

# Resilienza ed economie green per il futuro dell'architettura e dell'ambiente costruito

SAGGI E PUNTI  
DI VISTA/  
ESSAYS AND  
VIEWPOINT

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**Abstract.** Il concetto di resilienza nell'ultimo decennio è messo in stretta relazione strategica con gli obiettivi primari di 'circolarità dei processi' e di *Green Economy* applicati all'ambiente costruito e all'edilizia, a partire dai documenti programmatici internazionali della UNEP nel 2008 e dell'OECD nel 2010. Il dibattito è ad oggi appena impostato, e la ricerca ancora tutta da sviluppare, ma il potenziale apporto della Progettazione Tecnologica dell'Architettura appare centrale. Il contributo affronta criticamente principi, approcci di metodo e di progetto, e azioni strategiche strutturali per una maggiore resilienza dell'ambiente costruito richiesta dalla Commissione Europea, e ne affronta le prospettive di sviluppo nel nostro Paese, sia a livello istituzionale nazionale che sul piano dell'intervento locale, ruotanti prevalentemente intorno agli assi strategici di lavoro tracciati e portati avanti dagli *Stati Generali della Green Economy*.

**Parole chiave:** Resilient Design, Green Economy, processi circolari, ambiente costruito, progettazione tecnologica.

## Inquadramento delle questioni

Sebbene fin dagli anni '80-'90 il concetto di resilienza sia stato introdotto sul piano teorico nella progettazione ambientale a livello internazionale<sup>1</sup>, solo nell'ultimo decennio è stato messo in stretta relazione strategica con l'innescio dei 'processi circolari' e con le metodologie connesse alle economie *green* e *circular*.

Il rafforzamento delle capacità di resilienza quale obiettivo primario di un'economia *circular* e *green* applicata all'ambiente costruito e all'edilizia emerge a partire dai documenti programmatici internazionali '*Global Green New Deal*' della UNEP nel 2008 e '*Towards Green Growth*' dell'OECD nel 2010, fondativi del concetto di 'circolarità dei processi' e di *Green Economy* (UNEP, 2008; OECD, 2010). I successivi, centrali documenti '*Towards a Green Economy*' e '*Green Economy Coalition*' presentati rispettivamente nel 2011 e nel 2012 dalla UNEP hanno sottolineato che sono due gli ambiti nei quali il contributo della *Green Economy* e del connesso innescio di 'processi circolari' incidono per

Resilience and green economies for the future of architecture and the built environment

**Abstract.** Over the past decade, the concept of resilience has been strategically and inextricably linked to the main aims of the Green Economy and 'process circularity' as applied to the field of the built environment and buildings, starting with the international policy documents published by UNEP in 2008 and by the OECD in 2010. This debate has only just been outlined and there is still plenty of research to be done, but the potential contribution of Technological Design in Architecture seems key. This paper critically analyses the principles, the method- and design-based approaches and the structural strategic measures that can improve the resilience of the built environment, as requested by the European Commission, and considers the prospects for its development in this country, both at a national institutional level and at a local level, primarily gravitating around the strategic working axes that have been outlined

il futuro del nostro ambiente costruito: la capacità di resilienza e adattamento ai mutamenti macroclimatici e ai loro impatti microambientali (UNEP, 2011) e quella di resilienza e adattamento ai problemi legati alla progressiva limitatezza e non rinnovabilità delle risorse naturali (UNEP, 2012).

La prima implica la riduzione della vulnerabilità dei sistemi urbani agli eventi atmosferici estremi, l'aumento della capacità di adattamento degli edifici e degli spazi aperti, l'impiego dei sistemi bioclimatici, l'incremento di sicurezza e di comfort ambientale.

La seconda investe la capacità dell'ambiente costruito di reagire all'evolversi dell'impovertimento ecologico e del capitale naturale, del depauperamento delle risorse materiche e fisiche e della minaccia energetica, con le sue inefficienze e la non rinnovabilità delle sue fonti, a scapito, alla lunga, anche della qualità della vita. Non mancano i riscontri sul piano intellettuale e scientifico di questo recente spostamento di ottica che privilegia l'attenzione all'indagine sulle potenzialità del ruolo che una economia *green* e *circular* può esercitare per l'elevazione delle capacità di resilienza di quel complesso 'sistema di sistemi' che sinteticamente chiamiamo *built environment*<sup>4</sup> (Cheshire, 2016; Capra, 2017).

Il Simposio internazionale '*Ecomondo/Ecoworld*' recentemente tenutosi a Rimini per gli Stati Generali della Green Economy<sup>2</sup> (col Premio per lo Sviluppo Sostenibile sotto l'egida del Presidente della Repubblica), ha sancito la improrogabilità e l'urgenza di una diffusa applicazione di tale visione: la Città del futuro in Italia, in linea con le sperimentazioni più avanzate testimoniate dagli ultimi sviluppi del '*Green City Capital Award*' della Commissione Europea<sup>3</sup> e con le nuove direttive del *Directorate-General for the Environment of the European Commission*, dovrà essere oggetto di un Piano nazionale che ne promuova "l'aumento della

– and continue to be pursued – by the States General of the Green Economy.

**Keywords:** Resilient Design, Green Economy, Circular Processes, Built Environment, Technological Design.

## An overview of the issues

Although the concept of resilience was introduced at a theoretical level in international environmental planning and design as far back as the 1980s and '90s<sup>1</sup>, it is only in the last decade that it has been strategically linked to the triggering of 'circular processes' and methodologies associated with green and circular economies.

The first time the main aim of a green and circular economy was stated to be the strengthening of the level of resilience of the built environment was in two international policy documents: UNEP's 'Global Green New Deal' in

2008 and the OECD's 'Towards Green Growth' in 2010, which established the concepts of 'process circularity' and a 'green economy' (UNEP, 2008; OECD, 2010). Subsequent key documents – 'Towards a Green Economy' and 'Green Economy Coalition', which were presented by UNEP in 2011 and 2012 respectively – stressed that there are two areas where the contribution of a green economy and the associated triggering of 'circular processes' influence the future of our built environment: the resilience and adaptation to macro-climatic change and its micro-environmental impacts (UNEP, 2011) and that of the resilience and adaptation to the problems caused by the increasing scarcity and non-renewability of natural resources (UNEP, 2012).

The former involves the reduction of the vulnerability of urban systems to extreme weather events, an increase in

resilienza, supportato con gli strumenti e gli indirizzi della Green Economy” (FSS, 2017).

Il dibattito sulla interazione tra *Green Economy* e resilienza per la mitigazione e l'adattamento agli impatti prodotti dai mutamenti climatici<sup>4</sup> e agli effetti generati dalla progressiva scarsità delle risorse – con la riduzione dei rischi-chiave che tali impatti comportano sull'ambiente costruito (Fig.1) – è ad oggi appena impostato, e la ricerca ancora tutta da sviluppare, ma il potenziale apporto della Progettazione Tecnologica dell'Architettura appare centrale.

Occorre, per compiere i corretti passi in avanti, da una parte operare una disamina critica delle principali implicazioni di approccio e delle relative innovazioni processuali utili per approfondire la portata dei principi-chiave che animano i temi del 'progettare resiliente'; e dall'altra prendere in esame le potenzialità di azione nelle future sperimentazioni della Progettazione Tecnologica dell'Architettura sull'ambiente costruito in termini di indirizzi strategici correlati, tra gli altri, ai nuovi 'Green Growth Indicators 2017' (OECD, 2017) e al recente 'Programma di transizione alla Green Economy in Italia' (CNGE, 2017).

### **Presupposti teorici e approcci di metodo nell'interazione progettuale tra Green Economy e Resilient Design**

flessione iniziata anni fa sulle pagine di questa stessa rivista (Tucci, 2013): quali sono i principi-chiave che a livello internazionale si pongono come presupposti teorici dell'interazione tra *Green*

Con riferimento ai due ambiti tematici in oggetto, è centrale per lo sviluppo del primo dei due passi sopra richiamati porsi due domande-chiave, quasi a proseguire idealmente una riflessione iniziata anni fa sulle pagine di questa stessa rivista (Tucci, 2013): quali sono i principi-chiave che a livello internazionale si pongono come presupposti teorici dell'interazione tra *Green*

the adaptive capacity of buildings and open spaces, the use of bioclimatic systems, an increase in safety and environmental comfort.

The latter involves the built environment's ability to react to the increasing impoverishment of our ecology and our natural capital, the squandering of our material and physical resources and the energy threat, with its inefficiencies and the lack of renewability of its sources, which in the long run will also be detrimental to quality of life.

There is no lack of evidence of this recent shift in perspective on an intellectual and scientific level, a perspective that prioritises research into the potential role that a green and circular economy could play in raising the level of resilience of that complex system of systems we succinctly call the built environment (Cheshire, 2016; Capra, 2017). The Ecomondo international symposium

that was recently held in Rimini by the States General of the Green Economy<sup>2</sup> (with the sustainable development award promoted by the President of the Italian Republic) confirmed the undeferrable urgency of a widespread application of such a vision. In Italy, the City of the Future must be the subject of a national plan that promotes its 'increase in resilience, supported by green economy tools and approaches' (the Fondazione per lo Sviluppo Sostenibile sustainable development foundation, 2017), in keeping with the most ground-breaking trials highlighted in recent developments of the European Commission's Green Capital Award<sup>3</sup> and in the new directives issued by the European Commission's Directorate-General for the Environment.

