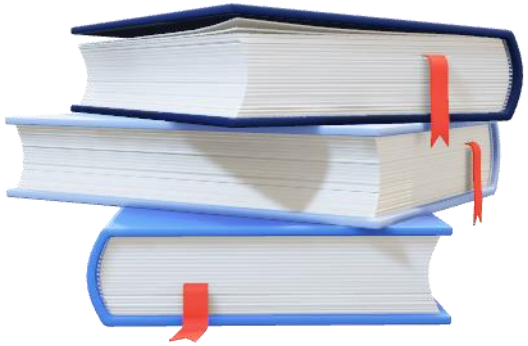
Pasquale CAPEZZUTO[1]
Graziano DE SCISCIOLO[2]
Cataldo GUARAGNELLA[3]

1 - Technical Commission UNI 058 "Sustainable cities, communities and infrastructures"
2 - Polytechnic of Bari, Electrical and Information Engineering Department
3 - Polytechnic of Bari, Electrical and Information Engineering Department

Smart sustainable buildings design principles

Content

- paper purposes
- reference context
- building key role
- holistic approach
- BaaS concept
- smart sustainable building design
- future development
- conclusions



Paper purpose

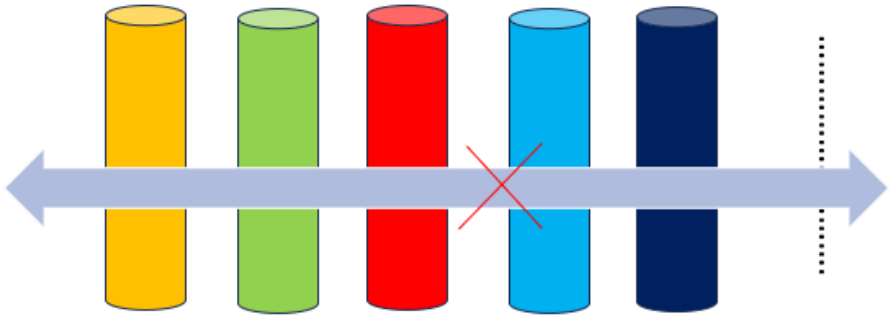
The paper analyses the reference context and recent indications for building sustainability in the literature, in standards, in the Union policies.

It proposes a new conceptual model, a new paradigm for a holistic view, which take into account the multifaceted dimensions, in terms of integrated performances responding to the context goals, for building contribute to city sustainable development.

Economic, environmental, technological, and social challenges in buildings :

- climate change
- energy consumptions
- decarbonization
- nature disconnection and biodiversity loss
- standard use and needs satisfaction
- user’s discomfort

Silos approach considers single performances



Buildings design silos approach

Reference context

Buildings

Heating, cooling, domestic hot water, lighting, and powering appliances are responsible at the EU level of 40% of final energy consumption and 36% of energy related greenhouse gas (GHG) emissions.

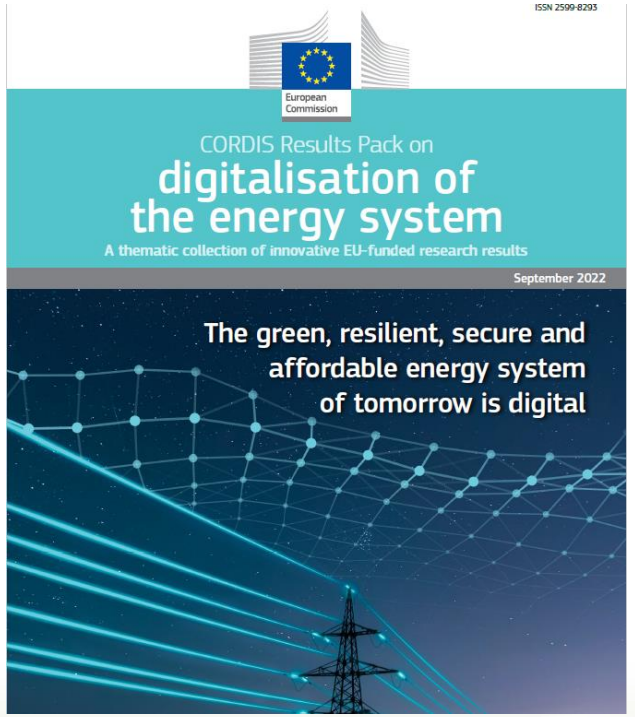
Construction and demolition waste accounts for almost 40% of all waste generated in the EU.

EU policys landscape

Smart energy system

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Digitalising the energy system - EU action plan



Buildings key role

Buildings must play an active role in an intelligent urban energy system.

