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Technological and Environmental Housing and Lifestyle Design: how the approach has evolved and how its requirements have been innovated

*Fabrizio Tucci**

1. The Ecosystemic Approach

The first issue that needs tackling if we wish to properly formulate any discussion concerning the complex (and constantly evolving) framework of principles that should form the basis of a methodological approach – an approach designed to embody the requirements of environmental sustainability and energy efficiency that environmental concerns now consider essential and binding when it comes to the modern-day design of buildings, districts and cities and the amount of technological knowledge required – is the issue of the fundamental importance of a systemic vision in order to efficiently and effectively manage environmental design strategies and tools when working on any kind of trial, from the construction and architectural level, in the strict sense of the term, up to that of the urban district which today is beginning to enjoy an interesting phase with the growing number of pilot schemes involving solar cities and small ecological settlements where the environmental quality is extremely high, the consumption of resources is extremely low and energy requirements are almost zero.

The critical clarification that can be made by reviewing the serious implications that lie behind the notion of 'system' and 'ecosystem' are fundamental for the formulation of a discussion that wishes to move on to the systemic interpretation of buildings and cities as places of interaction where the environmental aspect has a crucial role.

The basic thesis to be faced, and to reflect on, under the particular point of view triggered by the matter, is awareness that the multiplying effect of the interactions activated on one side of the town, or territory, implies reorganizational potentialities beyond the original point in which such process begins. In this respect, Hall and Fagan are illuminating. In the reflections on the approach to the problem of complex systems by synergy science, they say: "In case of many natural systems, as well as a series of systems produced by man, the macroscopic state is obtained through a process of self-organisation of microscopic elements; therefore, the system obtains a specific space, a temporal and functional structure, without a specific global action from outside".

In the light of the observations by the German physicians, it is important to point out that in the change project, to avoid the object of change becoming easily unstable in the course of time, the project cannot involve the whole system right from the beginning: first of all, it has to stabilise itself in a limited region, so to say, 'isolated' in the system, in which it will be gradually acknowledged by the more or less rapid communication among parts. Then it is necessary to start to determine the relations and interactions with wider fields of an "Ecosystem", as Odum Says, gradually changing and adapting its state up to the stochastic dimension defineted the "constantly dynamic balance", or the "constant dynamism of perpetual balance seeking". As Fritjof Capra and his colleagues pointed out dealing with the question of 'stochasticity', it is exactly from the classic theory of state changes that the interpretation of his phenomenon originates – as fundamental and necessary phase to 'decode' fluctuation properly, in order to avoid it being neutralised in the new environment built without being acknowledged.

In other words, it is exactly such framework that fosters the theoretical approach by parts, and increases the value of real organic action over a small time-space segment of the ecosystem hosting it. The model, characterising and distinctive role of this approach needs time to adjust to the local maturation conditions allowing the macro-system itself 'to accept' the action, and to understand its scope and importance, above all, if it is experimental and innovative, until output assimilation in terms of environment.

The concepts of 'cyclization' and 'fluctuation' of relationships between living and non-living materials encourage us to focus on the key of the relation between partial elements and the whole; a basic principle of the systemic thought, perhaps the most general one, is exactly the one of the continuous shift of the point of view from the parts to the whole and vice versa; in short: the skill to shift attention among the several system levels.

In the whole living world, we find systems included in other systems; by applying the same concepts to the different levels of an architecture or one part of the same – for instance, the concept of stress to a building entity – important results were often achieved, on the theoretical level as well as on the project and application level.

On the other hand, it is also necessary to realise that, in general, different system levels represent different degrees of complexity. At each level, the phenomena observed have properties which are not owned by lower levels. It's no accident that the systemic properties of a certain level are 'emerging' properties, since they emerge among the numerous ones potentially present at that given level.

Therefore, the logical switchover to the dimension of the 'non-scalar transversal character' of bioclimatic planning is rapidly gaining ground. This affects the taking into consideration of the characteristics and properties of the several levels and, as we have just said, strengthens the principle of diversification against the well-known one of homologation.

The analytical cognitive investigation on the characters and properties of the different levels of interpretation of the action area has to be understood in this sense: every part is analysed in its intrinsic qualities as well as, and above all, in relation to its skill to be in relation with the whole context. However, by now, it is clear – as quantum physics undoubtedly shown us – that there are actually no 'parts' to be regarded as independently or separately. What we call 'one part' is nothing but one scheme in an indivisible plot of interactions: we can thus regard the shift from the parts to the whole as a necessary shift of our attention from the objects to the interactions among themselves.

'In a way, this is a figure/background shift', was James Lovelock's incisive comment, which reminds us of the desperately critical words of Hugo Häring when, in 1926, he challenged the 'winning' line of

the Modern movement in the positions held by Hilberseimer and Le Corbusier, and remarked how dialogue with the factors involved in an urban plan, such as natural and environmental aspects, was lacking and, in any case, left in the background compared to – as he called it – the 'closed and holistic concept of the city-for-itself'.
The explicit reference to the crucial role of the 'interactions' paves the way to the reflections on the second question. In order to create the right conditions for the planner to operate properly and effectively, following the aforesaid phases, it is convenient to provide an 'adaptive' principle to set the ecologic parameters of the intrinsic qualities of existing or planning phases, in order to determine proper approaches to solve complex questions such as the one of evaluating and organising the 'interactions' going on in the territorial and settlement ecosystems. Those logics are based on a complex vision of the local, socio-economic, political, cultural, geographical, climatic, environmental variables and dynamics; but at the same time, they are meant to provide solutions to paradigmatic questions; logics are different in relation to the choice of specific actions – different spaces for configurations, functions and performances – but comparable in relation to the common criteria of judgement followed.
The question of determining those judgement criteria, to be followed in the choice of specific actions, is an important and necessary phase, above all, if we take into consideration it as part of a context characterised by resource scarceness and increasing emergency situations.