The debate regarding the interaction between green economies and resilience for mitigating and adapting to

*Economy e Resilient Design?* Quali gli approcci metodologici necessari per un efficace sviluppo progettuale?

In risposta alla prima questione possiamo individuare, tra i tanti connessi col concetto di resilienza, i 9 principi centrali anche per la *Green Economy*, sui quali fa perno sia la necessità di acquisire la dimensione della 'temporaneità' sul piano progettuale, sia quella di accettare la dimensione della 'indeterminatezza' nell'indirizzo e controllo del momento valutativo *ex ante* ed *ex post* degli interventi. Sono quelli, organizzabili in tre 'triangolazioni', di: riflessività, auto-organizzazione e inclusività; robustezza, flessibilità e adattività; integrazione, connettività e reattività, ricorrenti in forme diverse sia nel report 'Urban Adaptation to Climate Change in Europe' della European Environmental Agency (EEA, 2012); sia nel 'City Resilience Framework' elaborato contestualmente all'iniziativa *100 Resilient Cities* (Arup, 2015); sia, infine, nel fondamentale report della Commissione Europea 'Implementation of the Circular Economy Action Plan' (European Commission, 2017).

Essi, nella rilettura complessiva e sistemica che stiamo operando, svolgono due funzioni strategiche, in quanto fattori in grado di innestare nei sistemi urbani la capacità *in generale* di «percepire cambiamenti e disturbi indotti dall'ambiente circostante adattando le proprie strutture e funzioni alle nuove condizioni, senza disturbare il naturale flusso della propria vita» (EEA, 2012), e *in particolare* di «rispondere dinamicamente ai processi di cambiamento in atto e agli effetti indotti dalle perturbazioni esogene o endogene quali i mutamenti climatici e la progressiva scarsità di risorse» (EC, 2017).

Sulle tre 'triangolazioni' si poggiano i tre approcci di metodo e di progetto propri delle economie *green* e *circular* che, stagliandosi

the impact of climate change<sup>4</sup> and the effects of the increasing scarcity of resources – by reducing the key risks that these impacts pose to the built environment (Fig. 1) – has only just been prepared and there is still plenty of research to be done, but the potential contribution of Technological Design in Architecture seems key.

In order to move forward in the right direction, we need to carry out, firstly, a critical review of the main implications involved in our approach and the relative process-based innovations that are useful when examining the importance of the key principles that underpin the issues of 'designing resilience'; and secondly, examine the potential actions of future trials in Technological Design in Architecture on the built environment in terms of strategic approaches linked to, among other things, new 2017 Green Growth Indicators (OECD,

2017) and the recent 'Transition Plan towards a Green Economy in Italy' (the National Council of the Green Economy, 2017).

### **Theoretical prerequisites and methodological approaches in the design-based interaction between green economies and resilient design**

As regards the two thematic areas discussed here, we need to ask ourselves two key questions if we want to develop the first of the two steps forward mentioned above, as if to conceptually continue a consideration that was first raised years ago in the pages of this journal (Tucci, 2013): what are the key principles that, at an international level, are the theoretical prerequisites for interaction between green economies and resilient design? What methodological approaches are necessary for successful design-based development?

per la loro carica di innovatività non solo nell'impostazione ma nella visione stessa dei problemi, possiamo definire caratterizzanti l'interazione tra *Green Economy* e *Resilient Design*:

- *Self-reliant approach* (i cui principi di riferimento sono: riflessività, auto-organizzazione e inclusività), l'approccio dei tre più stratificato nel tempo ma ancora molto da sperimentare e da evolvere, per il quale l'ambiente costruito e la sua architettura devono diventare sistemi 'autopoietici' (Schumacher, 2010) capaci di assicurarsi un'esistenza ininterrotta anche attraverso un'auto-rigenerazione sequenziale e funzionale delle loro 'componenti'. Una indicazione di approccio, questa, molto importante per la cultura tecnologica del progetto<sup>5</sup>: "Le componenti vengono aggregate e scisse, ma l'intensità di questi processi è sempre in armonia con la conservazione dell'unità e dell'identità del sistema e della sua organizzazione" (Herzog, Steckeweh, 2000). È un approccio che potrebbe permettere ai più diversi sistemi degli ambienti costruiti di ridurre la dipendenza del loro destino dai meccanismi di accumulazione di risorse e dalle strutture di concentrazione del controllo delle accessibilità ai beni e servizi (ILO, 2016). È un approccio che, proiettato verso uno sviluppo caratterizzato da un alto grado di sostenibilità e di efficienza ecologica ed energetica con un elevato livello di organizzazione e di scambio tra le sue funzioni, spinge alla 'diversificazione autopoietica' delle attività, degli usi, dei ruoli, e così facendo espone meno l'ambiente costruito che lo applica all'andamento globale dei mercati (GreenBiz Group, 2016) e ai *climatic change global trend*<sup>6</sup>, facendogli anticipare ed evitare (o comunque attenuare) gli effetti potenzialmente devastanti legati all'impiego unidirezionale di quelle risorse fisiche, di quelle fonti energetiche, di

quelle politiche economiche, piuttosto che di altre (European Commission, 2013).

- *Error-friendliness approach* (i cui principi di riferimento sono: robustezza, flessibilità e adattività), approccio che significa 'buona disposizione nei confronti degli errori', cioè non solo 'tolleranza degli errori' ma anche 'cooperazione flessibile e amichevole' con essi, che produca di errore in errore una progressiva 'robustezza adattiva' del sistema. Si è visto come nella stessa teoria dell'evoluzione delle specie i processi evolutivi non comportino mai l'eliminazione degli errori e dei fallimenti che, anzi, ne sono un elemento indispensabile. Ed è un elemento che deve diventare 'imprescindibile' anche in una visione *green* e resiliente del comportamento prestazionale dei sistemi tecnologici delle nostre architetture e del nostro ambiente costruito<sup>7</sup> (Hausladen et al., 2011): nei processi evolutivi del *natural environment* il requisito-chiave è la 'inclinazione alla flessibilità mutazionale nel superamento del fallimento', *chiave* perchè tale inclinazione si fa patrimonio genetico dell'intera specie e non del semplice individuo, diventando quella che potremmo chiamare 'coscienza di specie' o, trasponendola al *built environment*, 'codice genetico e mutazionale' di un ambiente costruito resiliente (Lakhtakia, Martin-Palma, 2013). Dunque una traccia importante da perseguire nella sperimentazione tecnologico-progettuale sulle architetture e le città, che spinge la ricerca scientifica a concepire la resilienza come, in fondo, la capacità del sistema di adeguarsi agli errori, di adattarsi ai malfunzionamenti e di superare i fallimenti derivanti da eventi nuovi o imprevisi, esogeni o cronicamente endogeni: in una parola, «resilienza come continua capacità di rettificazione dell'errore» (Armstrong, 2012).

In answer to this first question, we can identify nine key principles of the green economy from among the many that are linked to the concept of resilience. These key principles are the basis for the need to acquire the characteristic of 'temporariness' at a design level and the need to accept 'indeterminateness' when guiding and monitoring assessments before and after improvement work. These principles, which can be arranged in three 'triangulations', are: reflexivity, self-organisation and inclusiveness; robustness, flexibility and adaptivity; integration, connectivity and reactivity. They recur in various different forms both in the European Environmental Agency's 'Urban Adaptation to Climate Change in Europe' report (EEA, 2012), in the City Resilience Framework that was produced at the same time as the 100 Resilient Cities initiative (Arup, 2015) and, last but not

least, in the European Commission's fundamental report on the implementation of the Circular Economy Action Plan (European Commission, 2017). In the general systemic reinterpretation we are conducting, these principles carry out two strategic functions, in that they are factors that can trigger in urban systems, generally speaking, the ability to perceive change and disturbance caused by the surrounding environment, adapting their structures and functions to the new conditions, without disturbing the natural flow of their existence (EEA, 2012) and, *in particular*, the ability to react dynamically to the processes of change underway and the effects created by exogenous and endogenous disruption such as climate change and the increasing scarcity of resources (EC, 2017). These three 'triangulations' form the basis of three methodological design

approaches typical of green and circular economies that – notable for their level of innovation not only in the way they are framed but also in their view of the problems faced – we can claim are characteristic of the interaction between green economies and resilient design:

- The *self-reliant approach* (whose benchmark principles are: reflexivity, self-organisation and inclusiveness), an approach where the built environment and its architecture must become 'autopoietic' systems (Schumacher, 2010) that can ensure an uninterrupted existence for themselves through a sequential and functional self-regeneration of their 'components'. This approach is very important for the technological culture of design<sup>5</sup>: components are grouped and separated, but the intensity of

these processes is always in harmony with the preservation of the system's unity and identity and its organisation (Herzog, Steckeweh, 2000). It is an approach that could allow the various different systems of the built environment to reduce their dependence for survival on mechanisms that accumulate resources and on structures controlling access to goods and services (ILO, 2016). It is an approach that is oriented towards a kind of development that features a high level of sustainability and ecological and energy efficiency, with a high level of organisation and exchange between its functions that leads to the 'autopoietic diversification' of activities, uses and roles and thus is less prone to exposing the built environment that applies it to global market trends (GreenBiz

– *Dynamic-responsive approach* (i cui principi di riferimento sono: integrazione, connettività e reattività), approccio per il quale la cultura tecnologica del progetto dev'essere capace di mettere in condizioni i sistemi ambientale e architettonico di rispondere alle costanti interazioni con le trasformazioni in atto in modo insieme sinergico, dinamico e appropriatamente reattivo. Nella scienza contemporanea è chiamato anche 'capacità di replica' nell'ambito di un 'perenne disequilibrio dinamico' (Haken, 2003), che costituisce come noto un requisito fondamentale per l'esistenza stessa di tutti gli esseri viventi (Krusche, 2001; Sieverts et al. 2005). È una gestione di tipo 'green' dell'economia delle proprie interazioni – la più naturale e meno dispendiosa di risorse che esista – che si basa sulla specifica capacità dei caratteri 'tecnologici' del sistema di 'riorganizzarsi dinamicamente'<sup>8</sup> (Hausladen, Tucci, 2017). Una sfida affascinante, su cui la Progettazione Tecnologica avrà molto da lavorare, è la necessità di permettere agli elementi componenti il sistema resiliente di 'de-intensificare' o 'disaccoppiare' quest'ultimo dai requisiti materiali del suo funzionamento o nel 'diversificare' le risorse utili a svolgere un determinato compito, tanto più se queste versano in un regime di limitatezza. Il paradigma per i tecnologi è nelle caratteristiche 'prestazionali' dei sistemi resilienti in natura, che consentono loro 1) di riconfigurarsi in tempo reale qualora si verifichi un qualche sconvolgimento; 2) di impedire che i problemi di una parte si ripercuotano a cascata sulle altre; 3) di aumentare o diminuire la scala delle loro operazioni al momento opportuno e comunque ogni qualvolta si renda necessario (Zolli, Healy, 2017).

È importante sottolineare che i tre approcci non vanno visti in alternativa, ma in modo sinergico e interrelato nell'ambito di ogni

indirizzo d'intervento strategico in tema di resilienza, con accento sull'uno o sull'altro a seconda della natura degli interventi.

### **Indirizzi e indicatori strategici 'green growth' per un futuro più resiliente dell'architettura e dell'ambiente costruito**

E siamo così giunti alla terza domanda-chiave: come passare dalla codificazione di un quadro di presupposti teorici e di approcci metodologici propri delle economie *green* alla formulazione

di possibili indirizzi strategici per una effettiva elevazione dei gradi di resilienza dell'ambiente costruito?

È stato affermato che la questione della resilienza "non sembra essere oggetto propriamente progettabile e i suoi contorni non definiti ne rendono difficili i momenti dell'indirizzo prima e della misurazione poi, e per questo richiederebbe l'affiancamento di altre discipline per l'indirizzo e l'ausilio di indicatori di supporto per la misurazione" (Lisa et al., 2015). E anche in questo caso offrono un'importante supporto la visione e la ricerca sviluppati dalla *Green Economy* quale ambito fortemente interdisciplinare, ma avente come asse portante la cultura tecnologica del progetto. Il *White Paper* della Commissione Europea *'Towards a European framework for action'* (European Commission, 2009), rafforzato dal successivo *report* della Un-Habitat *'Saving Cities: Adaptation as part of Development'* (Un-Habitat, 2011), afferma che le opzioni possibili di azione 'green' per interventi volti ad innalzare le capacità di resilienza, mitigazione e adattamento dell'ambiente costruito possono essere classificate in tre principali categorie:

– *azioni strategiche strutturali 'grigie'*, ovvero categorie di interventi 'fisici' (per questo 'strutturali') nell'ambiente costruito che siano basate su servizi di progettazione tecnologica per

Group, 2016) and climatic change global trends<sup>6</sup>, helping it anticipate and avoid (or at least mitigate) the potentially devastating effects of a single use of those particular physical resources, energy sources and economic policies rather than others (European Commission, 2013). – The *error-friendly approach* (whose benchmark principles are: robustness, flexibility and adaptivity), an approach that implies a 'benevolent disposition towards mistakes', and therefore not merely a 'tolerance of mistakes' but rather 'flexible and friendly cooperation' with them, resulting in – one error after another – the gradual 'adaptive robustness' of the system. We have seen how even in the theory of the evolution of the species, evolutionary processes never involve the elimination of mistakes or failures that, quite the

contrary, are an essential element of them. It is an element that must become instrumental in a green and resilient vision of the performance of the technological systems of our buildings and our built environment<sup>7</sup> (Hausladen et al., 2011). In the evolutionary processes of the natural environment, the key requirement is an 'inclination towards mutational flexibility in overcoming failures', 'key' because this inclination becomes part of the genetic heritage of an entire species and not merely of one individual, becoming what we could call 'a species's consciousness' or, if we transpose this to the built environment, the 'genetic and mutational code' of a resilient built environment (Lakhtakia and Martin-Palma, 2013). Thus it is an important line to follow when experimenting with buildings and cit-

ies, which drives scientific research to understand resilience as, deep down, a system's ability to adjust to mistakes, to adapt to malfunctions and overcome the failures caused by exogenous or chronically endogenous new or unforeseen events: in short, resilience as the continuous ability to rectify errors (Armstrong, 2012).

– The *dynamic-responsive approach* (whose benchmark principles are: integration, connectivity and reactivity), an approach where the technological culture of design must be able to make environmental and architectural systems capable of responding to the constant interaction with the changes underway in a fashion that is synergic, dynamic and appropriately responsive. In modern-day science, it is also called the 'ability to respond' in

conditions of a 'perennial dynamic imbalance' (Haken, 2003), which is a fundamental requirement for the very existence of all living things (Krusche, 2001; Sieverts et al., 2005). It is a 'green' way of managing the economy of one's interactions – the most natural kind and the one that wastes the least amount of resources – that is based on the particular ability of a system's 'technological' features to 'dynamically reorganise themselves'<sup>8</sup> (Hausladen and Tucci, 2017). One fascinating challenge that will provide technological design with plenty of work is the need to allow the component elements of a resilient system to 'de-intensify' or 'decouple' such a system from the material requirements of its working performance or the 'diversification' of resources that can help carry out a particular

realizzare operazioni di *deep renovation* di edifici e infrastrutture (scelti tra il patrimonio esistente in quanto essenziali per il benessere socioeconomico della società) che li rendano capaci di resistere auto-poieticamente a eventi estremi [azioni per le quali occorre sinergia dei tre approcci, con particolare accento su quello *Self-reliant*];

- *azioni strategiche infrastrutturali 'verdi'*, cioè categorie di interventi 'biofisici' nell'ambiente costruito che aiutino ad incrementare la resilienza degli ecosistemi e che, pur puntando ad arrestare la perdita di biodiversità e il degrado degli ecosistemi e a ripristinare i cicli dell'acqua, utilizzino allo stesso tempo le funzioni, i servizi e le risorse offerti dagli ecosistemi per realizzare soluzioni di resilienza e di adattamento più efficaci sotto il profilo economico, e a volte anche più praticabili, rispetto alle sole infrastrutture grigie, improntate su un'ottica di progressivo irrobustimento *nature-based* [azioni per le quali parimenti occorre sinergia dei tre approcci, in questo caso con particolare accento su quello *Error-friendliness*];
- *azioni strategiche non strutturali 'soft'*, ovvero la definizione e l'applicazione di politiche e procedure sull'ambiente costruito, di divulgazione delle informazioni e di incentivi di *Green Economy* volti a ridurre o a prevenire la vulnerabilità non solo degli elementi urbani oggetto di un intervento d'impronta 'grigia' o 'verde' ma dell'intero sistema sia ai mutamenti ambientali (cambiamenti climatici) che ai problemi cronici (scarsità delle risorse), nei loro impatti sotto forma di malfunzionamento dei sistemi, di eventi imprevisi, financo di catastrofi [azioni per le quali anche in questo caso occorre sinergia dei tre approcci, con particolare accento su quello *Dynamic-responsive*].

role, even more so if these are limited. The model technologists must follow lies in the 'performance' characteristics of nature's resilient systems that allow them to: 1) rearrange themselves in real time whenever there is an upheaval; 2) ensure that problems in one area do not have repercussions on other areas; 3) increase or reduce the scale of their operations at the right time or, in any case, whenever necessary (Zolli and Healy, 2017).

It is important to stress that these three approaches should not be seen as alternatives, but combined and integrated whenever plans are being prepared for strategic work that prioritises resilience, focusing on one or the other depending on the nature of the work to be carried out.

