of Maddaloni, described below, is located in an area that is bordered to the east by the main Apennine corridor and to the north by a cross-regional corridor. The first connects, in that part of the territory, the Regional Park of Taburno Camposauro to the Regional Park of the Partenio, while the second connects the regional coastline to the hinterland in the direction of Puglia, Basilicata and the Adriatic [1].

This is an extremely favourable position. The redevelopment of the area may represent an important opportunity to achieve, through environmental mitigation measures, a local ecological connective capable of connecting to that on a higher level.

The environmental improvement interventions have basically two objectives: the first one is to make available or increase the number of habitats suitable for the refuge and reproduction of many species; the second one is to enable or improve the connectivity between these habitats allowing the "protected" movement of the fauna.

In this case, the choice of the mitigative and compensatory types proposed takes into account the emerging critical issues that characterize the territorial context. The interventions planned in the requalification project for the construction of a local ecological network that will coordinate with the supra-local scale, on the one hand, related to increasing the biodiversity of the affected agricultural areas, while on the other, improving the transverse and longitudinal connectivity along the main axes of the link roads.

The biodiversity of the agricultural ecosystems has been greatly reduced over the past few decades, not only due to the extreme specialization of crops, but also to the abandonment of traditional crofting systems, such as hedges and trees, that were important ecosystems for many animal and plant species [2]. Hedges and rows represent a haven of refuge and survival for all species that can no longer find a suitable place to reproduce in the fields [3]. They also act as biological corridors to connect on a local scale, encouraging an exchange of genetic material between both plants and animals through the connection with otherwise isolated natural areas [4].

The requalification project involves inserting vegetation strips consisting of rows and field hedges along the edges of the agricultural areas, with particular attention to their length, width and height.

Another type of intervention concerns the linear infrastructures. It is well-known how territorial biological connectivity is often inhibited by the presence of connecting axes (road and rail) which constitute barriers with little or no biological permeability and cause the phenomenon known as environmental fragmentation.

The proposed interventions in the project for the restoration of the cross-ecological connections, altered by the presence of roads, regard the green bridges or fauna underpasses. It is artificial artefacts, transverse to the road section, which allow for the crossing of the infrastructure of the animal species.

The essential characteristics for a correct design of these steps are: location, size, construction material of the structure, material used for the walking surface at the base of the crossing structure, the additional adjustment measures of the accesses that involve the development of vegetation dwelling and placement of fences and perimeter structures of "invitation" for conveying animals to the entrances of the passages. These conditions are highly dependent on the needs of the individual animal groups [5].

For the longitudinal reconnection, the project marks the realization of vegetated strips with tree and shrub vegetation or the use of plant biomass in short cycles for energy production in the sections where the infrastructures cross agricultural matrices mixed with high-density residential and productive areas.

In these cases, it is desirable to use biomass installations matched to the high hedge rows, in order to absorb part of the emissions, redesign the landscape taking the trends of the rural fabric and constitute a source of income for the farmers [6].

3. The case study of Maddaloni, Campania (Italy)

There are many abandoned or unused green areas in our national territory. If they were used they could improve the aesthetic features of neighbourhoods, the citizens' perception about their own current urban situation and, consequently the quality of their daily life.

An important task of the urban regeneration is to not be self-centered, but to be useful to the community, or in other words to serve the users in an efficient and suitable way.

The requalified area considered is located in Maddaloni in the province of Caserta in the region of Campania (Italy): it's an urban reality village near one of the Tifatini hills, so it has always had a strong relation to the natural surrounding, which has been decreasing in the last years because of the building expansion (Figure 1).

Figure 1: Territorial location (design thesis by Barbara di Vico)

The requalification intervention is about three green areas situated next to each other, to which useful functions have been assigned related to three nearby structures -a supermarket, a church and a school- developing respectively three main themes (Figure 2):

• the Green City theme, based on urban farming and related to the supermarket;

• the Sociality theme, where nature becomes the scenery to human interactions, related to the church;

• the Environmental Education theme, a subject which has become increasingly more important due to the lack of green lungs in the city.

The Green city theme is about the production of zero-kilometer vegetables, that allows the emission reduction of carbon dioxide and air pollutants caused by road transport.

The production of vegetables in urban areas can also take place in closed spaces -such as supermarkets- thanks to the use of indoor technologies, such as vertical green walls and boxes for hydroponic cultivation. The first technology allows to improve the internal

microclimate of the supermarkets and to grow small vegetables for sale, the second to cultivate aromatic plants thanks to a water recirculation hydraulic system.