In order to set this second series of remarks, we recall what we could define some sort of shared fundamental vision (and from which all the other considerations can unravel) of architecture's ancestral task: in the confinement of an indoor space, in the articulation of an in between space, in the characterization of an outdoor space, or in the connotation of a more complex series of indoor, intermediate and outdoor spaces in the urban field, its role has always been the one to protect, interact and self regulate itself in respect to the microclimatic conditions of the context. Conditions such as sun radiation we need to protect ourselves from and the lack of natural light we need to overcome; the outdoor temperatures of hot or cold climates that need to be mitigated and dominated; different forms and nature of rainfall that ought to be controlled or the lack of the latter that needs to be overcome by applying different forms of hydrological supply; the air mass fluid dynamics in their seasonal manifestations that ought to be handled and applied to architecture, or the access of ventilation phenomena that we need to protect from. But architecture's role has also been to manage, in the most effective and efficient way, the energy aspects functional to the way we live in respect to the available resources; and to guarantee an environmental comfort that is the outcome, the closest one to the optimal thresholds hoped for, of the problematic factors and limitations of contextual conditions, which are rarely naturally close to such thresholds; becoming bearer and vouch for social and justice needs and deliver effective and efficient answers to the functional requirements and to related distribution and use problems, by constantly searching for a research that is coherent and harmonious with the environmental characteristics of the context.

2. Design meta-criteria

The latest reflections are an important package of reference to go back to the first of the three questions I asked myself, and to focus on the field of conceiving the possible logic-cognitive phases which would be necessary to define (and implement) the whole requirements emerging more and more clearly today. For those requirements (we'll deal with them through the third question)

planners, and on the whole, the actors of changing and protection actions should be able to face different levels in different ways:

a) Interactive detection of conduct characteristics (in terms of the ability to establish interactions effectively) of the basic elements of the 'portion' of the architectural, urban or territorial system which is the subject of the action, regardless of the scale, such as:

1 – *'Spaces in':* the single spaces of the actions, adjusting transitions selectively and in a polyvalent way, in relation to the ways, roles, performances and configurations observed;

2 – *'Spaces between':* the intermediate spaces 'between' the ones which are the subjects of the actions, governing interaction and adaptivity processes;

3 – *'Spaces out':* the external spaces 'out' of intermediates and of the ones which are the subjects of the actions.

b) The understanding of the overall behaviour of the 'portion' of city or territorial system analysed, in terms of:

1 – detection of the dynamic balance of the continuous flows of internal interactions characterising the micro processes of the city or territorial portion studied;

2 – detection of the dynamic balance of the interaction flows which the city or territorial portion studied establishes with its immediate ecosystem macro-area around;

3 – detection of the dynamic balance of the continuous flows of interactions which the urban or territorial portion studied establishes with the broader macro-sphere of climate and environmental factors on the whole.

The basis of such approach, just apparently revolutionary in the scientific and planning world, is closely linked with contributions originating from very different disciplines, though more and more convergent in the last few years, owing to the need to define new ways of conceiving and setting the understanding and solution of problems. However, those contributions take also into consideration a ten-year development within which we, 'the technologists' played a fundamental and supporting role exactly thirty years ago, when someone laid the foundations for a systematic approach in the organic definition of the central and cultural role of technology for conceiving, setting and carrying out the project; such approach should be based on the awareness of the importance of what he called the 'ethics of knowledge', in which the milestones of the new method of process approach are the 'interactions' between principle of non-determination and concept of irreversibility, between consequences of the principle of irreversibility and consequences on the language, between language definition and the principle of evolution, between evolutionary approach and overcoming of the uncertainty/strategy dichotomy.

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In each of the lines of action potentially adoptable, the mark of the nine meta-criteria of judgement must always be present and correlated, at any time or level of application to the space-environment. Through its different, at times sector-based contributions, the very scientific literature refers to them in terms of control and reference to a proper action in the direction stigmatised through words such as 'ecologic' and 'environmental' – once again, with an important contribution from our scientific and disciplinary sector:

3. **the criterion of 'liminality' of project development conditions, always (*in dialectic reasoning*) in between dwelling, social and health quality seeking on the one hand, and the need for eco-friendliness on the other;**
4. **the criterion of 'ambivalence' of the border/frontier conditions of the element or the elements characterising the environmental action;**
5. **the 'repetition ability' criterion, that is, of 'self-preservation' (time repetition - renewal) and 'reproduction' (space repetition - multiplication) of the environmental action system;**
6. **the 'stochastic' criterion, recalled also in the first notes of this contribution, that is, of the ability to combine a 'casual' component with a 'selective' process, in such a way that just some results of the casual can last in the environmental action system;**
7. **the criterion of 'controllability' and 'correctability' of actions, consistently with the need for continuous updating and adjusting in progress of temporary project results, in compliance with the conception of *error friendliness*;**
8. **the two criterions, in relationship, of 'flexibility' and 'adaptability' of development and management processes, in a diachronic and synchronic way, of the results of the environmental action;**
9. **the criterion of biunique, non-destructive 'interactivity', with the resources of the environmental system;**
10. **the criterion of real use of systems and technologies, either traditional or innovative, capable of promoting and supporting a high level of ecological effectiveness of the whole behaviour of the city and/or territorial organism that is the subject of protection, safeguard or change actions.**

The logic-cognitive phases and the characters of the judgement meta-criteria emerged during the reflections made up to now, prefiguring the real opportunity to follow an evolution path tending to become more and more complex, are about the approach to the artificial action in terms of epistemology (the meaning of the changing action) and instrument-methods (how to structure the changing action). However, we must concentrate on the objective of such process: directing the contents of innovation in terms of technology, performance, morphology and physiognomy, in a framework of environmental awareness; the numerous and different consequences should represent and grant trend reversal, towards quality and ability to provide effective and immediate answers to problematic situations for emergency cases or resource scarceness.
In this respect, James Gleick reminds us that "simple shapes are inhuman. They are not in tune with the way in which Nature organises itself, or with the way in which the world is perceived by humans". Let's bear in mind that, in terms of formal values, new expressions of mathematics brought physical sciences in harmony with the contemporary feeling of Nature free of expressing itself and organising itself, such as fractal geometry or predictive adaptive systems, born recently but already explosive in

their interdisciplinary implications. In the last two decades, the vision or conception of the citizen or the architect with respect to Nature turned upside down. Now Nature is not ignored, or 'raped' any longer; on the other hand, it has to be observed and studied with respect. Finnish architect, teacher and designer Juhaani Pallasmaa was one of the first telling us that Nature is to give us teachings and directives as a real *Baumeister*.