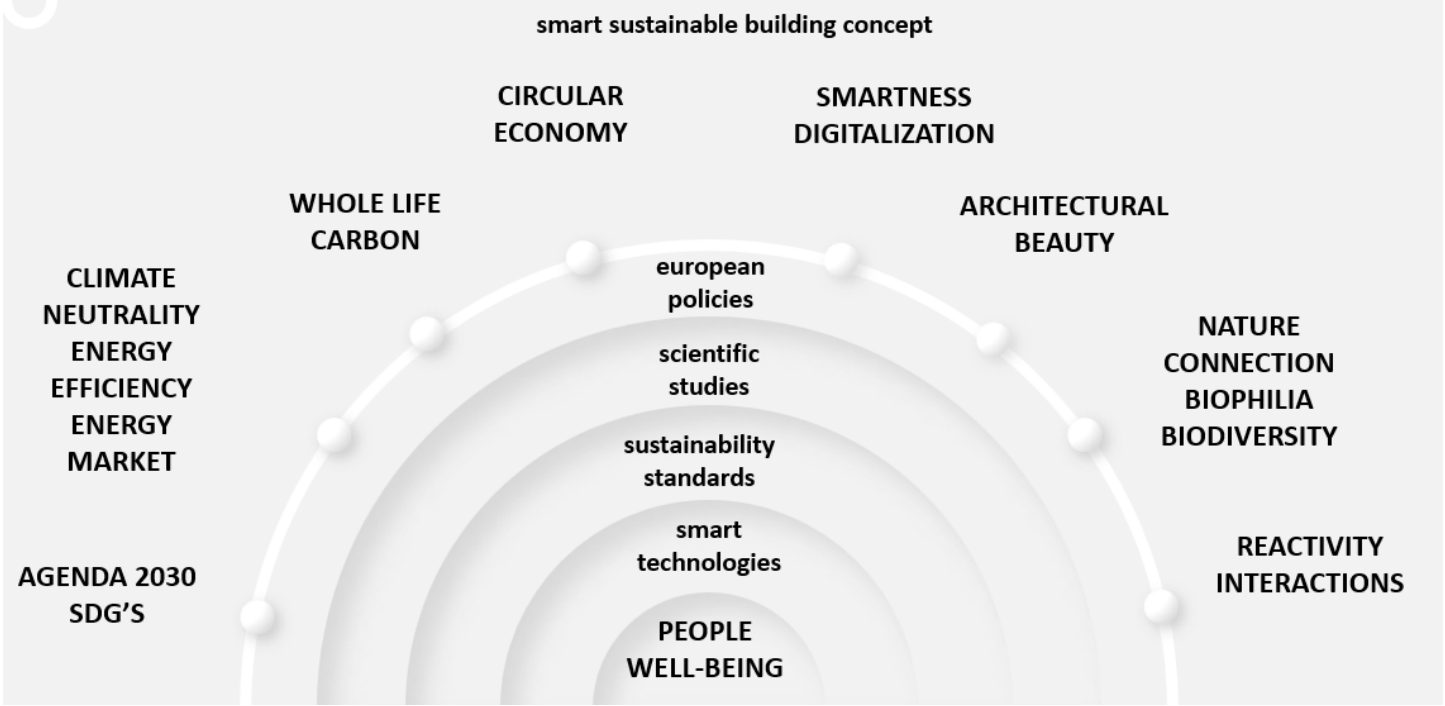
Technological innovations and digital technologies are changing the way we produce and use energy, the way we construct and use buildings.

Can enhance energy and resources efficiency, sustainability and reduce carbon footprint and create responsiveness.

Citizens in buildings are at the center of this new energy urban system.

Holistic approach

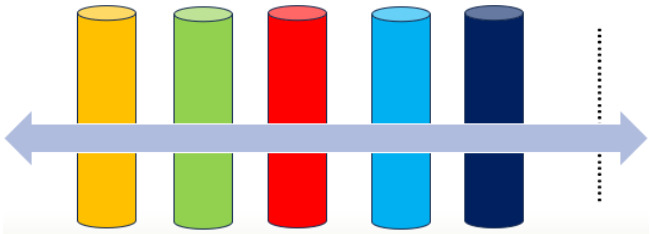
Holistic approach takes into account the key topics for buildings transformation.