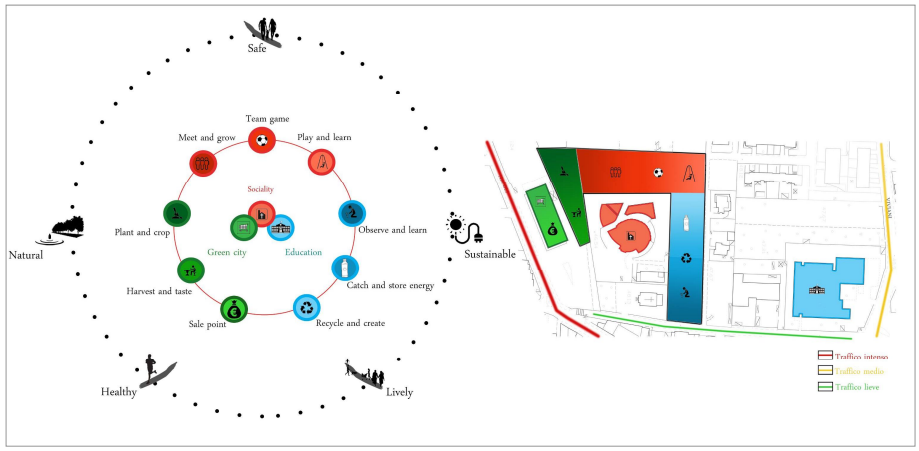

Figure 2: Concept and function distribution (design thesis by Barbara di Vico)

A key component for indoor cultivation of greens is the light, that cannot come exclusively from the LED lighting system. To achieve optimal lighting solar tubes could be installed to bring natural light inside through an optical device and a reflective channel, which also allows to break down the high costs due to the consumption of electric current.

Connected to the supermarket is the first requalified area, where urban farming allows to provide in part for the amount of vegetables that need to be sold. In this area a series of gardens have the additional task of allowing all users to experience the freshness and better quality of natural products. The vegetable waste will be used in so-called keyhole gardens, a soilless cultivation technique that transforms the vegetable waste into compost for growing greens.

Another technique used is that of synergistic gardening (from greek συνεργός, which means “working together”), where each vegetable becomes the nutrient of the other so as to let nature take its course while saving on maintenance and irrigation.

The second theme is related to sociality connected to nature and developed in the second requalified area belonging to the church.

Here the natural essences play a decisive role: the meeting area is characterized by an olive tree, chosen because it's a religious symbol of peace and brotherhood, surrounded by an area dedicated to the cultivation of the three most widespread medicinal herbs in the Mediterranean area: rosemary, oregano and sage. Charity events may be held in the square, characterized by the presence of myrtle, which adapts well to poor soils, and broom, indicated for the reforestation of degraded areas and the consolidation of plates for the typical dense texture of its roots.

The theme of environmental education is the focal point of the third and final area of intervention, related to the nearby school.

Teaching the cultivation of vegetables in urban areas is implemented through educational gardens in raised beds denominated square foot gardens, so called because they are subdivided by a 30 inches squared grid so that the families of the neighbourhood can adopt one or more squares so as to approach the logic of self production of vegetables.

The use of renewable sources is one of the issues often addressed in the environmental education workshops in school. That's the reason why photovoltaic trees with a branched structure made of metal tubes have been placed in this area, which provide Wi-fi and a charging station via USB inputs. To get the children to better understand how the sun can become a source of energy, each of the photovoltaic trees is paired to an interactive game that works via small panels.

Creative recycling workshops and exhibitions will also be held in the last area, allowing both younger users to express their creativity and artists to exhibit their works, created from recycled material, which could be used as street furniture.

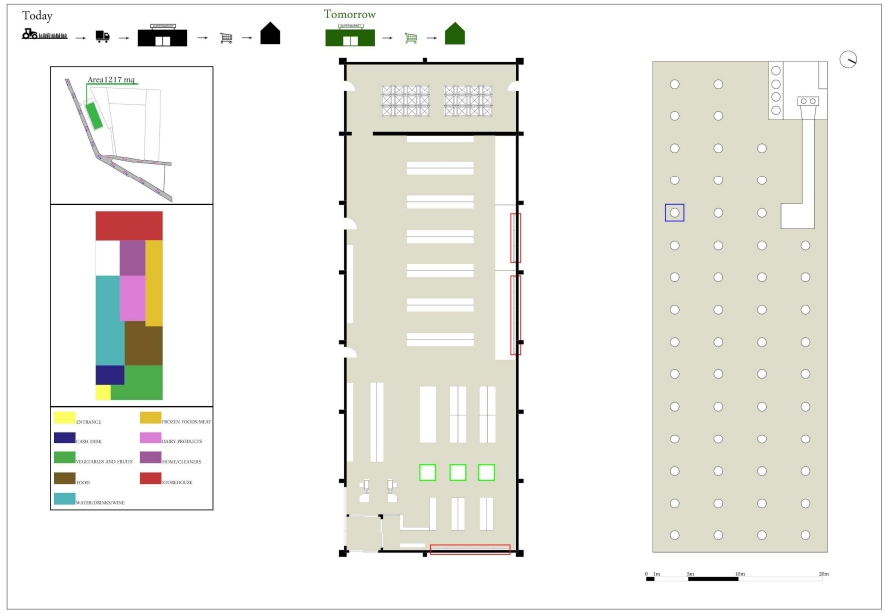

Figure 3: Green city_Market (design thesis by Barbara di Vico)