In any case, it is nevertheless necessary "to make Environment a big house, in the same way as one would like one's house to be a small Environment with its richness and complexities", and it is fundamental to give Environmental Protection a role, not just in terms of increasing environmental awareness and participation in nature cycles, but also in terms of indentifying and applying possible method requirements for the actions meant to establish proper processes of development of the interactions impressed in the changing dynamics of urban and territorial ecosystem reality.

3. Method requirements

In the light of the reflections made about the possible principles and meta-criteria which should be followed by any environment changing action, it is possible to try and summarise – in nine points – what may be defined the 'method requirement/characteristic system' which should be followed by any operational process based on the objective to answer the need of protection and safeguard actions, as well as recovery, change and environmental value increase, more and more often to be decided and supplied under emergency conditions:

- **the awareness that any attempts – though complex for itself – to reduce the parameters of the whole, thick and interrelated actions and relations based on exchange continuity, close interference of technological-physical-spatial dominions and transformation fields, run the risk of rendering such cognitive process fragile and vacuous, unless constantly accompanied with a strong critical control of data processing;**
- **rejection of the opportunity to relate the reading of architecture-technology-environment interactions to mechanisms of cause-and-effect univocally determined, in the awareness, that every operation about reality decomposition and re-composition processes inspired by the establishment of structures with stable and final hierarchies would make the attempt of understanding the environmental ecosystem reality actually fruitless and merely instrumental, as well as without any really scientific foundations;**
- **need for the continuous balance of empiricism and Noumenological questions of reference, in the conviction that for identifying the ecologic parameters of behaviour, and the intrinsic qualities of interacting technological aspects and environmental spaces, it is necessary to introduce logics of approach to the theme of evaluating systems based on the 'differentiation' of the choice of specific actions, as well as on the 'comparability' of those data in relation to the common criteria of judgement adopted;**
- **the shifting of logic-cognitive attention to the 'processes of material and immaterial relation or interaction' making up the essence of metabolism of the environmental part which is the subject of the action, and which characterise the behaviour of the technological systems and of the organism itself on the whole, in place of the usual attention paid to the analyses-estimates of the solely functional or formal-spatial aspects of the environment on the whole;**
- **the 'vitality' of the environmental action morphologic and technologic system, always ready to question itself and always ready for development, sensitive to the specific socio-economic-cultural-geographic characteristics of the environmental object of the changing application;**

- **the 'flexibility' of the environmental action system, capable of changing coherently at the same time with the evolution of space, the interactions and the ways of living of the users of those spaces, and of the actors of those interactions, a matter by now unavoidable, about which all the most significant international figures of architecture technology are expressing themselves;**
- **the 'tolerability' of a certain margin of error in the environmental action process, the one which German biologist Christine von Weizsäcker called *Fehlerfreundlickeit,* "the serene awareness and acceptance of the error or malfunctioning case", and which is also contemplated in the law of evolution and existence of nature itself;**
- **the 'ascalarity' of the approach to the accomplishment of the environmental action, based on the rejection of the possibility of identifying an exact and preferential scale of system application, consistently with the conviction that the real task of seeking an operational definition – as stated by Ceruti, Tiezzi and Funtowicz with different points of views – is studying the interactions of different, possible reading levels, "rather than trying to discover the only real and proper time and space scale for sustainable development, a scale which does not exist";**
- **for its nature, the 'adaptivity' of the environmental action morphologic and technological system does not require (or denies) an 'absolute' or 'univocal' position about the structure generating data, and concentrates the whole research specification effort on the accomplishment of a 'system architecture', whose 'predictive' effectiveness – as stated by Massimo Buscema in its *Special issue on artificial neural network and complex systems* - is based on the 'Theory of Independent Judges'. In compliance with such Theory, the use of a complex series of some predictive *tasks* can be the real turning point to direct properly any kind of research, experimentation and process conception for the actions in our realities, missing operating certainties to a greater and greater extent.**

*** Fabrizio Tucci is Associated Professor of Technological Design, Supervisor of the Scientific Committee and Scientific Board for the PhD in Planning, Design and Technology of Architecture and Director of the Post-Lauream Master's Degree in Bioecologic Architecture and Sustainable Technologies for the Environment, PDTA Department, Faculty of Architecture, La Sapienza University, Rome.**

NOTES

1. *As regards this aspect, see my previous contributions, particularly those included in the following publications*: *Quality and Ecoefficiency of Urban Transformations*, 2002; *Well Tempered Envelope*, 2006; *Technology and Nature*, 2008; *Environmental and Energy Efficiency in Architecture*, 2011; *Ecoefficiency of the Architectural Envelope*, 2012; *Atlas of Technological Systems for Bioclimatic Architecture. Natural Building Ventilation*, 2012.