#### **Strategic green growth indicators and approaches for a more resilient built environment and architecture in the future**

This brings us to a third key question: how can we move on from the codification of a framework of green economy theoretical prerequisites and methodological approaches to the formulation of possible strategic orientation for increasing the resilience of the built environment?

It has been claimed that the question of resilience does not seem to be something that can actually be designed and its indeterminate outlines make it difficult to (initially) orient and (later) measure, and that is why we need other fields when orienting indicators supporting measurement (Lisa et al., 2015). Here, too, enormous support comes from the vision and research developed by the green economy as

Sulla questione della 'misurabilità' e 'valutabilità' di tali categorie di azioni è altrettanto centrale (e ormai imprescindibile) il ruolo che la recente evoluzione degli indicatori nel campo delle economie *green* e *circular* applicate all'edilizia e alla città svolge sulle nuove dinamiche progettuali di 'co-evoluzione' e 'circolarità' tra ambiente costruito e utenza. In questo senso assume un passaggio strategico la presa in considerazione dei recentissimi *Green Growth Indicators 2017* dell'OCSE, dove i quattro pacchetti di nuovi indicatori proposti (I. *Environmental and Climatic productivity*, II. *Natural Resource Asset Base*, III. *Environmental Quality of Life*, IV. *Economic opportunities and Policy Responses*), rimandano non a caso all'obiettivo ultimo dell'aumento di *resilienza dell'ambiente costruito* per un possibile futuro in regime di cambiamenti climatici e di progressiva limitatezza delle risorse ambientali, richiamando nel I pacchetto la categoria di azioni 'strutturali grigie', nel II pacchetto quelle 'infrastrutturali verdi' e nel III e IV quelle 'non strutturali soft' [si veda la Fig. 2 con la classificazione del completo set di indicatori] (OECD, 2017).

Nella consapevolezza della necessità di un'applicazione sinergica dei tre approcci *Self-reliant*, *Error-friendliness* e *Dynamic-responsive*, in coerenza con l'impostazione dell'*European framework for green action* e dei numerosi documenti che ne sono seguiti, e in accordo col set di indicatori *Green Growth*, gli Stati Generali della Green Economy hanno di recente prima elaborato un Manifesto per la 'Città Futura'<sup>9</sup> (Antonini, Tucci, 2017), poi stilato un corposo *report* che ne delinea gli assi portanti della sua attuazione (SGGE, Tucci, Parasacchi, eds., 2017).

Una parte consistente degli ambiti di indirizzo e delle loro strategie prioritarie contenuta in quest'ultimo documento è dedicata allo sviluppo di una maggiore resilienza delle Città italiane verso

a highly inter-disciplinary field that, however, is based on the technological culture of design.

The European Commission's White Paper entitled 'Adapting to Climate Change: Towards a European Framework for Action' (European Commission, 2009), supported by UN-Habitat's subsequent 'Saving Cities: Adaptation as Part of Development' report (UN-Habitat, 2011), asserts that the possible green options for improvement work designed to improve the resilience, mitigation and adaptation of the built environment can be grouped into three main categories:

- 'grey' *strategic structural measures*, i.e. categories of 'physical' (and therefore 'structural') improvements of the built environment that are based on technological design services in order to complete the 'deep renovation' of buildings and



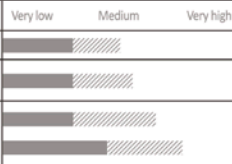



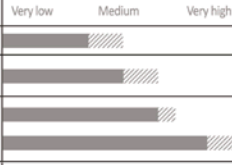



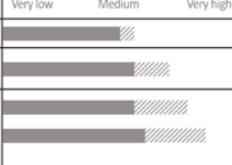

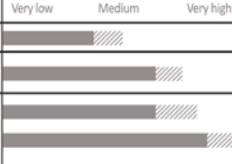

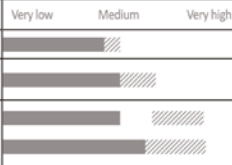



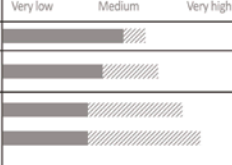




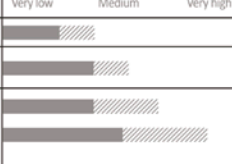
infrastructure (selected from the existing built heritage on the basis of their importance for society's socio-economic well-being), helping them autopoietically resist extreme events [measures that require a synergy between the three approaches, with a particular focus on the *self-reliant approach*];

- 'green' *strategic infrastructural measures*, i.e. categories of 'biophysical' improvements to the built environment that help increase the resilience of ecosystems and that, though aiming to halt the loss of biodiversity and the decay of ecosystems and to restore the water cycle, use the functions, services and resources that ecosystems have to create better adaptation and resilience solutions from an economic point of view, solutions that are sometimes more practical as well compared to










01 | Quadro dei rischi-chiave per l'ambiente costruito derivanti dagli impatti da cambiamenti climatici in regime di scarsità di risorse, e potenziali di riduzione di tali rischi attraverso l'incremento delle capacità di resilienza favorita dallo sviluppo di Green Economy. Fonte: Rielaborazione dell'autore in relazione alle attività di coordinamento e ricerca da lui svolte nel Consiglio Nazionale della Green Economy e in riferimento ai contenuti degli ultimi report dell'IPCC (in particolare: Working Group II Contribution to the IPCC's Fifth Assessment Report WGII AR5)

Overview of the key risks posed to the built environment by the impact of climate change in a situation of scarce resources, as well as the potential for reducing these risks by increasing the capacity for resilience favoured by the development of the Green Economy. Source: Elaborated by the author according to both the coordination and research activities he developed with the National Council of the Green Economy and the contents of the last IPCC reports (in particular: Working Group II contribution to the IPCC's Fifth Assessment Report WGII AR5)

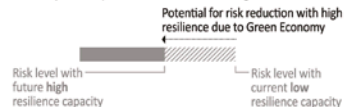
**KEY RISKS FOR THE URBAN ENVIRONMENT, DETERMINED BY THE IMPACTS OF CLIMATE CHANGE AND RESOURCE SCARCITY, AND POTENTIALS FOR REDUCTION OF SUCH RISKS BY MEANS OF INCREASED RESILIENCE CAPACITY FOSTERED BY THE DEVELOPMENT OF GREEN ECONOMY**

KEY RISKS FOR THE BUILT ENVIRONMENT	RESILIENCE-RELATED ISSUES AND PERSPECTIVES	DRIVERS OF CLIMATE-RELATED IMPACTS	TIMEFRAME	RISK LEVEL OF IMPACTS AND POTENTIAL FOR THEIR REDUCTION BY MEANS OF INCREASED RESILIENCE CAPACITY DUE TO GREEN ECONOMY
I. Risks associated with flooding in coasts and river basins, driven by increasing urbanization, increasing sea levels, coastal erosion, and peak river discharges	Increased resilience capacity fostered by Green Economy can prevent most of the projected damages and provide: 1) Experience in hard flood-protection technologies and increasing experience with restoring wetlands 2) High costs for increasing flood protection 3) Potential barriers to implementation: demand for land and environmental and landscape concerns	 	Present Near term (2030-2040) Long term (2080-2100) + 2°C + 4°C	Very low Medium Very high 
II. Risks associated with water management and water supply systems	Options of resilience growth fostered by Green Economy include: 1) Changes to network infrastructure and demand-side management, to ensure sufficient water supply and quality 2) Increased capacity to manage reduced freshwater availability 3) Flood risk reduction	  	Present Near term (2030-2040) Long term (2080-2100) + 2°C + 4°C	Very low Medium Very high 
III. Risks associated with the drying trend. Significant reduction in water availability from river abstraction and from groundwater resources, combined with increased water demand (for irrigation, energy, industry, domestic use) and with reduced water drainage and runoff as a result of increased evaporative demand	Increased resilience capacity fostered by Green Economy relates to: 1) Proven adaptation potential from adoption of more water-efficient technologies and of water-saving strategies (for example for irrigation, crop species, land cover, industrial and domestic use) 2) Implementation of best practices and governance instruments in river basin management plans and integrated water management in urban systems	  	Present Near term (2030-2040) Long term (2080-2100) + 2°C + 4°C	Very low Medium Very high 
IV. Risks associated with increasing heat islands. Declining work productivity, increasing morbidity (dehydration, heat strokes, heat exhaustion) and mortality from constant exposure to rising temperatures. Particularly at risk are construction workers, children, homeless people and the elderly.	Projected damages of delay in increased resilience capacity fostered by Green Economy: 1) Resilience options will be limited for vulnerable groups (elders and children) if not matched with appropriate policies 2) Resilience options will be limited in the construction sector where working conditions under poor safety measures may occur 3) Limited resilience capacity may deteriorate beyond repair in a + 4 °C world scenario.		Present Near term (2030-2040) Long term (2080-2100) + 2°C + 4°C	Very low Medium Very high 
V. Risks associated with increasing heat waves. Increased economic losses and people affected by extreme heat waves: impacts on health and wellbeing, labour productivity and air quality, and increasing risk of wildfires	Increased resilience capacity fostered by Green Economy will result in: 1) Implementation of warning systems 2) Adaptation of dwellings, workplaces and of transport and energy infrastructure 3) Reductions in emissions to improve air quality 4) Improved wildfire management 5) Development of insurance products against weather-related yield variations		Present Near term (2030-2040) Long term (2080-2100) + 2°C + 4°C	Very low Medium Very high 
VI. Risks associated with energy supply systems, worsened by resource scarcity	The projected full increase in resilience capacity fostered by Green Economy should keep under consideration that: 1) Most urban centers make intense use of energy, with energy-related climate policies focused only on mitigation measures 2) A few cities have adaptation initiatives underway for critical energy systems 3) There is a potential for non-adapted, centralized energy systems to magnify impacts, leading to national and transboundary consequences from localized extreme events	  	Present Near term (2030-2040) Long term (2080-2100) + 2°C + 4°C	Very low Medium Very high 
VII. Risks associated with housing, with exponential aggravation determined by resource scarcity	The projected full increase in resilience capacity fostered by Green Economy should keep under consideration that: 1) Poor quality, inappropriately located housing is often most vulnerable to extreme events 2) Adaptation options include the upgrading of building regulations 3) Some city studies show the potential for adaptation of the built patrimony and simultaneously for the promotion of mitigation measures, adaptation and development goals. Rapidly growing cities or those rebuilding after a disaster, especially have opportunities to increase resilience 4) Without adaptation measures, risks of economic losses from extreme events are substantial in cities with high-value infrastructure and housing assets, with broader economic effects possible	   	Present Near term (2030-2040) Long term (2080-2100) + 2°C + 4°C	Very low Medium Very high 