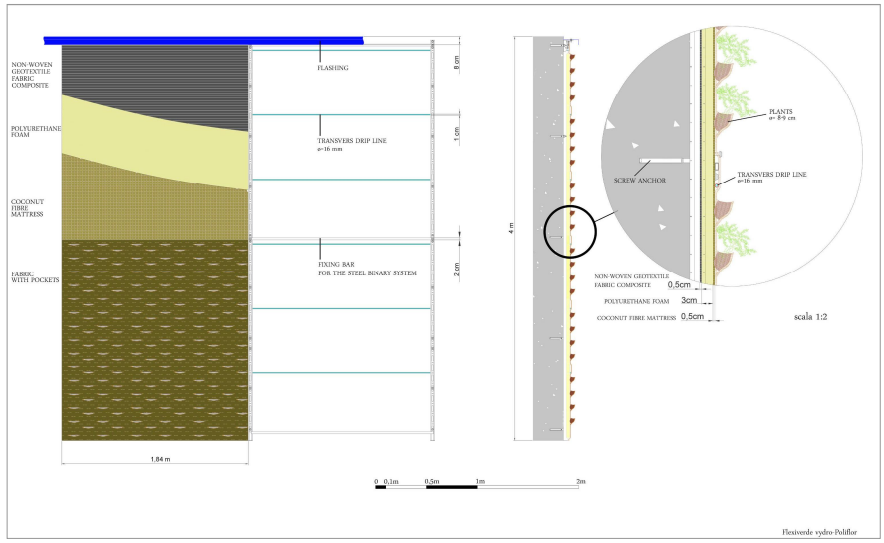

Figure 4: Green city_Market_Indoor technological interventions_Vertical green wall (design thesis by Barbara di Vico)

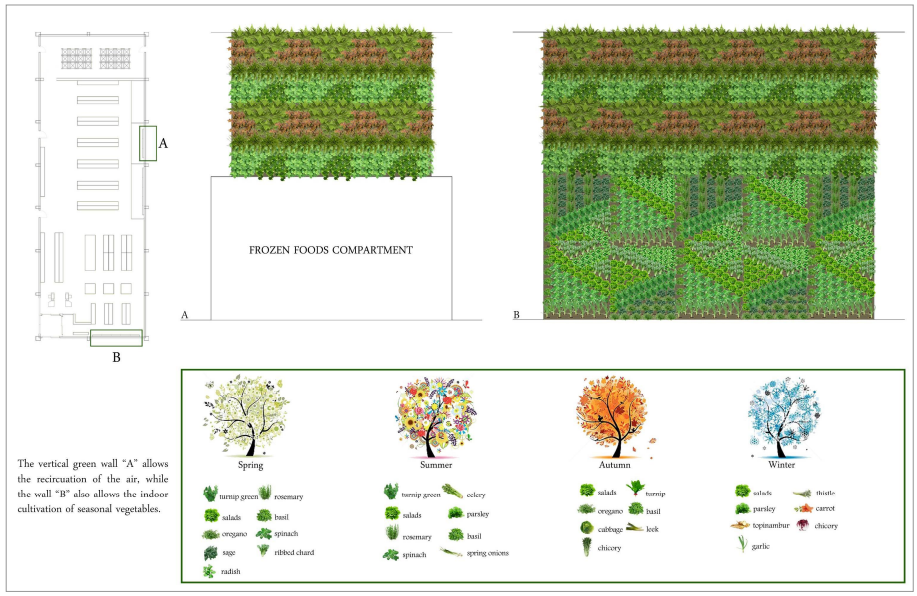

Figure 5: Green city_Market_Indoor technological interventions_Vertical green wall (design thesis by Barbara di Vico)