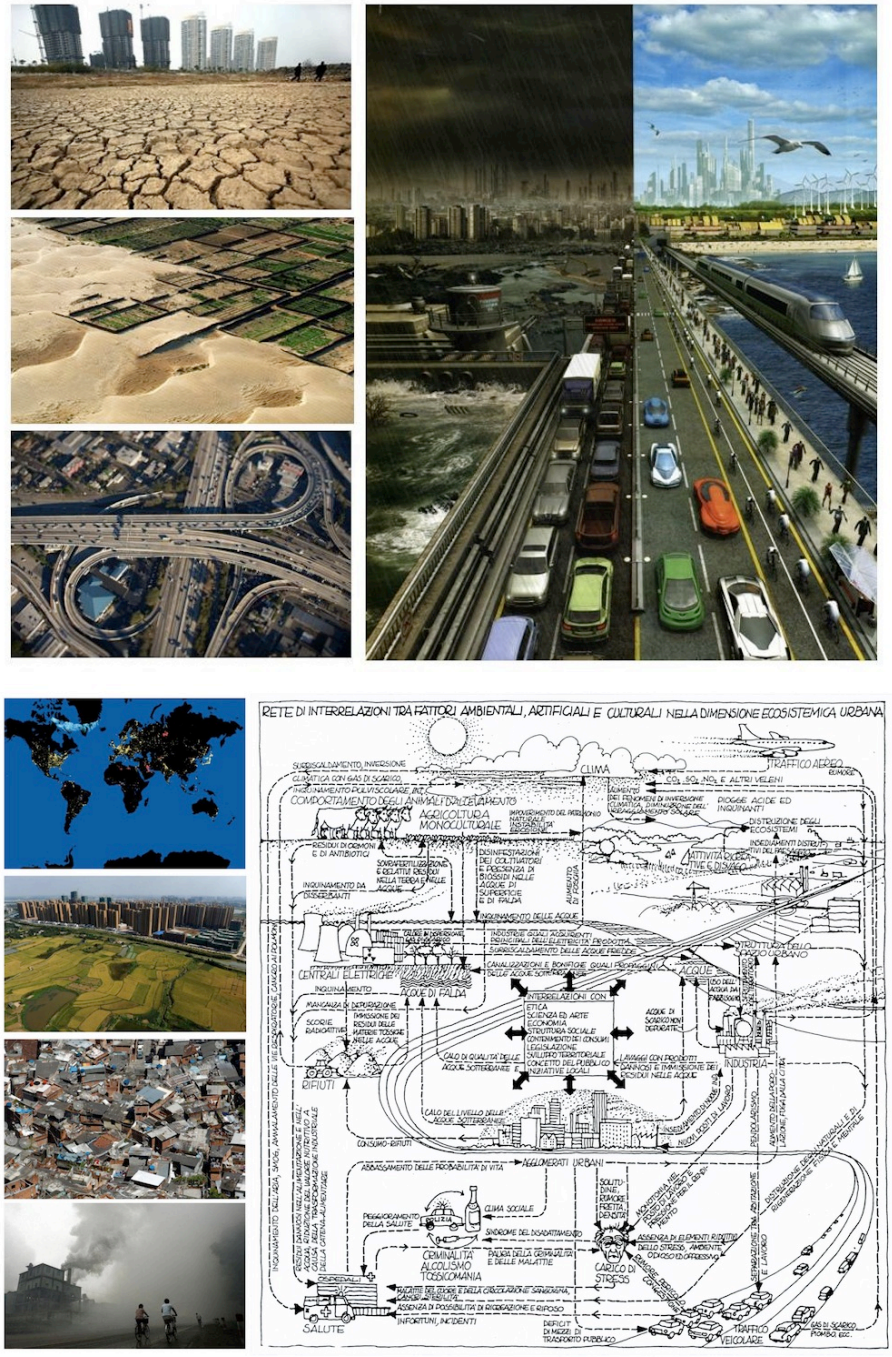


Fig_01 – Alla sfida ‘ambientale’ – insieme alla imprescindibile, auspicabile, ma per ora in netto ritardo, azione della classe dirigente dell’umanità – siamo chiamati a dare un contributo importante e strategico noi tecnologici, designer, progettisti, pianificatori, in quanto principali attori degli interi processi degli interventi di trasformazione dei prodotti, delle architetture, delle città e dei territori, e nello specifico in quanto soggetti che, nell’intervenire puntualmente e diffusamente alle diverse scale e nei più articolati ambiti, sono di fatto tra i potenziali protagonisti di un possibile, concreto, cambiamento di tendenza.

Fig_02 – Gli studiosi, i ricercatori, i progettisti e in genere gli attori degli interventi di trasformazione e recupero ambientale dovrebbero poter spaziare in modo trasversale e ubiquo sul livello di comprensione del complessivo comportamento del sistema architettonico, urbano o territoriale analizzato, in termini di rilevamento dell’equilibrio dinamico dei continui flussi di interazioni interne che caratterizzano la processualità ‘micro’ della parte studiata; dei flussi di interazioni che la parte studiata stabilisce con il suo immediato macro intorno esterno ecosistemico; e dei continui flussi di interazioni che la parte studiata stabilisce con la macrosfera più ampia dei fattori climatici e ambientali nel loro complesso. Schema riadattato e ispirato agli studi di Per Krusche.

