IJPP
ISSN: 2239-267X

World changing, climate changing, urban changing. Toward a new sustainable urban planning

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Abstract

It is clear, as recently established scientifically, that global change is produced by man-made activities carried out on the planet. For a long time, experts have found anomalies and irrationally risky human actions as regards processes which are destroying environmental systems and their natural biotypes. Cities, where in a few years about the 75% of the global population is expected to live, represent one of the main entropic systems, in particular because of the concentration of climate-altering activities.

The attention given to subjects: "sustainable" development, participated urban planning, sustainable mobility, and so on, has been characterising investigations in the field of urban and regional sciences. It is now necessary to achieve a new "ethic" in urban planning, in order to pass from investigation to practice, by codifying a new sustainable process in order to manage territorial transformations.

This paper suggests an investigation on this new process, defined as

"eco town planning", pointing out the basic features and the systemic approach on which it is based. Finally a case study is described which has been carried out in a mid-size city in Italy: Benevento. An "off-grid" urban district, with no greenhouse gas emissions, has been designed for the new city masterplan.

1. Anthropic/Enthropic systems

Considering the earth as a living organism capable of self-regulation, through the constant research on balance among its several components, represents the basic condition of the GAIA hypothesis, worked out by James Lovelock in the '60s. According to Lovelock's view, based on systemic logic and cybernetics, the living planet is able to reach balance by absorbing the entropic effects produced either by the action of some biological components (biocenosis) or, in some cases, by neutralising or eliminating those components. Every organism modifies its biotype (from bacteria to human beings) but the effects of this modification are then balanced by the cycles of the planet (Lovelock, 1992).

Climate changes, felt also at local level, are a sign of the undergoing global dyscrasia in natural cycles: the chlorophyll photosynthesis, the oxygen cycle, the geo-chemical cycle, ocean streams, and so on (according to alternation: cold/hot, hard/soft, order/chaos). The oxygen cycle, allowing life on earth, shows worrying modifications. The increase of greenhouse gases, the main cause of temperature increase on the planet, is producing important imbalances in many relationship cycles of earth system. The ocean streams (e.g. the Gulf Stream) and the Mediterranean ones too, which determine the global climate balance, are changing (in temperature, salinity and flow) and seas are no longer capable of absorbing the CO2 for the survival cycle, because of surface water heating, which hinders the mixing with deep water. Man has ignored the harmonic design of the planet by breaking this mechanism, with his presence and activities, and producing malfunctions, whose effects are being recognised just now.

Many of these assumptions belong to the environmental approach, which

from Capra to Rifkin, from Batheson to Crutzen, has been stigmatising the self-destructive action of man on earth and in particular of those belonging to the western world. According to the above-said approach, the environmental emergency and the energy problem should both be considered as entropic phenomena, strictly correlated. The only energy reference point, linked to the use and exploitation of fossil fuel, represents an inflexibility of people's organization that is producing endogenous imbalances and could determine worrying "flakings" in the global socio-economic organisation. At present, all over the world, there is an oil consumption of 12 billion litres every day (maybe litres provide a more effective measure than the common expression in "barrels"). Leaving out possible disasters, most experts forecast a sharp decrease in the estimated global fuel supply.

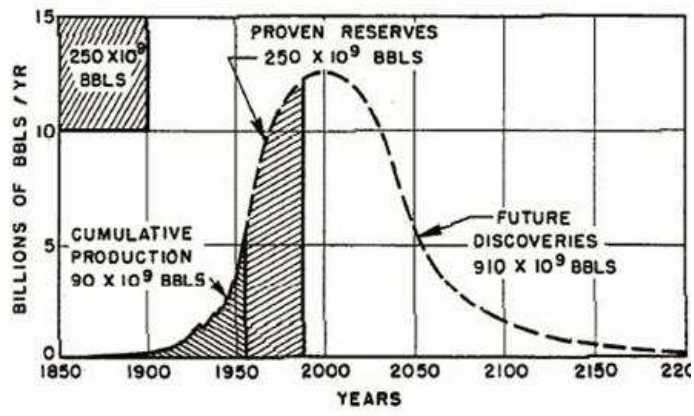

Figure 1 – The curve of Hubbert

Taking into account Hubbert's theory, we can notice that we are almost at the beginning of the descending curve of fuel supply; more rosy prospects place again the "turning point" around 2013. That fact means also that the drilling of the remaining fuel from the oilfields will be more difficult and will cost much more (Hubbert, 1974). So the problem is systematically global.

The effects of climate changes that have been taking place in the last few years are global and interconnected and include: deglaciation (with the consequent rise of sea level), desertification, increase in salinity of the sea, intense climate events and catastrophes (monsoon transformation of climate), reduction of biodiversity and so on.

The problem is national and macro-regional and is still more serious for

Europe and for the Mediterranean and Italian areas in particular. By analysing the reports and studies of the IPCC (Intergovernmental Panel on Climate Change) and the European Environment Agency, we can infer that, during the last century in Europe, an increase of about one degree in medium temperature has been recorded.