LEGEND\_Climate-related drivers of impacts on the built environment

-  Extreme precipitation
-  Drying trend
-  Damaging cyclones
-  Warming trend (heat islands)
-  Extreme temperatures (heat waves)
-  Flooding
-  Water acidification
-  Increase of CO<sup>2</sup> emissions
-  Water level rise (sea and river)

Level of risk of impacts and potential for reduction resulting from increased resilience





le macro-questioni dei cambiamenti climatici e della progressiva limitatezza delle risorse, che si possono riassumere nei seguenti assi (per l'articolazione dei quali si rimanda alla Fig. 3):

*Assi strategici di resilienza sul piano degli indirizzi 'strutturali grigi':*

1. Innalzamento delle capacità di adattamento dei sistemi architettonici, urbani e territoriali;
2. Sviluppo delle capacità di mitigazione delle cause dei cambiamenti climatici nell'ambiente costruito;
3. Aumento dell'efficienza energetica, dell'efficacia bioclimatica e dell'impiego di fonti rinnovabili in architettura.

*Assi strategici di resilienza sul piano degli indirizzi 'infra-strutturali verdi':*

4. Valorizzazione del capitale naturale e dei servizi ecosistemici;
5. Innalzamento della qualità ecologica dei sistemi di infrastrutturazione *green and blue*;
6. Aumento della qualità ecologica del capitale tecnologico e dell'efficacia nell'uso delle risorse.

*Assi strategici di resilienza sul piano degli indirizzi 'non-strutturali soft':*

7. Promozione sistematica dei processi di valutazione della sostenibilità ambientale, della resilienza e del ciclo di vita nei processi decisionali;
8. Promozione e incentivazione dei processi di rigenerazione resiliente urbana e di riqualificazione, recupero, manutenzione del patrimonio esistente;
9. Promozione e incentivazione di progetti e interventi innovativi di qualificazione resiliente degli edifici pubblici.

Il lavoro è *in progress*, e la sua evoluzione prevede entro il prossimo anno approfondimenti applicativi in termini da una parte di elaborazione di proposte per una nuova normativa in materia,

the mere use of grey infrastructure, based on a perspective that focuses on gradual, nature-based strengthening [measures that also require a synergy between the three approaches, though here the accent is on the *error-friendly approach*];

– 'soft' non-structural strategic measures, i.e. the formulation and application of built environment-based policies and procedures promoting information on the green economy as well as incentives designed to reduce or prevent vulnerability – not only of the urban elements that are being improved in a 'grey' or 'green' way, but of the *entire* system – to environmental alterations (climate change) and chronic problems (the shortage of resources) and their impact, which manifests itself in system malfunction, unforeseen events and even catastrophes [measures

whereby, as ever, a synergy between the three approaches is required, with a particular emphasis on the *dynamic-responsive approach*].

As regards the issue of being able to measure and assess these categories of actions, the role that newly developed indicators in the field of green and circular economies, as applied to buildings and cities, plays in new 'co-evolution' and 'circular' design mechanisms involving the built environment and its users is equally key (and now essential). Here the OECD's newly established 2017 Green Growth Indicators take on a strategic role, where it is no coincidence that the four packages of new indicators it proposes (I. *Environmental and Climatic Productivity*, II. *Natural Resource Asset Base*, III. *Environmental Quality of Life*, IV. *Economic Opportunities and Policy Responses*) are all focused on the ultimate aim of in-

anche nel confronto con la legislazione internazionale esistente in materia e con casi di studio realizzati virtuosi, dall'altra di elaborazione di *policies, benchmarks* e *best practices* appropriati per i caratteri del nostro territorio, col relativo adeguamento dei *green growth indicators*.

È su tali elementi strategici, dall'impostazione dei presupposti teorici alla formulazione degli approcci e degli indirizzi, che si è fondata in questi ultimi mesi la costruzione a livello nazionale di tre fondamentali documenti che tutti ruotano intorno all'obiettivo ultimo di conferire maggiore resilienza ai nostri territori, città, architetture<sup>10</sup>: il 'Piano Nazionale di Adattamento ai Cambiamenti Climatici' PNACC (CMCC, MATTM, 2017), la 'Strategia Energetica Nazionale' SEN (MATTM, MISE, 2017) e la proposta di un 'Piano Nazionale per la Rigenerazione Urbana' PNRU (CNGE, 2017).

### **Conclusioni: prospettive di resilienza e Green Economy per il futuro dell'architettura e dell'ambiente costruito**

È possibile affermare in queste linee conclusive che l'interpretazione e l'analisi delle numerose attività in corso di sviluppo in Europa e in Italia sui temi trattati in interazione con i principi e gli approcci delle economie *green* sembrano indicare un significativo cambiamento nel campo della Ricerca e della Sperimentazione tecnologico-progettuale sul tema della resilienza.

Se provassimo a riesaminare le osservazioni da un punto di vista più ampio, che consideri i numerosi effetti che il progetto tecnologico informato dalla *Green Economy* può avere sull'organizzazione morfologica e prestazionale dell'ambiente costruito, rileveremo che l'implementazione di tali scenari di sviluppo sta già

creasing the resilience of the built environment for a possible future that will have to deal with climate change and the growing scarcity of environmental resources, harking back to the category of 'grey structural' measures in the first package, 'green infrastructural' measures in the second package and 'non-structural soft' measures in the third and fourth package (see Fig. 3 for the complete classification of indicators) (OECD, 2017).

Aware of the need for the combined application of the *self-reliant, error-friendly and dynamic-responsive approaches*, in keeping with the orientation of the 'Adapting to Climate Change: Towards a European Framework for Action white paper and the many documents that have followed, and in accordance with the set of Green Growth Indicators, the States General of the Green Economy recently drafted a manifesto

for future cities' (Antonini, Tucci, eds. 2017) and then went on to publish an in-depth report that outlines the main axes of its implementation (States General of the Green Economy, Tucci, Parasacchi, eds., 2017).