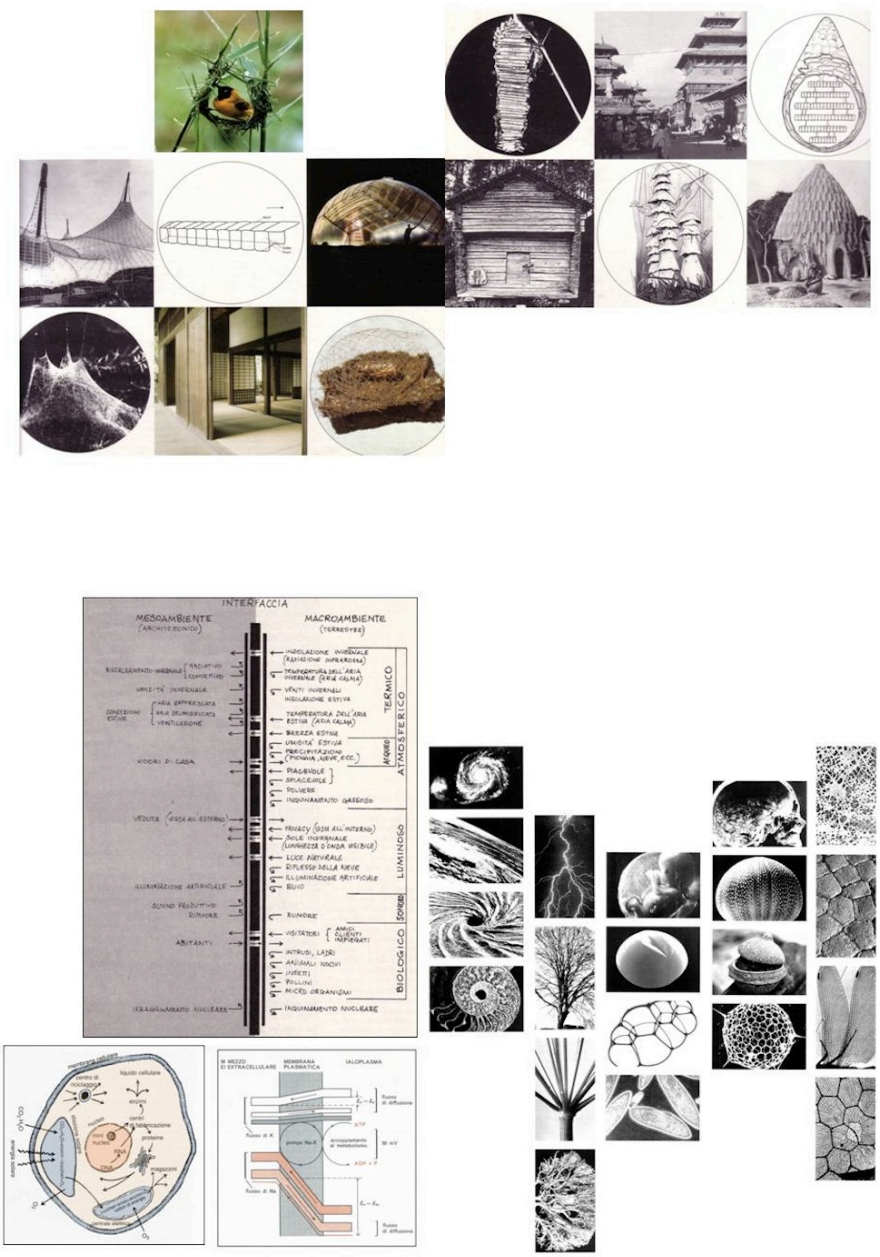
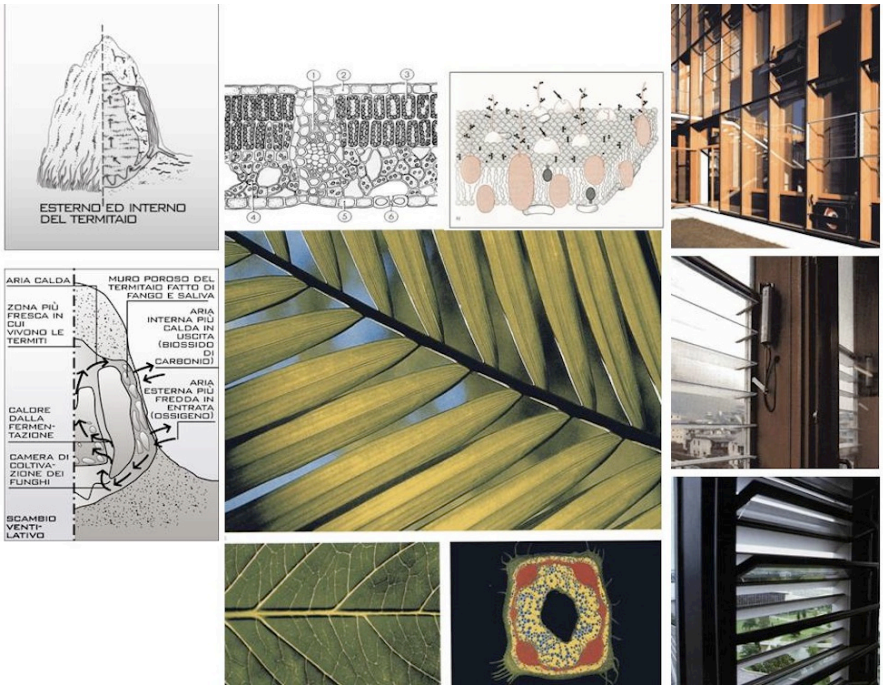


Fig_03 – Cosa intendiamo per ‘bioclimatico’ e, di più, per ‘sistema bioclimatico’ – termini caratterizzanti lo stesso titolo di questo contributo? Troviamo risposta nelle autorevoli parole di Victor Olgyay, secondo il quale un insieme bioclimatico, o sistema bioclimatico, è un’unità che include tutti gli organismi che vivono insieme (comunità biotica) in una data area, interagenti con l’ambiente fisico, nelle sue componenti naturali e artificiali, in modo tale che un flusso di energia, materia e informazioni conduca ad una ben definita struttura biotica e ad una ciclizzazione dei materiali tra viventi e non viventi all’interno del sistema.

Fig_04 – La consapevolezza tecnologica ambientale nella progettazione induce gli sperimentatori ad esplorare e ad indagare i ruoli che vengono ad assumere elementi-chiave dell'ambiente costruito quali quell’importantissimo, strategico “sistema di sistemi tecnologici” che è l’involucro architettonico, la pelle degli edifici, la *smart skin*, in quanto capace, finalmente, di dialogare attivamente e fattivamente con i fattori materiali e immateriali, biofisici e microclimatici, quali il soleggiamento nei suoi molteplici aspetti termici, l’illuminazione naturale, la temperatura esterna dell’aria, la ventilazione naturale, e i tanti altri elementi che vanno oggi ad informare un possibile quadro innovativo dei requisiti per un’architettura bioclimatica.