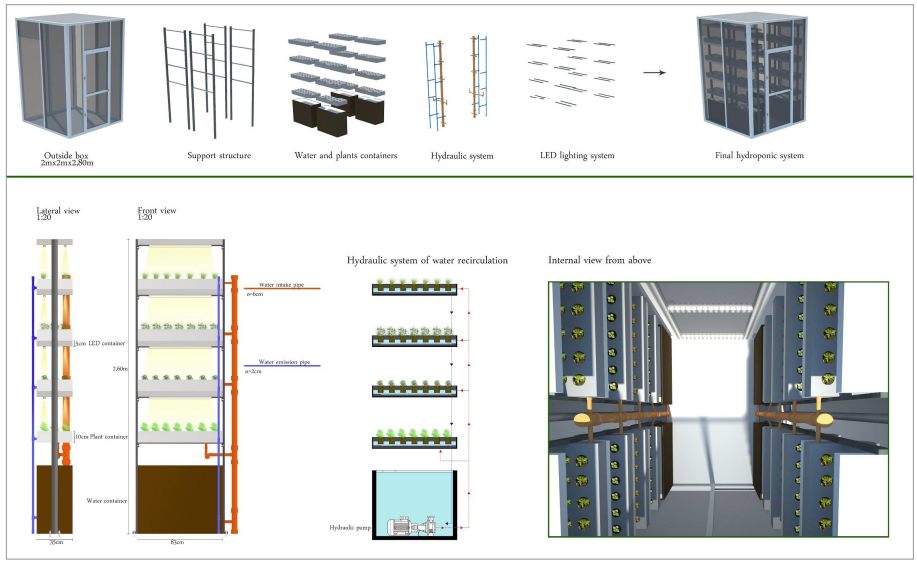

Figure 6: Green city_Market_Indoor technological interventions_Hydroponic cultivation (design thesis by Barbara di Vico)

Figure 7: Green city_Market_Indoor technological interventions_Internal view (design thesis by Barbara di Vico)

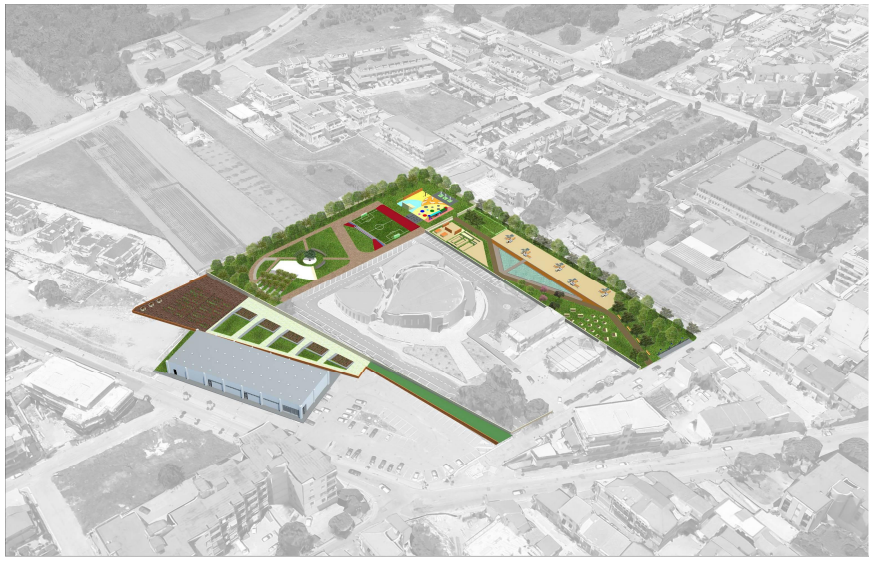

Figure 8: Overall view of the intervention (design thesis by Barbara di Vico)

4. Conclusions

This work has discussed the re-equilibration of highly urbanized contexts, focusing on the benefits that the requalification of abandoned areas could bring to the daily life of citizens and how it could protect the ecosystem variety by creating a strong relation between the urban area and the natural surrounding.

These interventions have been applied to a particular case study, showing how by using natural and sustainable techniques we can generate multiple ecological-environmental benefits.

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Housing Policies and Urban Economics Vol.5 (Dicembre 2016), pp. 75 - 89

Asinara International Living Lab: Sustainable tourism Strategic Plan for eco-system regeneration and territorial innovation

Antonella Trombadore[1], Dusan Rolovic[2], PierPaolo Congiatu[3]

Sunto. Avviare un processo di rigenerazione in chiave di turismo sostenibile, in un ecosistema fragile come quello dell'isola dell'Asinara che ha visto nel tempo lo stratificarsi di funzioni e relazioni socio-economiche complesse, da lazzaretto a carcere di massima sicurezza a parco nazionale e area marina protetta, diventa una sfida e richiede un approccio integrato per la gestione delle risorse naturali e antropiche, la rivitalizzazione sia del tessuto imprenditoriale che di una nuova "community", puntando sui temi dell'innovazione.

Parole Chiave: Gestione sostenibile delle risorse naturali, Turismo sostenibile, Architettura sostenibile, eco tecnologie, energie rinnovabili.

Abstract. The island hosted several prison complexes in the past two centuries, now converted into a National Park. The project focuses on the development of a Strategic Plan for the regeneration of the island to create new activities and functions which are both compatible with its responsible touristic potential and especially with the fragility of the ecosystem. The activities are supported by a network of structures and services to maintaining the balance of the ecosystem, allowing the creation of a model of sustainable management of natural resources.

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Keyword: Living Lab, Sustainable Tourism, Local Planning, Sustainable Architecture, Renewables Energy and Eco technologies

1. Territorial challenges

The Mediterranean islands are characterized by ecosystems and environmental heritage of great value. In a perspective of sustainable development, it becomes necessary to stimulate the regenerative capacity of territories and natural resources, for local identity development in a spirit of cooperation and community involvement. In this process it is necessary to involve actors other than the public administration. SMEs play a key role in the implementation and activation of local development. All small islands are characterized by a plurality of decision makers (town, natural park authority, region, state) that are often poorly interconnected. Each of these entities is involved for different and often conflicting reasons in the management of public and collective goods.