A large part of the orientation provided in this document and the priority strategies listed there is dedicated to the development of a greater level of resilience of Italian cities as regards the macro-issues of climate change and the worsening shortage of resources, which could be summed up in the following key axes (which are developed in greater detail in Fig. 3):

*Axes of resilience in terms of 'grey structural' strategic orientation:*

1. Increasing the adaptive capacity of architectural, urban and territorial systems;
2. Mitigating the causes of climate change in the built environment;

02 | La rielaborazione del quadro dei 'Green Growth Indicators' (pubblicati dalla OECD nel maggio 2017), operata nell'ottica della costruzione *in progress* di un metodo applicabile alla valutazione dell'aumento di resilienza dell'ambiente costruito. I 'Green Growth Indicators' rappresentano la recente evoluzione degli indicatori sul piano internazionale nel campo delle economie *green* e *circular* applicate all'edilizia, alle città e al territorio, e svolgono un ruolo di interfaccia con la questione della misurabilità e valutabilità delle categorie di azioni strategiche 'strutturali grey', 'infra-strutturali green' e 'non-strutturali soft' richieste dalla *European Commission* quali basi per il rafforzamento delle capacità di resilienza dell'architettura e dell'ambiente costruito. Fonte: Elaborazione dell'autore a partire dai contenuti del recente *report* della OECD sugli Indicatori della Crescita Verde [riferimento: Organisation for Economic Cooperation Development (2017), *Green Growth Indicators*]

*The reformulation of Green Growth Indicators (published by the OECD in May 2017), revised in view of the ongoing construction of a method for assessing the increased resilience of the built environment. Green Growth Indicators are the most recent evolution of international indicators in the field of green and circular economies as applied to buildings, cities and territories, and they act as an interface with the question of the measurability and assessability of the 'grey structural', 'green infrastructural' and 'soft non-structural' categories of strategic measures requested by the European Commission as a basis for strengthening the resilience of architecture and the built environment. Source: Drafting by the author based on the content of the new OECD's Green Growth Indicators report [reference: Organisation for Economic Co-operation and Development (2017), Green Growth Indicators]*

**FRAMEWORK OF THE GREEN GROWTH INDICATORS, TO BE ADOPTED AS THE INTERFACE FOR THE ASSESSABILITY OF "GREY", "GREEN" AND "SOFT" STRATEGIC ACTIONS FOR THE BUILT ENVIRONMENT**

Group/Theme	Proposed indicators	Type	Measurability	
<b>THE ENVIRONMENTAL PRODUCTIVITY AND RESOURCE CONSUMPTION</b>				
"GREY" STRUCTURAL INDICATORS	Carbon and energy productivity	<b>1. CO<sub>2</sub> productivity</b>		
		1.1 Production-based CO <sub>2</sub> productivity GDP per unit of energy-related CO <sub>2</sub> emitted	M	S
		1.2 Demand-based CO <sub>2</sub> productivity Real income per unit of energy-related CO <sub>2</sub> embodied in final demand	M	S/M
		<b>2. Energy productivity</b>		
	2.1 Energy productivity GDP per unit of TPES	M	S	
	2.2 Energy intensity by sector (manufacturing, transport, households, services)	M	S/M	
	2.3 Share of renewable energy sources in TPES and in electricity production	M	S	
	Resource consumption	<b>3. Material consumption (non-energy)</b>		
		3.1 Demand-based material consumption (comprehensive measure; original units in physical terms) Real income per unit of materials embodied in final demand, materials mix	M	M/L
		3.2 Domestic production-based material consumption Quantity of materials consumed, materials mix - Biotic materials (food, other biomass) - Abiotic materials (metallic minerals, industrial minerals)	P	S/M
3.3 Waste generation intensity and recovery ratios By sector		M	M/L	
4. Water consumption Quantity of water consumed, by sector (for agriculture: irrigation water per hectare irrigated)		M	M	
<b>THE NATURAL ASSET BASE</b>				
"GREEN" INFRASTRUCTURAL INDICATORS	Natural resources stocks	<b>5. Index of overall natural resources</b> Comprehensive measure expressed for the overall amount of natural capital	M	M
		Renewable stocks	<b>6. Water resources</b> Available renewable natural water resources (groundwater, surface water) and related abstraction rates	M
	<b>7. Vegetation resources</b> Area and volume of vegetation in the context in question; stock changes over time		M	S/M
	Non-renewable stocks	<b>8. Mineral resources</b> Available (global) stocks or reserves of selected minerals: metallic minerals, industrial minerals, fossil fuels, critical raw materials, and related extraction rates, in relation/proportion to the context under study or intervention	M	M
		Biodiversity and ecosystems	<b>9. Land resources</b> Land cover conversions and cover changes from natural state to artificial state - Land use: state and changes	M
	<b>10. Soil resources</b> Degree of topsoil losses on agricultural land with natural value and on other land of artificial nature - Agricultural land area affected by water erosion, other classes of erosion		P	S/M
	<b>11. Wildlife resources (to be further refined)</b> - Trends of bird populations and breeding bird populations in urban and peri-urban areas - Species threat status, according to the context in question - Biodiversity status, according to the context in question		P	S/M
	<b>THE ENVIRONMENTAL DIMENSION OF QUALITY OF LIFE</b>			
	Environmental health and risks	<b>12. Environmentally induced health problems and related costs</b> (for example years of healthy life lost from degraded environmental conditions) - Population exposure to air pollution, and the related health risks and costs	M	L
		<b>13. Exposure to natural or industrial risks and related economic losses</b>	P	S/M
		environmental services and amenities	<b>14. Access to sewage treatment and drinking water</b>	M
14.1 Population connected to sewage treatment (at least secondary, in relation to optimal connection rate) 14.2 Population with sustainable access to safe drinking water				
<b>ECONOMIC OPPORTUNITIES AND POLICY RESPONSES</b>				
"SOFT" NON-STRUCTURAL INDICATORS	Technology and innovation	<b>15. Research and development expenditure of importance to green growth</b> - Renewable energy sources (% of energy-related R&D) - Environmental technology (% of total R&D, by type) - All-purpose business R&D (% of total R&D)	M	S/M
		<b>16. Patents of importance to green growth</b> (% of a country's patent families worldwide) - Environment-related and total patents - Structure of environment-related patents	M	S
		<b>17. Environment-related innovation in all sectors</b>	M	M
	Environmental goods and services	<b>18. Production of environmental goods and services (EGS)</b> - Gross value added in the EGS sector (% of GGS) - Employment in the EGS sector (% of total employment) - To be complemented with: Environmentally related expenditure (level and structure)	P	M
		International financial flows	<b>19. International financial flows of importance to green growth</b> % of total flows and % of GNI	M
	19.1 Official development assistance			S
	19.2 Carbon market financing			S
	19.3 Foreign direct investment			M/L
	Prices and transfers	<b>20. Environmentally related taxation and subsidies</b> - Level of environmentally related tax revenue (% of GDP; % of total tax revenues; in relation to labour-related taxes) - Structure of environmentally related taxes (by type of tax base) - Level of environmentally related subsidies	M	S
		<b>21. Energy pricing</b> (share of taxes in end-use prices)	M	S
<b>22. Water pricing and cost recovery (tbd)</b>		M	S/M	
Regulations and managing approaches	<b>23. Indicators to be developed</b>	--	--	
Training and skill development	<b>24. Indicators to be developed</b>	--	--	

**LEGEND:**  
**Type:**  
**M** = main indicators (numbered and in bold) and their components or supplements (numbered)  
**P** = proxy indicators (bulleted) when the main indicators are not available  
**Measurability:**  
**S** = short term basic data currently available for a majority of OECD countries  
**M** = medium term basic data partially available, but calling for further efforts to improve their quality (consistency, comparability, timeliness) and their geographical coverage (number of countries covered)  
**L** = long term basic data not available for a majority of OECD countries, calling for a sustained data collection and conceptual efforts



03 | Quadro degli assi strategici di Resilienza articolati sul piano degli indirizzi 'strutturali grey', 'infra-strutturali green' e 'non-strutturali soft' richiesti dalla *European Commission*. Fonte: Elaborazione dell'autore in relazione alle attività di ricerca in progress del tavolo di lavoro nazionale "Policy dell'Architettura per la Green Economy nelle Città" che coordina nell'ambito degli Stati Generali della Green Economy [riferimento: SGG, Tucci, Parasacchi (2017), *Verso l'attuazione del Manifesto della Green Economy per l'architettura e l'urbanistica. Obiettivi, ambiti di indirizzo, strategie prioritarie*]

*An overview of the strategic axes of resilience, arranged according to the 'grey structural', 'green infrastructural' and 'soft non-structural' categories requested by the European Commission. Source: Drafting by the author in relation to the research activities of the National Working Group "Architectural Policy for a Green Economy in Cities", which he coordinate as part of the States General of the Green Economy [reference: SGG, Tucci, Parasacchi (2017), Towards the Implementation of the Manifesto of the Green Economy for Architecture and Urban Planning: aims, fields of orientation and priority strategies]*

**STRATEGIC AXES OF RESILIENCE, ARRANGED ACCORDING TO THE 'GREY STRUCTURAL', 'GREEN INFRASTRUCTURAL' AND 'SOFT NON-STRUCTURAL' CATEGORIES FOR THE BUILT ENVIRONMENT**