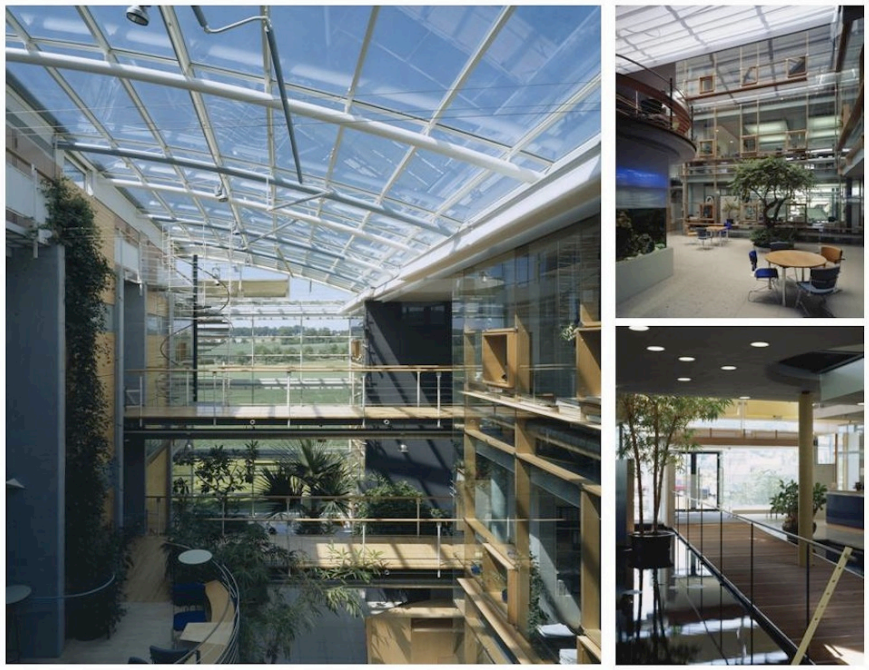


Fig_05 –Negli ultimi due decenni si è ribaltata la visione e concezione del cittadino, dell'architetto e del ricercatore verso la Natura: entità non più da ignorare e tantomeno da sottomettere e 'violentare', ma piuttosto da osservare con rispetto, studiare, e dalla quale ricavare insegnamenti e direttive come una vera e propria *Baumeister*, 'Maestra del Costruire'.

Fig_06 – Edificio per uffici a comportamento bioclimatico e ad alta efficienza energetica denominato "Haus für Ingenieure", realizzato ad Herremberg, Germania. Progetto di Kauffmann und Thelig, consulenza di A. Battisti e F. Tucci.

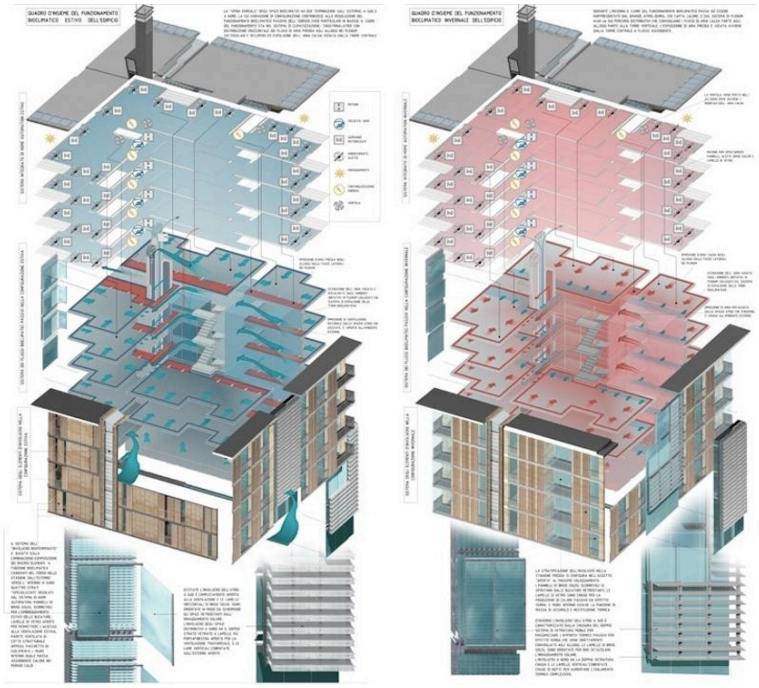
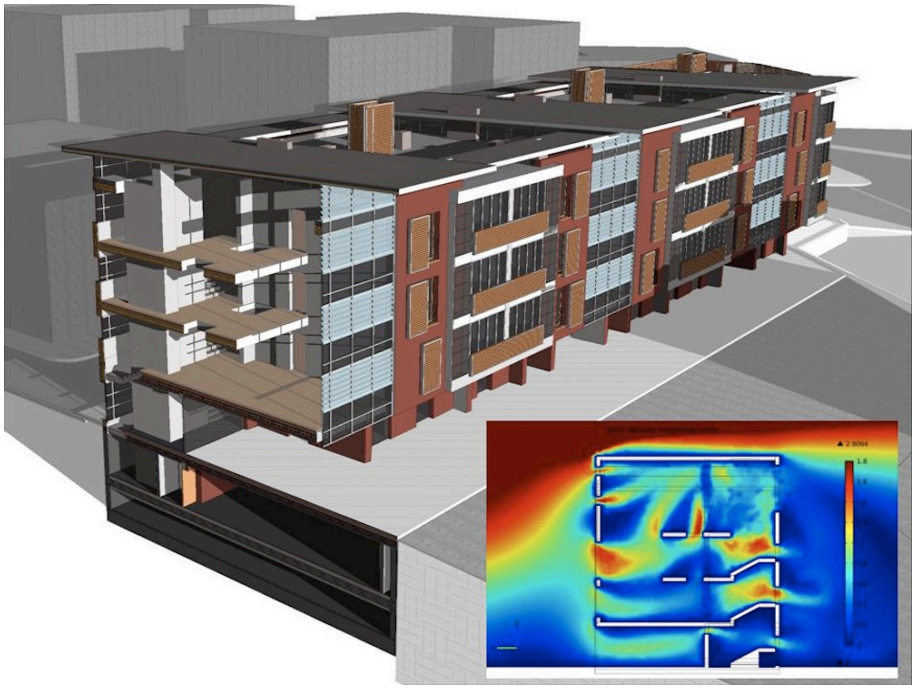


Fig_07 – Case bioclimatiche per l'Edilizia Residenziale Pubblica del Comune di Roma, 31 alloggi a Lunghezzina, Roma, nell'ambito del Piano di Zona "Lunghezzina 2". Concorso internazionale vinto da T. Herzog (capogruppo), F. Tucci (capo progetto), A. Battisti, F. Cipriani, M. Strickner. Comportamento bioclimatico passivo, classe energetica A+. In realizzazione.