In the Mediterranean area you can identify at least three different types of smaller islands, with a long and troubled historical sedimentation and today almost all of these islands are considered protected natural areas, whose management and protection is entrusted to national or regional parks.

These include nature reserves such as Montecristo, the former penal colony of Pianosa and Asinara and traditional tourist islands as Giglio, Capraia and Maddalena. Small islands are still full of stories of treasures, memories and symbols that have undergone a process of transformation in recent years, often uncontrolled and characterized by fragmented management, which altered the socio-economic characteristics, the land use and the use and regeneration potential.

The Asinara Island, located in the north-west of Sardinia, includes the National Park of Asinara, has a surface of 51,9 square kilometres, formed by four minor mountain systems that are surrounded and linked by a narrow and flat coastal belt.

The marine and underwater island environment is a protected natural area and the Island, in its territory, represents an *unicum* in the Mediterranean area from a geological point of view, as well as its flora and fauna, both on land and sea, given the state of its territorial naturalness and outstanding presence.

2. Eco-tourism as opportunity for environmental development

In the Mediterranean regions tourism has always played a strategic role with significant territorial impact in economic and ecological terms, but over the years there has been a strong gap between coastal seaside tourism and cultural and scientific tourism.

This phenomenon, similar in all the islands albeit different in dynamics, resulted in the 70s and 80s exodus and demographic impoverishment of the smaller islands, with consequences on the management and maintenance of housing stock, on the economic activities of the present historic towns and the abandonment of the settlements and the countryside: a depletion of resources, reducing the competences and services that dramatically lowers the tourist attractiveness of the territories, even if placed in prestigious contexts.

The island of Asinara in different centuries underwent alternation of cultural influences, creating a succession of different social dynamics of communities and settlements: from Cala Oliva as the village of Ligurian fishermen to various hospitals in the first and second period, as well as Cala Reale and the agricultural structures of Campu Perdu and Santa Maria, and the prison sectors of Trabuccatu, Fornelli, Tumbarino.

Despite the diversity of the social structure, the Islanders have allowed us to maintain a dynamic balance between natural and man, being able to manage the entropy of the system in all its complexity, ensuring in parallel the development of agricultural activities in the economic and functional island life. The establishment of the Asinara National Park has fortunately slowed the phenomenon and led to a reversal of the trend, aiming at stimulating a growing demand for high environmental quality services, more aware of the rural and natural resource ecosystems, with a scientific approach and an international feel. Asinara is a privileged place to promote an innovative and sustainable tourism model for the territorial and regional context, where

natural potential and resources related to the authenticity of the places they are dominant, but not adequately exploited in the logic of a responsible tourism.

The Asinara territory can be an ideal and real testing ground for the international sharing and the promotion of a sustainable use pattern of low density territories and man-made high concentration of natural and cultural resources. A laboratory in which to test both systems of governance is the realization of ecological networks for smart resource management, integrated with business and agricultural models Km0. In this way it could trigger a virtuous process that on the one hand contributes to the revitalization of the area, on the other it favours an improvement in the competitiveness of local SMEs operating levels in the chain of tourist use. Thanks to the experimentation of a governance strategy and a participatory model of innovation and inclusive development, it becomes possible to make the system resources to enhance the economic structure towards a model of eco- tourism and responsible tourism, which will produce in the short and medium term an increase green growth in a sustainable development perspective.

3. The smart specializations as drivers of a living lab

The cultural options of the Asinara Park Plan

What is the vocation of a fragile and precious territory? Which economic valuation process can trigger the change? On what assets the objectives of a conscious management and resource protection can converge with a vision of development, revitalization and territorial innovation? What will be, and what features will take on the new *community* to be able to withstand the challenges of regeneration of an environmental and historical-cultural complex system? Already in 2013, the park plan has sanctioned the seven cultural options that have guided the strategic choices and the definition of management models, explicitly stating that "*The Asinara Park bases its peculiarities on the density of nature and history"* [1]:

1. The need to preserve the natural and historical heritage not only in its physical integrity, but also in the atmosphere. It can be defined as added value which transforms the use of space in an inner experience;
2. The need to organize the urban space of Asinara highlights the conservation of its natural density and history;
3. The environmental excellence cannot be preserved through simplifying processes of island environmental, but its preservation is also closely linked to the orientation of the territorial environmental policies to a wider context;
4. The prospect of the natural processes of evolution towards horizons of environmental and landscape diversity;
5. An environmental project to map territory resources and society development opportunities;
6. The environmental project as field process;
7. The environmental project as archipelago of environmental ecologies connecting, in the plot of environmental corridors, territorial islands as places network.