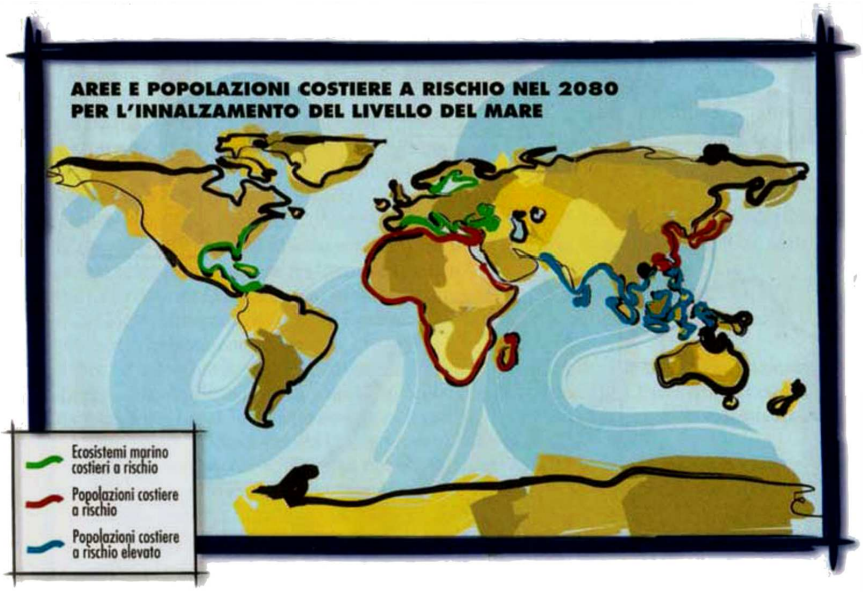

Figure 2 – Scenario of risk areas up to 2080, because of the sea level rises (source: ENEA).

Deglaciation has reduced about 50% of the volume of European glaciers since 1850, in particular the Alpine glaciers have lost about 70% of their volume, consequently in 2060, the disappearance of glaciers under 3500 mt. (above sea level) is expected

Indeed over one century, precipitation has increased in the north Europe and decreased in the south; this trend will continue in the following years. In the Mediterranean, as already said, there is a problem of change and remixing of water whose temperature is increasing. In Italy, between 1990 and 2005, the emissions of greenhouse gases increased by 12.1%. If we analyse the percentage of CO2 emission (leaving apart the other greenhouse gases) produced by the different anthropic activities, we find that the main contributions are caused primarily by energy production, then by transport and finally by tertiary and residential activities (largely by home heating). And specifically these sectors should be the first targets of mitigation, particularly in urban centres.

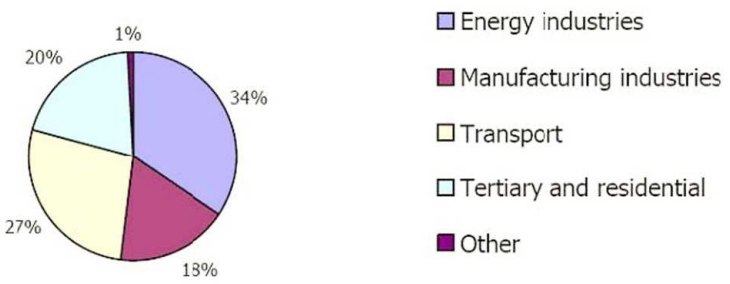

Figure 3 – Carbon dioxide emissions for activity sector in Italy (source: APAT Italy 2007)

The problem is particularly felt in urban areas. The slogan saying: "Witnesses of climate", which refers to the perception of the undergoing transformations, is well known now. As regards climate change, cities are affected by high rates of pollution by hydrocarbons, high urban temperatures (urban heat islands), limited and extremely intense meteorological phenomena (e.g. water bombs), acid rain, manifestation of new respiratory and allergic pathologies (the rise of one temperature degree seems to provoke an increase by 3% of urban death-rate), and so on (fig.3 and fig.4).

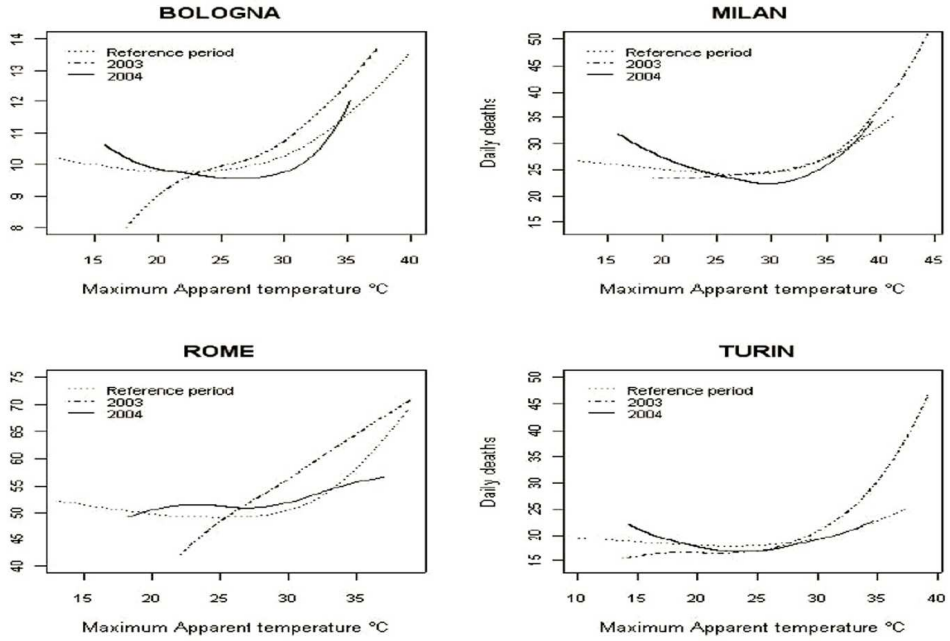

Figure 4 – Correlation between temperature and death-rate in 4 major Italian cities (source: Michelozzi, 2006)

Specific attention should be paid to the analysis of the impacts on the national economy, whose main driving sectors (industrial production, tourism, agriculture, services, and so on) are strongly affected by climate changes and water availability.