Fig_08 – Centrale nella progettazione bioclimatica è il passaggio logico alla dimensione di 'trasversalità-non-scalare', che non solo non pregiudica la presa in considerazione dei caratteri e delle proprietà dei vari livelli ma ne avvalora il principio di diversificazione contro quello ben noto dell'omologazione. In questo senso ogni 'parte' dell'oggetto dell'intervento progettuale non è analizzata solo nelle sue intrinseche proprietà, ma soprattutto in relazione alla sua capacità di rapportarsi col 'tutto' contestuale: ciò che chiamiamo 'una parte' non è altro che un elemento immerso in un costante flusso di interazioni con le altri 'parti', in una trama inscindibile di 'interfaccia', come si è tentato di fare nel progetto di Lunghezzina2 a Roma.

Fig_09 –Edificio di Edilizia Residenziale Pubblica per 18 alloggi del Comune di Monterotondo, Roma, nell'ambito del Piano di Zona "Cappuccini". Progetto di L. Cortesini, con A. Battisti e F. Tucci per gli aspetti tecnologici, bioclimatici e ambientali. Realizzato rispettando il low cost da ERP, abitato dal 2010, alta efficienza bioclimatica, classe energetica A+.

Fig_10 – Insediamento di 360 alloggi a basso consumo energetico a Colle della Strega, Roma. Progetto di M. Strickner e M. Di Pasquantonio, con A. Battisti e F. Tucci consulenti per gli aspetti tecnologici, bioclimatici e ambientali.



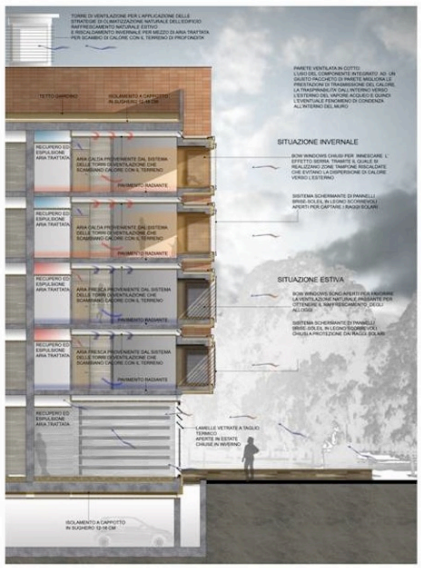
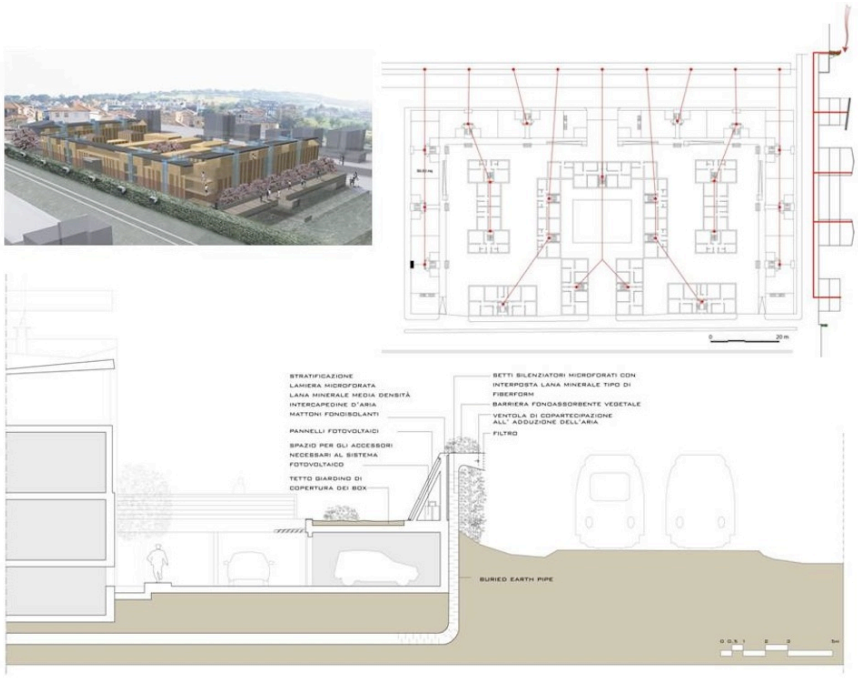


Fig_11 – Edificio di Edilizia Residenziale Pubblica per 24 alloggi del Comune di Firenze, a comportamento bioclimatico passivo e classe energetica A+. Progetto dell'ufficio tecnico di Casa Spa, direttore V. Esposito, con A. Battisti e F. Tucci consulenti per gli aspetti tecnologici, bioclimatici, energetici e ambientali.

Fig_12 – Edificio di Edilizia Residenziale Pubblica per 36 alloggi destinati a giovani coppie o anziani, del Comune di Cisterna di Latina, Latina, nell'ambito dei Contratti di Quartiere II. Comportamento bioclimatico passivo, classe energetica A+. Progetto dello Studio Arch-in-Progress, con A. Battisti e F. Tucci consulenti per gli aspetti tecnologici, bioclimatici, energetici e ambientali.