Cultural options of the Park Plan highlight the potential of the island but also the nodes that can pose threats to a process of development and revitalization: the community, the actors, the archipelago of local companies and territories.

The community

The lack of community reveals the fragility of an absence of network of users, citizens, inhabitants of a human capital of which few traces remain. Because you did not draft a physical territory without a community, the project of the Asinara Park, for the peculiarities of the territory, has in this sense a problem not easily solved. On the Island is evident a peculiarity: the presence of a beautiful territory, dens of opportunities, and the absence of a community involved in the development of natural and environmental resources. Far away is the idea of transforming the Island into a colony or to pre-establishes the "primary groups": we believe that an innovative solution can be found

by creating a new community of people and companies able to value resources.

There is no smart specialization of an area that is not linked to the human factor: what constitutes a territory are its inhabitants, with their skills and unique capabilities, which means that a place is different from another. The significance of smart specialization should therefore be extended, taking into account the specificities and particularities of the people (citizens, stakeholders, but also politicians and civil servants) that contribute to the strategic orientation of the local innovation policy.

4. Why an International Living Lab?

The creation of a community eco-system for territorial innovation

The creation of the Living Lab Asinara can stimulate a participatory process of territorial and economic regeneration and it can be considered at international level as a shared model of governance of public and collective goods of small islands, to support the connections between the various decision makers and the conditions for new business activities. As it is a border area it allows to develop a regional scale experimentation, with a comparison and a continuous exchange of potential synergies, complementarity and cooperation in the field of research and innovation with the neighbouring regions. In this way it is possible to allow the development of a shared operational approach, as a competitive model for the development of a network of eco-green infrastructure and sustainable use of the smaller islands.

The logic behind the innovation ecosystems represented by the Living Lab [2], which are based on open innovation model increasingly adopted across Europe, is to open to external environment companies and give them the opportunity to collaborate with different groups of stakeholders such as customers, researchers, suppliers, and the public.

For the purpose of developing innovative and competitive governance solutions, and actions of multilevel policy making (bottom up / top down, from regions to municipalities and vice versa), the Living Lab Asinara project involves the launch of a participatory process

involving civil servants, businesses on the territory, world of scientific and technological research, stimulating the active participation of the inhabitants, involving environmental associations, voluntary, social and cultural rights and the young local entrepreneurs. At European level, there are some examples of good practices that can be capitalized and shared. But the idea of the Living Lab Asinara aims to take a step forward, involving the administrations in the creation (from scratch) of a cross-border Living Lab as new open community dedicated to innovation, driven by users and populated by many international stakeholders, capable to "work through" boundaries.

Coordination with all the players that operate on the island is essential for the success of the project. We can (re) build a stronger value chain, extending and strengthening the connections between local and foreign companies, facilitating synergy between public funding and possible private investment, improving the conditions for growth and competitiveness across regional boundaries. The Living Labs are inextricably linked to various human and territorial factors, i.e. the ability to mobilize the population concerned, the various elements of social innovation and creativity of the process or of the same products, the renewed role of public institutions and especially local ones. Starting from the models already present in Europe, the idea is to experiment the Asinara Living Lab at international scale, in order to combine the innovation targets with the collective territorial innovation. It will be possible through a contamination of characteristics, specific strategies and activities aimed at implementing the conditions for an innovation jointly created according to a notion of collective learning, with a qualification on the specificities of fragile territories of the smaller islands. The comparison and the continuous exchange between the different actors involved in the innovation and territorial revitalization process, trigger favourable conditions and allow the development of a shared operational approach. Fostering the different experiences, a cross-cutting approach will be tested, including the civic spheres, political, economic stakeholders and technical decision makers.

The field and the actors of a Living Lab

If we imagine the foundation of an international Living Lab, we cannot limit the field of experimentation thinking Asinara Island as the island, as if it was a disconnected territory from the rest of the world. Its poetic value cannot be limited within the geographical boundaries. If we seek in its territory the warp and weft to weave broad connections, we can imagine what the interregional and cross-border dynamics of interaction scenarios that could trigger the regeneration process of a new open community dedicated to innovation, driven by users and populated by many stakeholders, capable of working across borders. The institutional process outlines, in this way, an "archipelago" of local companies and territories referred to these care, an archipelago of environmental ecologies, where the Island Asinara mother connects the network of environmental corridors of the "territorial islands" (...) as a network of places. [3]

The success and the proper functioning of a Living Lab is to be guaranteed by a strong management, that aims to stimulate the ability to integrate users and assess and highlight their needs in order to establish an organizational or territorial innovation containing elements of social innovation and not only economic and technical / technological. Through a cross fertilization process, consolidating the synergy and mutual learning beyond administrative boundaries, it will be easier to achieve a convergence of spatial development policies that increases the alignment benefits of their socio-economic systems. This would lead to increase the sensitivity of regional officials for the necessary logic of "competition" and mutual learning for the purpose of conception and implementation of innovation policies and best practices in their respective territories. This is the basis for the spread of a competitive model for the development of a network of eco-green infrastructure and sustainable use, which can be exported to other contexts of the smaller islands. Activities focusing on enhancing the common good will foster the natural potential (sun, wind, sea, water, soil, habitats, plants, animals, ecosystems and landscapes).