**AXES OF RESILIENCE IN TERMS OF 'GREY STRUCTURAL' STRATEGIC ORIENTATION**

Adaptation to the effects of climate change in architecture, cities and territories	<p><b>1. Increasing the adaptive capacity of architectural, urban and territorial systems</b></p> <p>1.1. To develop processes of knowledge of the morphological, technological, and environmental, and socioeconomic characteristics on the local scale</p> <p>1.2. To plan reducing the reduction of urban systems' vulnerability to extreme atmospheric events</p> <p>1.3. To promote multi-scale, shared design approaches to increase the resilience capacity of buildings, and of open and intermediate spaces</p> <p>1.4. To increase the use of bioclimatic systems and levels of safety, comfort, and environmental well-being</p>
Mitigation of the causes of climate change in the built environment	<p><b>2. Mitigating the causes of climate change in the built environment</b></p> <p>2.1. To accelerate the processes of 'Deep Energy Renovation' and of energy transition towards all smart, diffuse systems based on renewable sources aimed at reducing emissions</p> <p>2.2. To promote strategies of 'passive' mitigation in the buildings-open spaces system</p> <p>2.3. To promote methods of 'performance-based' design, simulation, and assessment on the urban and construction scale, for the reduction of environmental impacts caused by civil construction</p> <p>2.4. To reduce climate changing emissions by reorganizing urban transportation systems towards this end and with an emphasis on ecology</p>
Energy efficiency, bioclimatic efficiency and renewable sources in architecture	<p><b>3. Improving energy efficiency, bioclimatic efficiency and the use of renewable fuels in architecture</b></p> <p>3.1. To design and optimize the bioclimatic behaviour of the construction and urban organisms that are the object of intervention</p> <p>3.2. To drastically reduce energy consumption in architecture and cities, while at the same time increasing energy efficiency and promoting models of Near Zero/Net Zero/Positive Energy Districts</p> <p>3.3. To maximize the use of energy from renewable sources by means of integrated and innovative components capable of generating and accumulating energy onsite and distributing it dynamically in the grid ('smart grids')</p> <p>3.4. To employ ecological techniques, technologies, components, and materials with low 'grey' energy'</p>

**AXES OF RESILIENCE IN TERMS OF 'GREEN INFRASTRUCTURAL' STRATEGIC ORIENTATION**

Natural capital and ecosystem services	<p><b>4. Promoting and enhancing natural capital and ecosystem services</b></p> <p>4.1. To increase ecosystem service in urban and peri-urban systems</p> <p>4.2. To strengthen ecological urban networks by promoting the ecological value of natural capital and increasing plant capital and biodiversity in cities</p> <p>4.3. To promote the design and development of new green infrastructures</p> <p>4.4. To promote nature-based solutions to increase the environmental quality of the interventions</p>
Ecological quality of green and blue infrastructure	<p><b>5. Improving the ecological quality of green and blue infrastructure</b></p> <p>5.1. To regulate and to free public urban spaces from private vehicular traffic and restore them to shared use</p> <p>5.2. To increase the networks of paths and pedestrian spaces, bike lines, and dedicated spaces for the growing use of bicycles. To promote intermodality</p> <p>5.3. To strengthen the lines of collective urban transport and the metropolitan rail transport networks</p> <p>5.4. To adopt the Urban Sustainable Mobility Plans (PUMS) while promoting the innovation of vehicles and of shared mobility services</p>
Ecological quality of technological capital and use of resources	<p><b>6. Increasing the ecological quality of technological capital and the efficient use of resources</b></p> <p>6.1. To make more intense use of the land resource, and to drastically reduce urban expansion</p> <p>6.2. To develop local production chains based on diminishing energy intensity and reducing carbon emissions, while at the same time improving the effectiveness and sustainability of the processes</p> <p>6.3. To incentivize reducing the consumption of resources and the quantity of waste, and to activate forms of circular economy fed by the residues derived from the production and demolition processes</p> <p>6.4. To promote processes and products with the use of 'smart' materials, technologies, and solutions that are more efficient, adaptive, and strictly appropriate for the various needs they must satisfy</p>

**AXES OF RESILIENCE IN TERMS OF 'SOFT NON-STRUCTURAL' STRATEGIC ORIENTATION**

Sustainability, resilience and LC assessments in decision-making processes	<p><b>7. Systematically promoting ways of assessing environmental sustainability, resilience and lifecycles in decision-making processes</b></p> <p>7.1. To develop, on the methodological/applicative level, instruments to be adopted locally, with the implementation of estimation, assessment, and environmental certification tools at the various scales of the product / construction system / building / neighbourhood / city / territory</p> <p>7.2. To develop, on the level of analysis/knowledge, appropriate benchmarks, targets, and databases centred upon the assessment needs specific to the territory</p> <p>7.3. To incentivize, on the level of process and project, the adoption and application on the local level of programmes of circular production/use/production organization</p> <p>7.4. To develop, on the political and regulatory level, local regulatory instruments aimed at incentivizing environmental assessment and approach to the life cycle, and at introducing levers and incentives for their application based on competitiveness and cooperation</p>
Regeneration, redevelopment, restoration and maintenance processes involving the existing heritage	<p><b>8. Promoting and incentivising resilient urban regeneration and redevelopment processes, restoration and the maintenance of our existing heritage</b></p> <p>8.1. To promote new real estate taxation in the strategies of urban Regeneration to guarantee an organic, structural strategy of resilient regeneration of entire parts of cities in the main areas of intervention</p> <p>8.2. To promote connecting the strategic area of urban Regeneration with the complementary one of zero land consumption</p> <p>8.3. To bring the requalification of public assets to the centre of local urban policies and to incentivize the requalification of private assets through forms of Public/Private Partnership</p> <p>8.4. To incentivize virtuous processes of maintenance and management after the fact, as well as the use of innovative technologies to offer evolved products and services in interventions on existing assets</p>
Innovative and resilient qualification projects involving public buildings	<p><b>9. Promoting and incentivising innovative projects and measures that increase the resilience of public buildings</b></p> <p>9.1. To promote 'Green public contracts' in the processes of qualification of public buildings</p> <p>9.2. To adopt and apply advanced ecological criteria and the Minimum Environmental Criteria in every type of intervention in public buildings</p> <p>9.3. To promote the passage from Smart Public Building to Smart City and vice versa, with virtuous feedback processes</p> <p>9.4. To incentivize and facilitate the application to public buildings of the regulatory changes introduced by the corrective Decree to the Public Contracts Code</p>

segnando un cambiamento radicale dei processi in atto nel modo stesso di concepire, appropiare e indirizzare progettualmente gli interventi di trasformazione nelle città e nell'architettura.

Tutto ciò rappresenta un'opportunità per un profondo rinnovamento della normativa in materia su scala nazionale e dei regolamenti edilizi su quella urbana e locale, e offre una straordinaria occasione per la riorganizzazione dei processi stessi di progettazione, basati su proposte di azione strategica reali e diversificate, capaci non solo di rendere operativi approcci *self-reliant* di tipo autopietico e di assorbire in modo *error-friendliness* fallimenti e malfunzionamenti quali passaggi fisiologici della propria crescita, ma anche di dimostrarsi *dynamic-responsive* ai mutamenti da *shock* improvvisi e da *stress* cronici di tipo microclimatico, meteorologico, bioclimatico e idrogeologico, per l'attuazione 'pro-attiva' di interventi strutturali 'grey', infra-strutturali 'green' e non-strutturali 'soft', volti alla evoluzione di un ambiente costruito che voglia definirsi 'responsabilmente controllato' all'interno di una più ampia accezione di 'resilienza' capace di confrontarsi con le complesse dimensioni del progetto e della cultura tecnologica di cui esso necessita oggi più che mai.

#### NOTE

1. I 'padri' delle riflessioni fondative negli anni '80 e '90 del concetto di resilienza su cui si sta impostando oggi l'evoluzione del pensiero rivolto al futuro dell'architettura e dell'ambiente costruito sono, tra gli altri, Holling, Laszlo, Herzog, May, Ewing, Csányi, Hahn, Krusche, Jourda, Sieverts, Haken, agli scritti dei quali si rimanda per gli opportuni approfondimenti.

2. La manifestazione internazionale "Ecoworld-Ecomondo" tenutasi a Rimini nel novembre 2017 ha avuto come tema portante quello della "Green Economy: una sfida per la nuova legislatura", promossa dal Consiglio Nazionale

3. Improving energy efficiency, bioclimatic efficiency and the use of renewable fuels in architecture.

*Axes of resilience in terms of 'green infra-structural' strategic orientation:*

4. Promoting and enhancing natural capital and ecosystem services;

5. Improving the ecological quality of green and blue infrastructure;

6. Increasing the ecological quality of technological capital and the efficient use of resources.

*Axes of resilience in terms of 'soft non-structural' strategic orientation:*

7. Systematically promoting ways of assessing environmental sustainability, resilience and lifecycles in decision-making processes;

8. Promoting and incentivising resilient urban regeneration and redevelopment processes, restoration and the maintenance of our existing heritage;

9. Promoting and incentivising innovative projects and measures that increase the resilience of public buildings.

This is 'work in progress' and its development envisages applicable in-depth analyses within the next 12 months involving, firstly, the drafting of proposals for new rules and regulations regarding the issue that will also take into account existing international laws on the subject and positive case studies and, secondly, the drafting of policies, benchmarks and best practices suited to the characteristics of our territory, with the corresponding adjustment of green growth indicators.

It is on such strategic elements – from the preparation of the theoretical prerequisites to the formulation of approaches and orientation – that the construction of three essential documents of national importance has been found-

della Green Economy in collaborazione con il Ministero dell'Ambiente, il Ministero dei Beni Culturali, il Ministero dello Sviluppo Economico e la *European Commission*. Gli atti sono consultabili presso [www.statigenerali.org](http://www.statigenerali.org)

3. L'*European Green Capital Award (EGCA)* è un'iniziativa nata nel 2010 dalla Commissione Europea finalizzata a promuovere e diffondere buone pratiche tra le città europee impegnate a migliorare l'ambiente urbano sulle questioni della sostenibilità e della resilienza.