In this worrying context, the controversial Kyoto protocol should be considered. In 1997, 160 countries gathered in order to discuss climate changes during the conference "COP3", and they proposed an international treaty which would oblige countries to reduce emissions of greenhouse gases. The treaty should have come into force upon the signature of the nation which would have produced an emission reduction equal to 55% of the total. In 2001 even Russia subscribed to the treaty and allowed it to come into force. Unfortunately, Australia and the United States of America, which are responsible for more than 36% of global emissions of greenhouse gases, did not agree. The USA brought forward reasons of economic development and scientific doubts on the real human responsibility for climate changes. At present, this responsibility has been scientifically checked but the United States has not yet ratified the protocol. Italy has bound itself to reduce emissions of greenhouse gases by 5% by 2012, 20% by 2020 and 60% by 2050. Unfortunately the emissions in the last 15 years have shown a CO2 increase of more than 12%.

Summing up, it is clear that it is necessary to activate knowledge and competences in all fields but with first reference to scientific research in order to work out and implement, as soon as possible, the actions of mitigation and strategies for adaptation to climate change. Italy is among the more exposed and vulnerable nations. All the other countries look at our country as a possible example to follow in order to find harmony between man and earth.

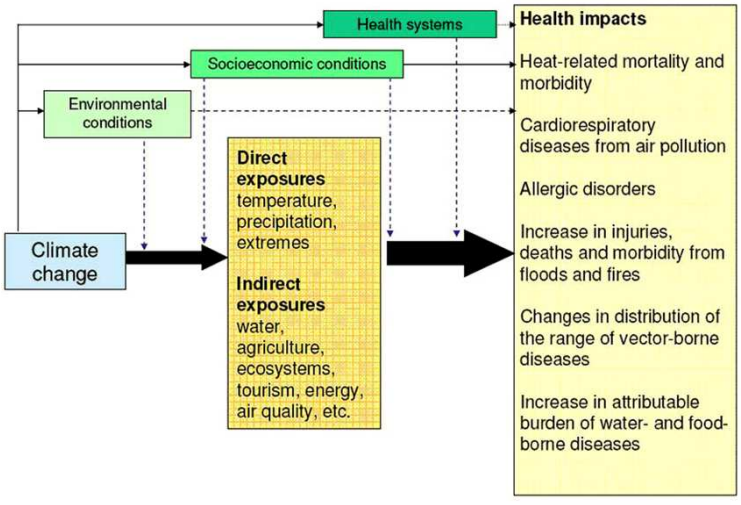

Figure 5 – Scheme of the impacts produced by climate change on people's health (elaboration by Confalonieri et al., 2007).

The City represents the place of maximum anthropic concentration.
As regards mitigation, urban systems should be considered as systems with high "anthropic entropy". Urban systems represent the place where interventions are needed and can be carried out in quite a short time. The procedures, protocols, rules, practices for the new management of territorial transformations should necessarily start from the intervention in the functional system (residence, mobility, production, services, and so on) and on physical systems (urban layout, heliothermic orientation, tones of surfaces and covers increasing the reflection of sunlight, home electric microgeneration systems) of the city. The approach and the indications for the intervention can refer to a new way of considering the management of territorial transformations, based on sustainability. "Ecotown planning", starting from the assumption that land is a non-renewable resource, suggests proposals both for mitigating and adapting to urban climate change and represents the first attempt to systematise the intervention on urban system components.

2. The energivorous city: Urban Entropy

On analysing world population statistics published by the United Nation Department of Economic and Social Affairs, we can see that by 2025 the earth's population could reach 8 billion, of which about 60% will live in urban areas. The estimates of the most densely-populated cities show a classification in which, by 2015, Asiatic metropolises will be the most populated ones (Tab.1). In Italy, about 42 million people live in cities and, in only one decade, coastal urbanization has increased by 60%.

Year	Rank order	Country code	Country	Urban agglomeration	Population (millions)
2010	1	392	Japan	Tokyo	36,67
2010	2	356	India	Delhi	22,16
2010	3	76	Brazil	São Paulo	20,26
2010	4	356	India	Mumbai (Bombay)	20,04
2010	5	484	Mexico	Ciudad de México (Mexico City)	19,46
2010	6	840	United States of America	New York-Newark	19,43
2010	7	156	China	Shanghai	16,58
2010	8	356	India	Kolkata (Calcutta)	15,55
2010	9	50	Bangladesh	Dhaka	14,65
2010	10	586	Pakistan	Karachi	13,12
2010	11	32	Argentina	Buenos Aires	13,07
2010	12	840	United States of America	Los Angeles-Long Beach-Santa Ana	12,76
2010	13	156	China	Beijing	12,39
2010	14	76	Brazil	Rio de Janeiro	11,95
2010	15	608	Philippines	Manila	11,63
2010	16	392	Japan	Osaka-Kobe	11,34
2010	17	818	Egypt	Al-Qahirah (Cairo)	11,00
2010	18	566	Nigeria	Lagos	10,58
2010	19	643	Russian Federation	Moskva (Moscow)	10,55
2010	20	792	Turkey	Istanbul	10,52
2010	21	250	France	Paris	10,49
2010	22	410	Republic of Korea	Seoul	9,77
2010	23	156	China	Chongqing	9,40
2010	24	360	Indonesia	Jakarta	9,21
2010	25	840	United States of America	Chicago	9,20
2010	26	156	China	Shenzhen	9,01
2010	27	604	Peru	Lima	8,94
2010	28	156	China	Guangzhou, Guangdong	8,88
2010	29	180	Democratic Republic of the Congo	Kinshasa	8,75