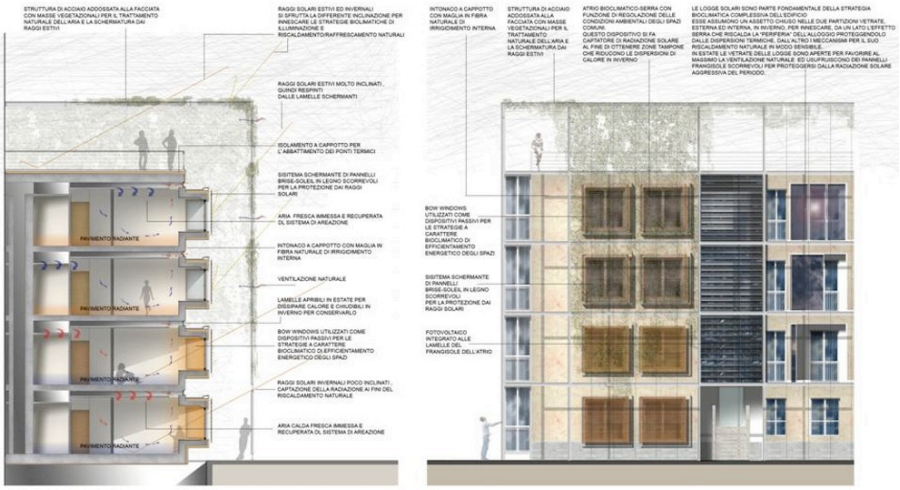


Fig_13 – Riqualificazione energetico-ambientale del Quartiere IACP “Villa Aosta” a Senigallia, Ancona. Ricerca Conto Terzi del Dipartimento ITACA dell’Università La Sapienza per l’ATER di Ancona, Responsabili e coordinamento S. Dierna e F. Tucci. Realizzato e abitato dal 2011.

Fig_14 – Riqualificazione energetico-ambientale del Quartiere IACP “Santa Barbara” a Nettuno, Roma, nell’ambito dei Contratti di Quartiere II. Progetto dello Studio Arch-in-Progress, con A. Battisti e F. Tucci consulenti per gli aspetti tecnologici, bioclimatici, energetici e ambientali.

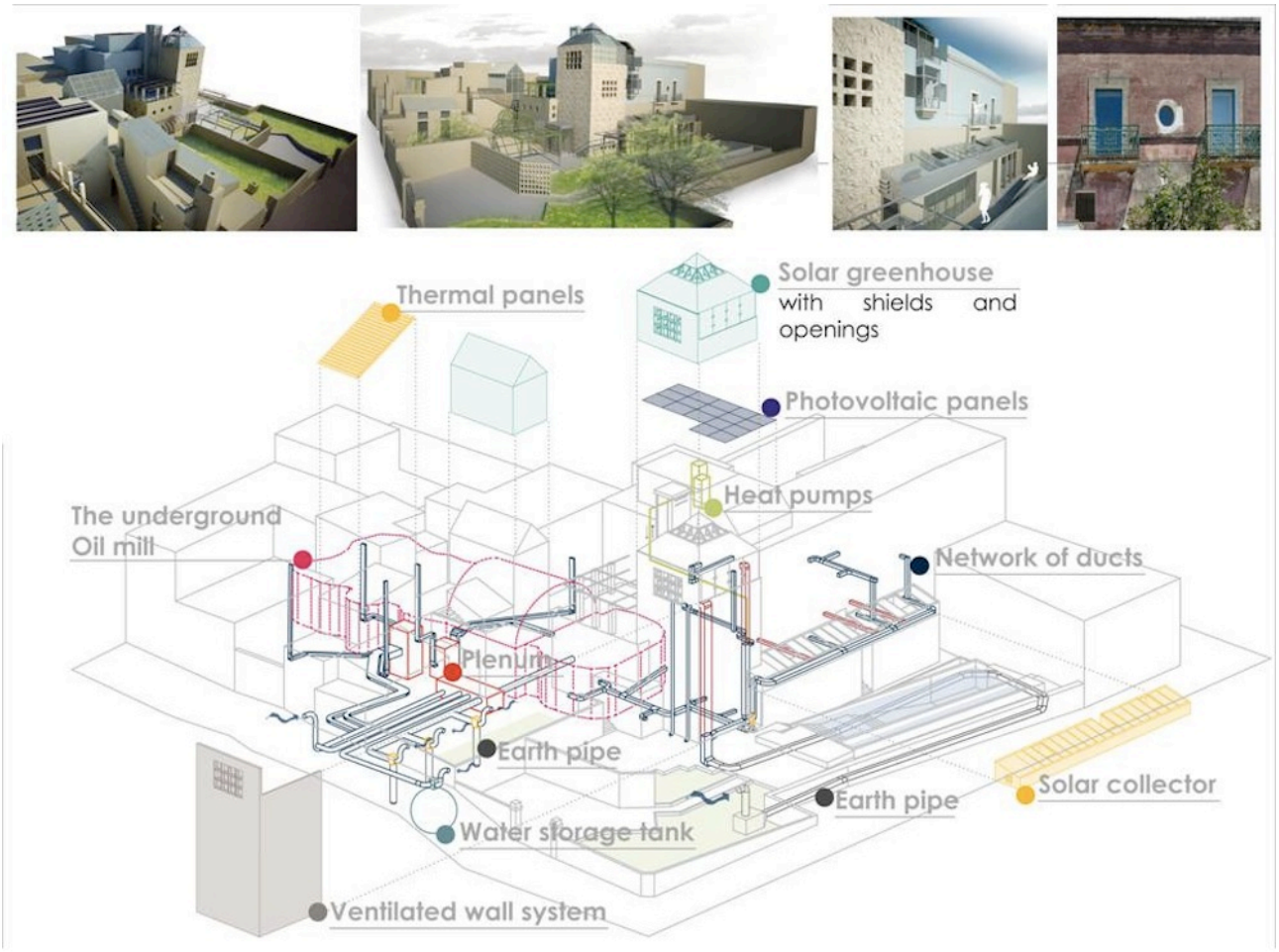


Fig_15 – Riqualificazione energetico-ambientale di un complesso residenziale a Salve, Lecce. Progetto di S. Dierna, V. Cecafosso, R. Morleo, con F. Tucci, F. Cipriani e M. Cimillo consulenti per gli aspetti tecnologici, bioclimatici, energetici e ambientali.