4. Particolarmente significativo della percezione odierna che le masse di cittadini nel mondo hanno del problema, è l'impatto che l'articolo di David Wallace-Wells, pubblicato il 9 luglio 2017 sulle pagine del *New York Magazine* descrivente un futuro scenario apocalittico dagli effetti dei cambiamenti climatici, ha esercitato su decine di milioni di lettori in tutto il mondo (Wallace-Wells, 2017).

5. La 'resilienza' *self-reliant* - afferma Thomas Herzog - «è una garanzia contro la crisi ambientale e una prevenzione contro il suo diretto passo successivo, il collasso».

6. Il report *An EU strategy on adaptation to climate change* della Commissione Europea del 2013 presenta analisi molto chiare, con valutazioni economiche tutt'altro che 'green': in Europa il 64% di tutti gli eventi in cui si sono riscontrate delle perdite economiche dal 1980 ad oggi sono imputabili ad eventi meteorologici e climatici (tempeste, inondazioni e ondate di calore); e il 95% delle perdite economiche complessive durante catastrofi ambientali derivano da tali eventi. Inoltre le minacce legate al clima sono destinate ad aumentare (con grande certezza) (IPCC, 2012; IPCC, 2013; IPCC, 2014; EEA, 2008; EEA, 2017).

7. «Qualche errore o addirittura fallimento regolare è di fatto essenziale per molte forme di resilienza, in quanto permette a un sistema di liberarsi di alcune delle sue risorse in modo da poterle riorganizzare o più facilmente sostituire quando per limitata disponibilità vengano meno o non funzionino più come dovrebbero» (Hausladen, 2011).

8. In questo tipo di approccio, fondato sulla capacità immediata del sistema resiliente di 'riorganizzarsi dinamicamente' (si veda anche: Coyle, 2011), i

ed in recent months. These all focus on the ultimate aim of increasing the resilience of our territories, cities and buildings<sup>10</sup>: the PNACC ('national plan of climate change adaptation') produced by the CMCC Euro-Mediterranean Center on Climate Change in 2017; the SEN national energy strategy produced by MATTM, the Italian Ministry of Environment, and MISE, the Italian Ministry of Economic Development, in 2017; and the proposal for a PNUR 'national plan for urban regeneration', produced by the National Council of the Green Economy in 2017.

#### **Conclusion: prospects for resilience and a green economy for the future of the built environment and architecture**

It is safe to end by saying that the interpretation and analysis of the many activities being developed in Italy and

elsewhere in Europe on the themes tackled in interaction with green economy principles and approaches seem to indicate a considerable sea-change in the field of technological and design-based research and experimentation as regards the matter of resilience.

If we were to attempt to re-examine observations from a wider point of view, one that considers the many effects that green economy-based technological design could have on the morphological organisation and performance of the built environment, we would note that the implementation of such development scenarios is already causing a radical change in the way we currently understand, approach and orient the design of improvement work in cities and architecture.

All this provides an opportunity for a thorough review of national legislation regulating this sector and building

dati aperti provenienti in tempo reale da quello che potremmo chiamare 'sistema di sensori' vengono classificati, passati al vaglio e combinati al fine di creare un significativo *feedback* continuo. Quando tali 'sensori' indicano l'approssimarsi o il superamento di una soglia critica, un sistema resiliente è in grado di garantire la continuità delle operazioni attraverso per l'appunto una 'riorganizzazione dinamica' sia del modo in cui persegue il suo scopo, sia della scala su cui funziona.

9. Il Manifesto della Green Economy per l'Architettura e l'Urbanistica 'La Città Futura', è stato elaborato dal Gruppo di Lavoro Nazionale "Green Economy per l'Architettura e l'Urbanistica" degli Stati Generali della Green Economy coordinato dall'autore, lanciato alla Casa dell'Architettura di Roma nell'aprile 2017 col sostegno, tra gli altri, della Presidenza della Repubblica, del Ministero dell'Ambiente, del Ministero dei Beni Culturali, dell'Associazione Nazionale Comuni Italiani, e di un ampio fronte di istituzioni internazionali (SGGE, 2017).

10. L'autore ha contribuito alle tre attività, rispettivamente: alle fasi di supporto e consultazione scientifica per l'elaborazione del 'Piano Nazionale di Adattamento ai Cambiamenti' e della 'Strategia Energetica Nazionale' in quanto membro del gruppo di lavoro nazionale "Clima ed Energia" degli Stati Generali della *Green Economy*; e alla proposta di 'Piano Nazionale per la Rigenerazione Urbana' in quanto coordinatore del gruppo di lavoro nazionale "Policy dell'Architettura per la Green Economy nelle Città" del Consiglio Nazionale della *Green Economy*.

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regulations on an urban and local scale, and offers an extraordinary opportunity to reorganise the processes of design, based on real, wide-ranging strategic proposals for action that can not only use *self-reliant* autopoietic processes and take onboard failures and malfunctions in an *error-friendly* way, considering them to be physiological steps in one's own growth, but can also prove themselves to be *dynamic-responsive* when faced with unexpected shocks and chronic micro-climatic, weather, bioclimatic and hydrogeological stress so as to implement structural 'grey' improvements, infrastructural 'green' improvements and non-structural 'soft' improvements designed to foster the evolution of a built environment that sees itself as 'responsibly controlled' within a wider interpretation of 'resilience', able to measure itself against the complex aspects of design and techno-

logical culture of which it is in need, more than ever before.

## NOTES

1. In the 1980s and 1990s, the 'fathers' of the reflections underlying the concept of resilience upon – a concept upon which thought regarding the future of architecture and of the built environment is evolving – included Holling, Laszlo, Herzog, May, Ewing, Csányi, Hahn, Krusche, Jourda, Sieverts, and Haken, whose writings are referred to for more in-depth analysis.
2. The international event 'Ecoworld-Ecomondo' held in Rimini in November 2017 had as its general theme '*Green Economy: una sfida per la nuova legislatura*' ('Green Economy: a challenge for the new legislature'), and was promoted by the National Council of the Green Economy in collaboration with the Ministry of the Environment,

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the Ministry of Cultural Heritage, the Ministry of Economic Development, and the *European Commission*. Its proceedings may be consulted at [www.statigenerali.org](http://www.statigenerali.org)

3. The *European Green Capital Award (EGCA)* is an initiative begun by the European Commission in 2010 aimed at promoting and spreading good practices among the European cities engaged in improving the urban environment with regard to the issues of sustainability and resilience.

4. Particularly significant of the modern perception that the masses of citizens in the world have of the problem is the impact that the article by David Wallace-Wells, published on 09 July 2017 in the pages of *New York Magazine*, describing an apocalyptic scenario of the effects of climate change, had on millions of readers around the planet. (Wallace-Wells, 2017).

5. According to Thomas Herzog, *self-reliant* 'resilience' is «a guarantee against environmental crisis, preventing its subsequent direct step: collapse».

6. The report '*An EU strategy on adaptation to climate change*' of the European Commission of 2013 presents very clear analyses, with results of economic assessments that are anything but 'green': in Europe, 64% of all the events that yielded economic losses since 1980 may be ascribed to weather and climate events (storms, flooding, and heat waves); and 95% of the total losses during catastrophes derive from these events linked to climate and weather phenomena. Climate-related threats are destined to increase (with great certainty) (IPCC, 2012; IPCC, 2013; IPCC, 2014; EEA, 2008; EEA, 2017).

7. «Some errors or even regular, modest failure is actually essential for many forms of resilience, as this enables a

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system to shed some of its resources in such a way as to be able to reorganize them, or to be able to replace them more easily when, due to limited availability, they are lacking, or do not function as they should». (Hausladen, 2011). 8. In this type of approach, founded upon the resilient system's immediate capacity to 'dynamically reorganize itself' (see also: Coyle, 2011), the open data originating in real time from what we might call the 'sensors system' are classified, sifted through, and combined to create a continuous significant feedback. When these sensors indicate nearing or exceeding a critical threshold, a resilient system is able to guarantee continuity of operations through, in fact, a 'dynamic re-organization' of the way in which it pursues its purpose, and of the scale on which it operates.

9. The Manifesto of the Green Economy for Architecture and Urban Planning,

the 'Future City' was developed by the 'Green Economy' for Architecture and Urban Planning National Working Group at the States General of the Green Economy coordinated by the author, launched at the 'Spring Meeting' of Fondazione per lo Sviluppo Sostenibile held at Rome's Casa dell'Architettura in April 2017 (SGGE, 2017).

10. The author contributed to three activities, respectively: to the phases of support and scientific consultation for the development of the 'National Plan of Adaptation to Changes' and of the 'National Energy Strategy' as member of the 'Climate and Energy' national working group at the States General of the Green Economy; and the proposal of the 'National Plan for Urban Regeneration' as coordinator of the 'Architecture policy for the Green Economy in cities' national working group of the National Council of the Green Economy.

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