Table 1 – Urban population inside the biggest metropolitan areas of the world (above 10.000.000 inhabitants); updating 2010 (source: United Nations Department of Economic and Social Affaire: Population Division)

As regards CO2 absorption and Oxygen production, it should be considered that one hectare of forest, made up of about 300 medium sized trees, can absorb about 5 tons of CO2 every year and produce about 3 tons of oxygen. From 2001 to 2005, in Italy, more that 5,000 hectares of land included in National Parks were burnt. Unfortunately, in 2007, about 679 fires destroyed over 19,000 hectares of vegetation inside the parks. Inside Campania region, fires destroyed about 4,000 hectares. Apart from spontaneous combustion produced by high temperatures, many fires are caused by pyromaniacs. In view of fighting against climate change, the action of a pyromaniac is similar to that of a scuba diver who intentionally stops the air of his oxygen bottles.

The most energy-consuming cities are those with a higher density of population in whose industrial areas many important productive activities are located. Consequently, the most energy-consumer cities are those with

higher urban entropy. To appraise this entropy it would be useful to consider the sum of the emissions produced by the following functions: residential, mobility and production on the one hand, and, on the other hand, for example, the quantity of urban green space containing trees. An interesting indication about this fact is given by the Italian Agency for Environment Protection and Technical Services report on the quality of urban environment. For residential activity, the production of urban solid waste should also be included, and this must be considered as one of the main anthropic causes of energy consumption: each citizen produces about 1.5 kg. of non-differentiated waste every day. As regards mobility, it should be considered that the number of vehicles circulating in Italy is up to 32 million units, of which 13 million vehicles are over 10 years old and so highly polluting.

It is quite clear that urban contexts should be the focal field of action and policy testing, in order to implement strategies of mitigation and adaptation to climate change, capable of stopping the emissions of greenhouse gases. We should start from town and regional planning, considering sustainability as the starting point of all the new actions. Town planning settles the conflicts and tries to "harmonise" the interests of different stakeholders who, with different roles, take part in the choice of the actions for urban transformation. In the new approach (Eco town planning) the participation of citizens should be firstly looked at in order to persuade them of the need for city transformation, according to an eco-compatible view.

Legambiente (an Italian environmental association) has recently published an interesting report stating that: "Cities represent a fundamental testing bench in order to invert the processes of Earth overheating. Urban areas are the principal producers of greenhouse gas emissions, because they are high energy-eaters". This report suggests some actions in order to drastically reduce emissions of CO2. Many of these actions are considered in eco-town planning. Also some Local authorities have already implemented interesting initiatives that can be considered best practice. It is therefore necessary to connect these experiences (and related competences) in order to create a network of experts, operators, administrators, and so on, whose main focus would be on the urban system.

3. Lesson from the past

The capture of natural energy, the collection and domestic use of rain-water, the orientation of houses according to the heliothermic axis to foster heating and insulation, the use of trees for shade and the inhabitants' protection and many other rules and pratices have been characterising human settlement for ages, and in particular the Mediterranean townscape. Those rules have been ignored with the advancement of technology, starting from the industrial revolution.

Before the Second World War there were a very few buildings using central heating plant with boilers which warmed water and piped it in the radiators of the houses. It is worth mentioning too that already in 1891 the American Clarence Kemp patented the first solar thermic plant and in 1897 one third of the houses in Pasadena, in California, were equipped with solar equipment for water heating.

The use of heating technologies seemed to free cities and architectural works from the bonds of heliothermic exposure, which from the first examples of collective change and adaptation of anthropic environment for developing a residential function - the city of Ur in Mesopotamia, for example - characterised building principles.

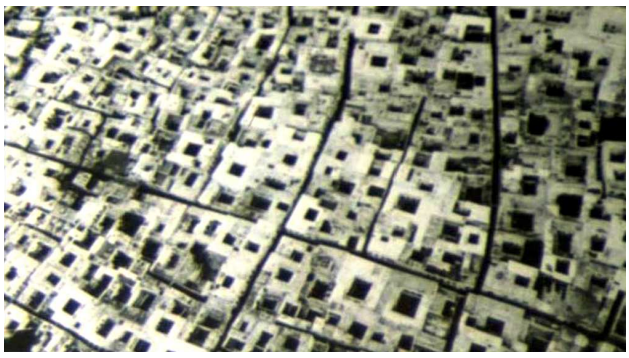

Figure 6 – The inner city of Tunis; houses with inner courts

The Mediterranean city still preserves characteristic houses which could be summed up according to some basic principles:

- Chessboard urban pattern to foster air circulation
- Orientation according to the heliothermic axis

Use of local building materials

- White or light painting of outside walls, to reflect solar radiation
- Courtyards to help cooling
- Systems of rain-water collection
- Use of specific techniques for inside ventilation and climate
- Location of fountains to lower urban temperature

We could quote other indications, but the listed ones seem to be the most relevant. In particular, as regards urban structure, the examples of the chessboard urban pattern are many: from the Greece of Hippodamus to the Barcelona of Ildefonso Cerdà. The typologies with inner courtyards characterise the inner parts of many Arab and African cities, typically painted with white lime (fig.6), like many other historical centres in South Italy. An interesting example of old techniques of house ventilation are the wind towers, placed in Iran and Pakistan, which take fresh air at a certain height and introduce it into the rooms on different floors in order to produce natural air recycling and cooling inside the house(fig.7). The baud geers have been recently used in some buildings in Morocco. All these "practices" belong to the Eco town planning principles and are interpreted to reshape the urban physical system.

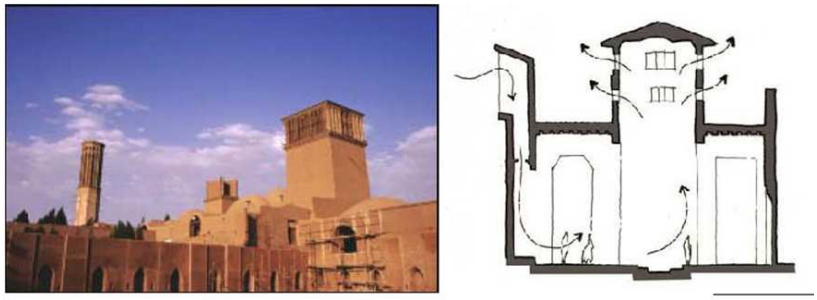

Figure 7 – The wind tower represents one of the most ancient systems for climate control of houses.

4. Toward a new way of managing urban transformation: eco town planning (ecourbanistica)

The systemic approach applied to the city moves from General Systems Theory, (von Bertalanffy, 1972) and is one of the main references for Eco town planning. It is possible to find also a strong reference to the new vision

of the city "as a complex, self-adapting system, or even a living ecosystem", (Pulselli et al, 2006). Here we aim at suggesting a systemic approach to the climate change problem in urban contexts, which entails the analysis of the different subsystems and the study of its components and relationships as regards global warming.

The present imbalance refers to a systemic problem and it is necessary to systematically work in order to recover the balance. The interventions should come from this approach in order to structure a sustainable urban planning. Consequently we could state that Ecotownplanning takes its approach from the systemic theory of the city and aims at recovering an endosystemic balance by stopping the production of entropy inside the different subsystems (physical, functional, socio-anthropic, geomorphological, psycho-perceptive, and so on) and the production of negentropy, thanks to the acknowledgement of energy-related interactions between the different subsystems, (Fistola, 2001). For instance, the availability of an efficient waste cycle allows the production of energy useful to the functional system and avoids the amassing of rubbish (which could cause a sanitary problem to the socio-anthropic system).

Among many system properties, we can detect one particularly interesting for our study: each system is included in a bigger system (meta-system) and, in turn, its parts are sub-systems. It is possible to affirm that among the different sub-systems forming the urban system we can detect three of them: a functional system, a physical system and a socio-anthropic system, (fig. 8).

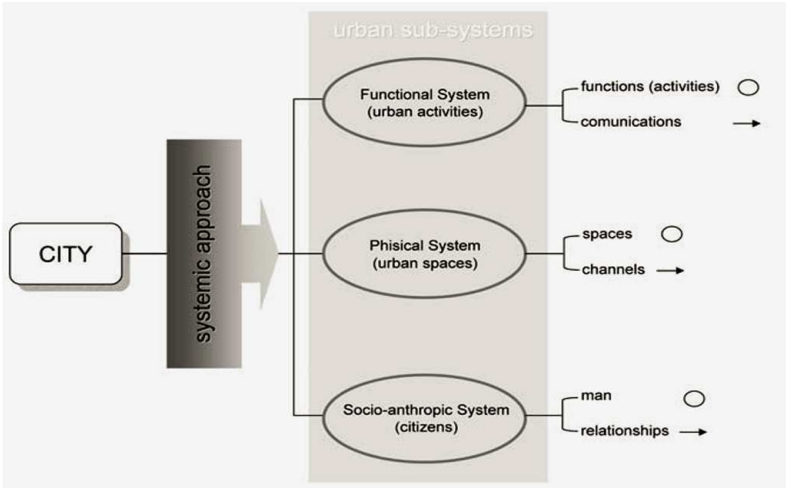

Figure 8 – The urban system and the three sub-systems detected in the systemic approach