The strategic assets: Asinara as archipelago of innovation islands

It would be interesting to establish a shared process for the drafting of a strategic document on the territorial system of innovation for Asinara, aimed to point out the local guidelines on innovation and technology transfer, identifying opportunities for intervention and the excellence to be valued according to systemic logics of development.

If we compare the data of the analysis conducted on the potential of scientific specializations that can arise from the exploitation of natural and man-made resources, with the evaluation of research infrastructures, the results is very surprising.

A network of excellence is present at the Asinara Island: the Centre for Environment Education, Crama as Marine Animal Rescue Centre, the Birds Research Center of Tumbarino, the diving and marine research center. Taking into account the estimated increase of competitiveness of the technological and productive excellence, (such as the reality of Farmasinara), it is possible to identify strategies for qualification and upgrading the infrastructure assets of the local system, on which launch pilot projects for territorial innovation, trying to stimulate a more effective regional intervention and programmatic synergies between the various levels of government.

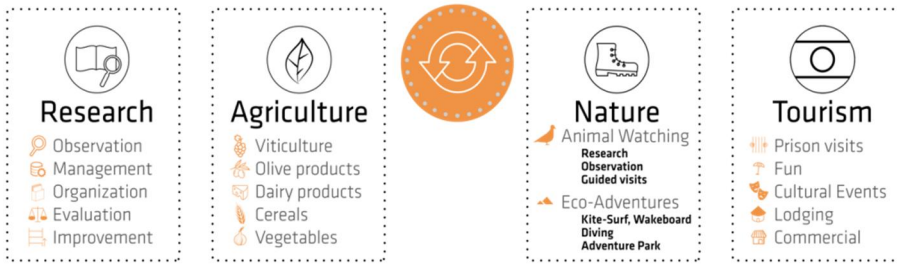

Fig. 1: General view of the assets

Four emerging priority assets on which to develop six areas of specific actions:

1. *Scientific and Technological Research*
2. *Protection of the environmental system*
3. *Green Production activities Agricultural / Rural Development*
4. *Responsible and experiential tourism*

Fig. 2: Diagram of priority assets and areas of specific actions

New activities have been conceived and designed according to the specificities of the park, so to increase its compatibility with the real needs of the place, and try to offer plausible solutions, from the economic point of view as well as from the feasibility point of view.

In particular, the planning was taken into account to organize the activities so as to make available all the valuable aspects of the island, trying to spread them throughout the year, in order to counter the excessive seasonal adjustments tourism.

Fig. 3: Diagram of cluster's structure and network of activities

5. I Cluster

The strategic plan *is* designed to initiate the *rebirth* and the regeneration process of Asinara island, through the development of functions compatible with the fragile ecosystem. It is based on the introduction of new and eco-compatible activities, integrated with the environment. However, to predict and to best design the arrangement and management of these new activities, it has developed an additional level of planning: the island's division into the Cluster and Network.

The term cluster is redefined in this case and applied to the particular natural and cultural context in which we find ourselves. It is to divide the island into several parts, which are considered self-sufficient but closely connected and collaborating.

This brings us to the concept of the island in the island: a complex of buildings, structures, agricultural and natural areas full of all types of services and activities related to its function. This self-sufficiency is related to one (or more) particular activity, well defined, with a series of facilities dedicated to it. These structures are usually obtained from the pre-existing buildings. Each cluster has a main theme, and in some cases we have an additional division, as some activities are located in various parts of the island.

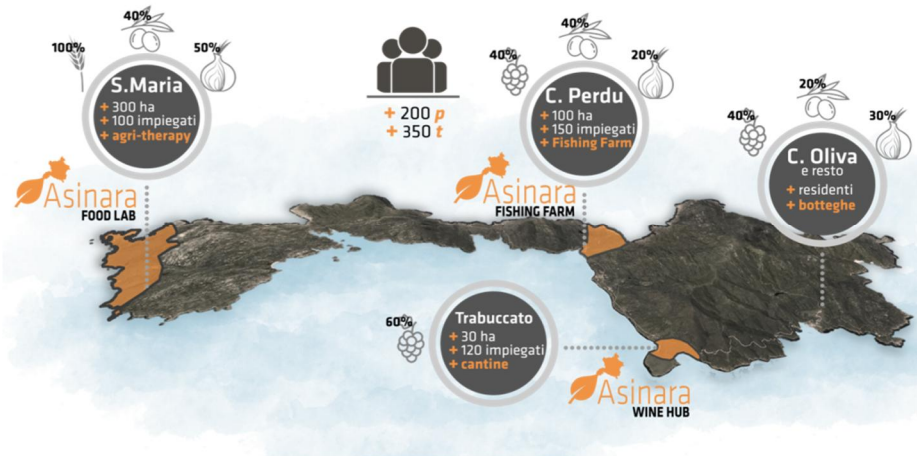

Fig. 4: The location and activities of the Cluster in the Master Plan

Agricultural Cluster. The activities related to agriculture are mainly located in the three major areas of the island: Santa Maria/Fornelli - with 300 hectares of fields, 200 of which had already been used for agricultural activities, Campu Perdu – between 70 and 100 hectares and Trabuccato - 30 hectares of old vineyards.