This conceptual distinction does not find any confirmation in physical reality, where systems are indivisible, but abstraction is permitted due to the adoption of the systemic logic for building up the interpretative framework. The functional system consists of all urban activities (functions) and relationships (communications).
The physical system consists of all urban spaces (houses, streets, and squares) inside which activities occur and channels where communications (physical, energy, telecommunications, etc.) flow.
The socio-anthropic system is composed of the urban community: the citizens (urban actors, stakeholders, decision makers and so on) and relationships among them.
The three sub-systems include the urban system and are linked by connections with each element of the functional system. (Fistola, 1992). *Eco town planning* is naturally rooted in: Gaia hypotheses, complexity theory – which represents the contemporary embodiment of general system theory (Batty, 2000) - urban ecology, in the theory of entropy and "antropocene", in bio-architecture, in the definition of sustainable city, in the assumption (being apparently revolutionary but expressed already in the 1970s and 1980's) that the city should be considered as a natural ecosystem, (Grieco 1982) and as such should be rebalanced with earth ecosystems.
Eco town planning, moving from a systemic approach, shows the real actions needed to be implemented in order to manage urban transformation, targeted to reduce anthropic entropy. The whole process, considering again the classic phases of urban transformation governance (knowledge, decision and action), could be articulated in the following phases:

Knowledge phase

- Systemic interpretation of the city
- Reading, calculating and assessing urban entropy
- Multilevel interpretation of the urban condition
- Listening of the experiences and proposals of urban stakeholders, actors and citizens

Decision phase

- Definition of reachable targets
- Sharing the targets with the urban actors

- Setting up policies for sustainable governance of urban transformations
- Transformation of policies into urban plan actions
- Communication and diffusion of urban plan choices

Action phase

- Definition of regulations to implement urban plan actions
- Applying management and support initiatives to implement urban plan actions

As regards the first phase, some studies should be worked out in order to show the conditions of the city's different parts. By using Geographic Information System (GIS) it is possible to work out an information model of territory, structured according to levels that can be populated through geo-referenced data on city. Interesting initiatives to collect and systematise data on the environmental quality of urban and metropolitan areas are being made by the Italian Agency for Environment Protection and Technical Services (APAT), which draws up a yearly report on the topic and arranges and updates useful on-line sites. The Urban Information Model enables urban planners to obtain and show the different pieces of information about anthropic/entropy phenomena. So it will be possible to work out several knowledge bases (digital maps) regarding the presence and entity of the processes.

We can roughly expect the following information bases:

- Map of urbanised surfaces according to building material and typology
  Map of the land use, showing the "intensity of use"
- Map of the intensity of vehicle flows on network
- Energy Map (energy consumption of the activities in the territory)
- Map of urban heat islands
- Map of urban micro-climate
- Map of air quality
- Map of green features
- Map of urban solid waste production
- Map of soil permeability

- Map of urban sunlight reflection

Starting from the collected information, its analysis and shared systematisation of the targets, differentiating the "ethics" according to the different urban subsystems, the following actions can be anticipated:

Functional System

- Planning multifunctional urban zones
- Reducing excessive intensity of use, also by adopting new technologies (ICT)
- Restoring the qualities of urban contexts by pointing out and recovering the original morphologies and use of urban colours
- Safeguarding the remaining green spaces and planning new urban green space, including shaded areas.
- Paying particular attention to developing and dealing with urban vacant sites
- Recovering vacant sites, by designing parks and gardens or by locating there new structures for energy production from alternative sources (solar plants, wind parks and so on)
- Supporting the processes of urban identity and sense of belonging
- Safeguarding the memory of the place
- Tending to the recovery the semantic values of the city
- Arranging forms of sustainable urban mobility (discouraging private vehicle transfers and fostering public transport and mobility cycle)
- Implementing sustainable mobility through car sharing, car pooling, and so on
- Organising interchange car parks outside the urban agglomeration and not locating multi-storey car parking in the centre or near it
- Promoting the recycling and integrated management of waste
- Using alternative sources for the energy needs of city (photovoltaic, solar, thermic, solar thermodynamic, wind, biomass, and so on).

Physical System

- In the new planning system, urban orientation should be considered according to the heliothermic axis and the predominant winds
- Safeguarding the ecological network and green areas

- Providing for protected and wooded pedestrian routes (green corridors)
- Providing for an interconnected network of urban green areas articulated into spaces and corridors
- Providing for a urban cycle network
- Promoting bio-architecture
- Providing for rain water collection, recycle and phyto-purification
- Aiming at high thermal insulation inside buildings
- Supporting micro-generation and diffused generation of electric energy
- Preferring the use of local materials
- Using "green" roofs for buildings
- Preferring the use of natural and/or recycled materials
- Providing for the use of new wall paints capable to capture CO2 and CO
- Use of fountains and water vaporisers in order to calm down urban temperatures and heat islands
- Use of gasification plants for urban solid waste treatment
- Planning the carbon sequestration plant near carbon or industrial plants that cannot be replaced
- Use of light materials and chromatisms to increase the sunlight
- Increasing public green areas (for air filtering from dust, abatement of temperature and CO2)

Law and Management Interventions

- Working out appropriate building regulations and implementing technical laws for mitigation of and adaptation to climate change
- Providing for a system of municipal certification of building energy efficiency
- Spreading the social culture of recycling and supporting separated waste collection
- Fostering the birth of the *Energy Service Companies* (ESCO)
- Discouraging mobility congestion in the urban centre (road pricing, congestion charges, and so on).

6. The Urbe Project

The URBE project (Urbanistica e Riqualificazione per Benevento Ecosostenibile) will demonstrate the planning possibility of implementing the Eco-town planning practices in an urban area intended mainly for residential use. The new area is undergoing a low-impact urban transformation in order to create a district with zero-emission of carbon dioxide. The area under study is located inside the city of Benevento (a midsize city of the South of Italy) in a place called: "Santa Caterina", close to the Libertà district containing council houses built between the immediate post-war period and the '70s.

Figure 9 – The site of the URBE project (in red)

The area has a surface of about 25 hectares and is located between the river Sabato and the Appia road (the ancient way to Rome) (fig. 9).
The objective of limiting housing density has led to the planning of two-storey semi-detached houses capable of accommodating about 400 people (in total).

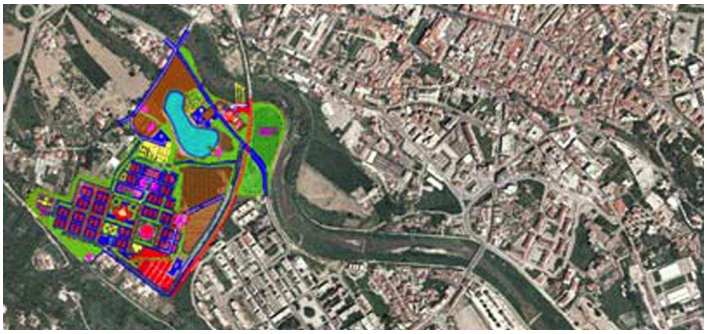

Figure 10 – Urban insertion of the URBE district inside the city of Benevento

The urban layout follows the heliothermic axis to maximize the use of solar radiation, which allows the production of electric power, using photovoltaic systems, and for the buildings to have a solar greenhouse. Also, the residential energy needs are supported by micro-hydro plants placed along the river and by a biogas plant with an anaerobic digester fed by solid waste produced by householders. The green part of the waste is used to produce compost for fertilising market gardens intended for biological and biodynamic cultivation placed north of the area. Near the biogas plant there will be a bamboo planting area for local re-oxygenation, because this plant can absorb about 17 tons of CO2 per hectare.

North of the site there will be also an artificial pond for rain water collection and the creation of wetlands, house refrigeration cycles (by micro pipes), water sports (rowing, wind-surf, and so on), and to support biodiversity. Around it there are green areas equipped with children's playground and a solarium.

The district road network is targeted to sustainable mobility. Inside the site, the only allowable mean of transport is by bicycle or by electric transport (golf-cart, mini-cars, segway, and bicycles). The only motor vehicles allowed are the emergency vehicles coming from the city. Residents' cars are left in the parking area, which is a useful intermodal exchange, placed near the station of the Naples-Benevento railway and the tram stop connecting to the urban centre. The residents are taken to their house by an electric or hydrogen shuttle that will be called from smart stops and will cover the whole area (fig. 10).

A cycle track has been planned on the east side of the site to enable cyclists to reach their houses. Close to the parking there will be a bike-sharing point for residents and railway users as well as a "garden-square" and a primary school, consisting of 12 classes.

Figure 11 – Plan of the district with the different locations

The main locations, as shown in fig. 11 are:

Outdoors areas with tourist facilities
Outdoor space is intended for several allocations, where different activities and services are offered in order to create an eco-sustainable development, targeted to make people become environmentally friendly.

Micro-hydro
Technological systems developed by hydraulic engineering, which produce electric power by the water motion of the Sabato river.

MTB Biogas plant
Mechanical Cold Waste Treatment. These systems represent the best alternative to incineration, in terms of environmental impact. According to the type of waste, there are different results, from the anaerobic digestion: production of good quality compost for agricultural use, biogas production

to produce electric power and heat or to supply the gas network, fuel production for cement factories and thermal power stations instead of coal and petrol ones. A further advantage of the biological treatment techniques is that in urban waste about 60% of the waste is biodegradable. That fraction can be handled by MTB techniques that, through aerobic processes, rot down vegetable material, oxidized by carbon dioxide and water. Anaerobic treatment (without air) transforms, if necessary, the cellulose fraction which is more resistant to bio-oxidization into biogas (mainly methane and carbon dioxide).

Artificial lake
Water is indispensable for reducing high temperatures. The artificial lake is planned for this purpose and represents the cornerstone of several activities targeted to making people be aware of nature and to develop respect.

The telematic square
The telematics square is the link between new technologies and eco-sustainable urban environment. The space will be equipped with solar panels and micro wind systems to meet with the energy consumption of the four areas that compose it: PC area, video and audio area, conference room and study room.

Bamboo Plantation
Bamboo is a useful plant against pollution. A plantation can capture about 17 tons of carbon per ha each year.

Cycle path
The cycle path is included in the district road system, equipped with specific signs and protection system on the neighbouring roads.

Life Route
A 3 Km. long pedestrian route, supplied with arboreal plants, connected with sports facilities and picnic and refreshment areas.

Nut Plantation
The use of nut plants arranged in rows as a system to cut down excessive solar radiation.

Ground level car park
The shelters inside the car park will be equipped with roofs supplied with solar panels to produce electric power.

In particular the square has been planned to create a socialisation point suitable for cultural performances (outdoor summer shows, initiatives for children during all seasons, a weekly street market, events to raise public awareness of energy saving and climate change, and so on). The primary school will be reached by cycle and pedestrian routes, which cross the whole green area used as thematic park, and there will be a school-home transport service driven by electric power for children's school-home mobility. The green areas are planned to create a sense of continuity with the public greenery characterising the urban context. As already said, the green planning will be divided into two areas: the first one creating a wide lowland forest of high plant stems for absorbing CO2; the second is close to the future new primary school, with a wide lawn and a botanic garden.