Eco-Urban Cluster. The two "urban hinges" of the island, Cala Reale and Cala Oliva, take on an important aspect in the plan as they would have the role to absorb, manage and contain most of the inhabitants and visitors, as well as various services dedicated to them. The plan for the area of Cala Reale is the recovery of all abandoned structures, unused or ruined, and the placement of various functions: commercial, accommodation, public, housing. In the central area, near the sea, we want to create a common public environment, with a number of facilities dedicated to leisure and events, with the idea of creating a 'centre' of the island's activities, a square surrounded by various services.

Fornelli Cultural Hub. The prison of Fornelli and the relevant structures, represent a complex of its own. The character and the large size of the structure present an opportunity for the creation of a multi-purpose center with a full offer for visitors, a *island-park gate*, within which there will be different functions, both public and private. It involves the construction of: living labs for research activities, accommodation / suites for researchers, half open space dedicated to events and theatrical performances..

Eco-Adventure Network and Natural Research Network. Clusters are also complemented by the network of eco-adventure activities and by naturalistic research activities. These activities, while not having a base with separate facilities, will be supported by a series of small complexes that span the island, both in the areas where such activities will be carried out. Most facilities will be built in Cala Reale and in Trabuccato area and Fornelli.

6. Environmental And Economic Impact: Final Considerations

The plan is integrated with other strategies for sustainability, an essential part of planning for a fragile environment as the island of Asinara. It is important to reaffirm the peculiarity of the environment and the natural balance of the plan. The inclusion of new features, therefore, must not only be compatible from an ecological, economic and social point of view, but it must be accompanied by a relevant resource management in an intelligent and forward-looking way. As for the identification of intervention strategies, the method adopted was to create a schedule of references, later adapted and redesigned to be part of the strategic plan. These solutions are based on a number of different possible interventions, ranging from energy efficiency field to the intelligent management of the waste and the organization of mobility. [5]

Water: is one of the most critical resources within the insular, because the whole system is based on the management of a network of reservoirs that provide water for all uses on the island. The strategies implemented also, therefore, will focus on this existing system. It is expected, first of all, a total recovery and restoration of tanks, with particular attention to those relevant to urban areas, as provided by the Park Plan.

Energy: the second resource planning is the subject of sustainable energy. Compared to the situation with the management of water, electricity is in much better condition. Electricity is supplied to the island by an underwater cable along approximately 4km, it continues along the main road, extending along the entire island. The strategic plan foresees in particular the use of photovoltaic materials, but in an alternative way and updated to take over in the minimum visual impact fees that have to be respected.

Waste Management: the collection, waste management and disposal are a very interesting topic within the strategic plan. Although the Plan of the Park identifies the current system as a functional and satisfying one; the inclusion of new features and new structures creates

an increase in tourist flows that could pose serious problems for the collection and management of waste.

Mobility: it also plans to incorporate in the plan a vision and a completely new strategy regarding the island. Given the particularly sensitive environment, the plan provides for a maximum CO2 emission control, eliminating the transport by the car, except for cases emergency, support services. It thus opens the possibility to also create a small network of public transport, of small size and 100% electric. It is expected that most of the displacement takes place through electrical machines, equipped with paths and complemented by different shelters and small facilities for information of all types.

The economic impact of the pilot project: based on an integrated and participatory management of all new activities, as well as on the inclusion of public and private institutions of various levels, the park plan also is part of a network of European funded and supported projects. The strategic plan is part of this context and the intervention strategies are fully integrated into invariant design. The economic concept includes a number of initial investments by the Sardinian region, local and national authorities and various cooperatives with an interest in the activities proposed by the plan. In addition it is expected that the plan could fall within the framework of the EU funding. These initial funding would provide a base for the first series of interventions, in particular the organization, pre-design and placement of some new functions for the park.

These early interventions would be directed mainly to the activation of agricultural production, rehabilitation of the relevant structures and the creation of a suitable environment for the development of niche tourism. Realization of these assets and related facilities would allow the launching of agricultural production as well as completion of the tourist island. These activities, in turn, could provide further economic basis for the subsequent development, and implementation of the rest of the structures and functions, in particular the stabilization of the local brand, and the creation of necessary conditions for saving resources. This plan provides for the achievement of a high level of self-

sufficiency in different scales, with the idea that the new and modern activities could possibly become a basis for economic, cultural and trade development of the island.

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