The watering ditches on the site are preserved in order to drain the land and safeguard trees and shrub species characterising the district. In all the public and private green areas soil permeability is preserved.
The house units will have the following characteristics:

- Two-storey buildings with the possibility of using the ground floor as office or workshop;
- Private and public green areas on the ground (and eventually on the roof), placed according to bioclimatic green techniques;
- Windows in each flat equipped with cross ventilation;
- The roofs can be pent roofs, flat roofs, hanging garden roof (walkable) or non walkable green roof;
- A solar greenhouse at the entrance of the house.

Each flat has its own green space and that will make the surface around the

building permeable, refilling the underground aquifers. In the outdoor area there will be, for each building or for a group of buildings, an underground cistern to collect rain water for residential needs (refilling of water flushes) and maintenance of green areas. The distribution of trees will be carried out by considering the tree size at its maximum growth and thinking about the importance of planting local deciduous shrubs to the south-east and south-west and the evergreens to the north. That distribution is meant to improve the buildings' microclimate, with shaded and cool areas in summer and an adequate protection against winter winds. A study of the shadows thrown by trees onto building fronts, and on cycle-pedestrian and vehicles routes and parking areas has been carried out. The preferred trees and shrubs will be those producing fruits and flowers.
Ecological points are to be placed with containers for separate collection of different kinds of household waste (paper, plastics, glass and biodegradable waste) close to the road. Each flat will be supplied with a special space for the separate collection of household waste. The surface needed for these containers and to carry out mechanized collection is about 20 square meters. This area will have the most resistant and impermeable pavement. The ecological point will be planned in a very detailed way in order to assure its aesthetic quality.

7. Eco-Sustainable and bioclimatic architecture

The basic planning criteria for this kind of building start from a first analysis of the land on which a structure will be built: it is necessary to check that there would not be very intense electromagnetic fields and negative geological factors. The external walls should assure an adequate thermal insulation through materials and techniques assuring correct protection against damp.
The building material used will be ecological, consisting of *bio-eco-compatible components*, choosing them from among the ecological brands, so in all the phases of their use-cycle they will have a low impact on environmental systems and will meet the biological needs of the users (EEC Dir.880/92 and 1836/93, as well as the Community Resolution 17271993).

The total insulation from the outside has been planned by using thermal plasters and triple glazed windows; on the roof, there will be thermal solar panels to produce hot water (Fig.12).

Figure 12 – Study of building typologies

Figure 13 – The rear view of the unit

The outside painting will use photovoltaic paint: "Photon Inside" (developed by the National Research Council of Italy) capable of transforming the outside surfaces into photovoltaic panels to produce electric power for the flat (fig. 13). Natural glues will be used for laying tiles and floors; the inside and outside frames will be made of wood treated with vegetal varnishes. In any case, it is recommended to use lead-free varnishes and to limit the use of varnish with strippers. Besides, vegetal silicone will be used to close cracks (reducing or eliminating chemical silicones). As regards the pipe systems, these will be all made of polyethylene and polypropylene (since they are recyclable material) reducing or eliminating PVC which contains polyvinyl chloride.

It has been calculated that the use of renewable energy will produce a 90% reduction in the demand for electric power produced by traditional systems and will succeed also in significantly cutting down the emissions of greenhouse gases. All the building units, taking the site characteristics in mind, will be seismic insulated by means of proper dissipators. The total cost of each flat will be of about Euro 170,000, which will allow young couples to buy a flat in the district and the residents to take advantage of the certification of energy efficiency.

9. Conclusions

The urgent need for new procedures, actions and, maybe, methodologies to face up to urban climatic change is felt by every urban operator. In Italy many institutions and organisations are implementing networks and producing interesting studies. All over the world experts share ideas and tests in order to intervene in the city. It is necessary to radically change models of behaviour and the use of resources and, probably, to redefine the model of economic development too.

A new town planning is required, which would reorganise its protocols through a systemic approach to the city, based on sustainability, organising through participation and developing through actions of urban mitigation and adaptation. The first implementable action of mitigation concerns the models of individual behaviour in relation to saving, recycle and reuse. Each person should be aware that there is a need for a new social ethic, starting from little daily changes of behaviour. It should be a duty of experts and operators to lead these changes, a crucial topic of new town planning practices. Sustainability should become a value diffused through the practices of participated town planning. It is essential to foster new bottom-up initiatives that can rightly enter the Ecotown planning process.

Maybe it is not useful to search for sustainability in the present town planning laws. Instead of discussing and analysing the possible connotations of sustainability and interaction in existent Italian town planning tools, whose matrix refers to 60 years ago when environmental and ecological theories were considered irritating assumptions of visionaries against urban development, it would be better to conceive a sort of town planning renaissance in our Country. Eco town planning should represent an offer of method, procedures and laws which propose new sustainable development of cities capable of driving urban transformation. This does not mean to choose the zero option, stopping any activity and change, but to join development with the policies of sustainability, compatibility, solidarity and inclusive modernisation. The principles of Gaia should be restored. The experts, regional scientists, town planners and operators managing urban and

territorial transformations should operate in a new perspective. We should hurry to recover a global balance (even if non perfect) and assure a satisfying urban quality to future generations whose survival will depend on our present choices.

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