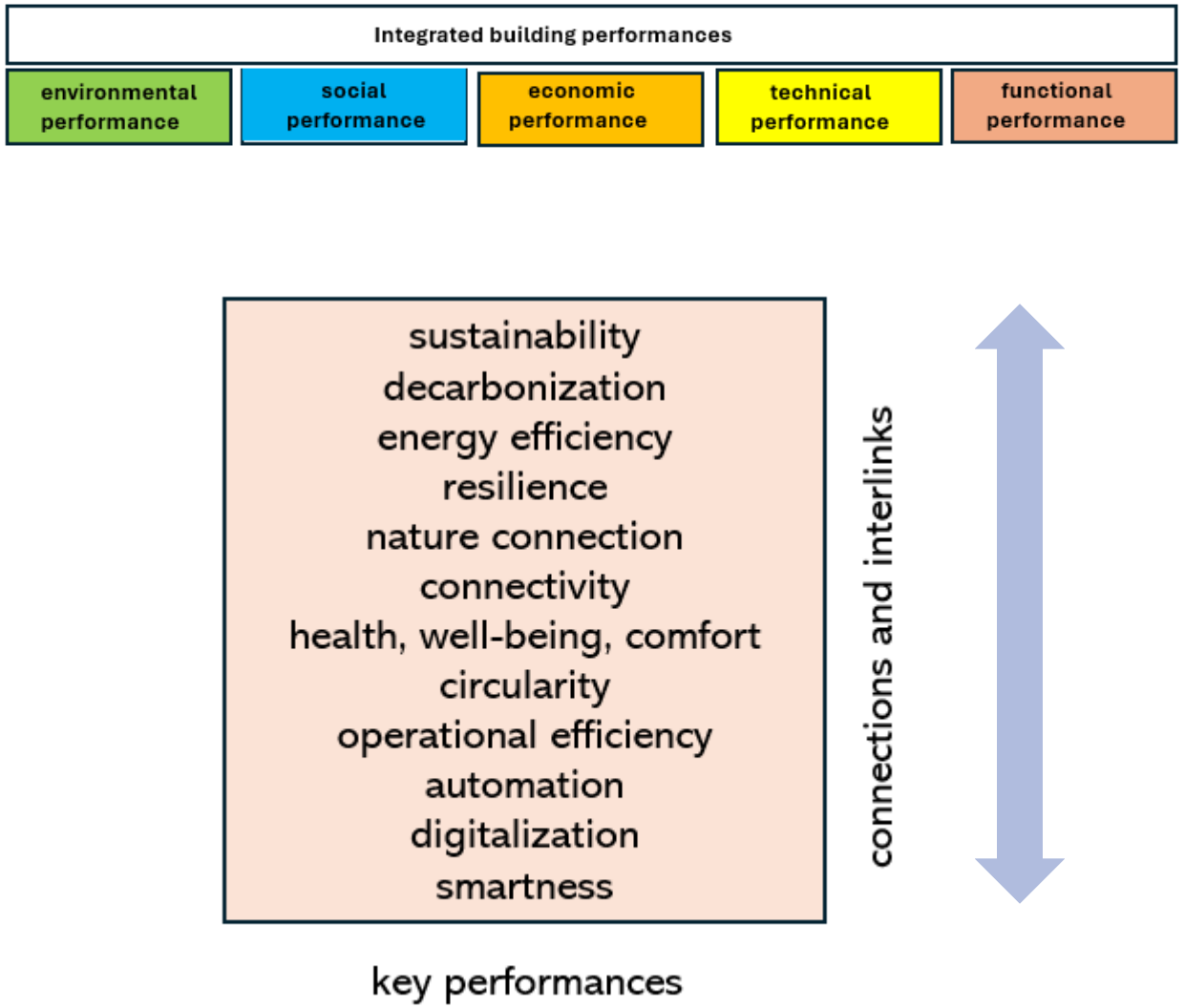
A new smart sustainable building concept is needed, according to the statements of EU policies, scientific studies and standards, to ensure people well-being and decarbonization goals.

Building integrated performances

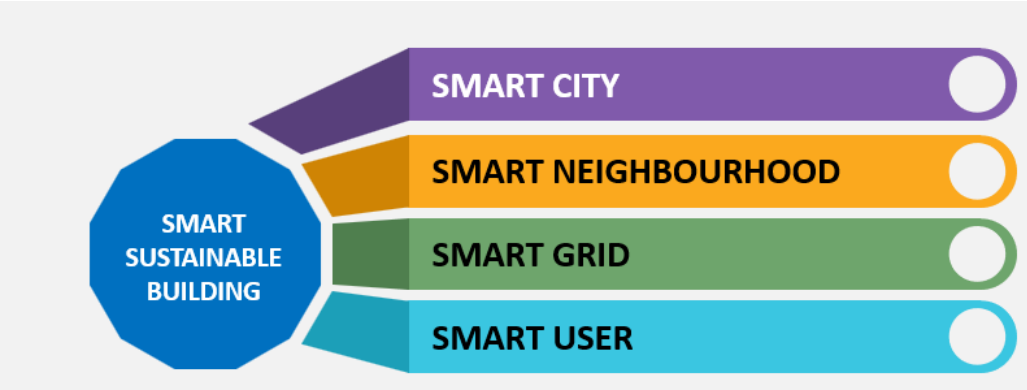
Smart sustainable buildings, as part of urban energy system, ensure key performances in an integrated way, considering linkages and interactions between the building and other buildings, the districts and the whole city.



Building design integrated approach



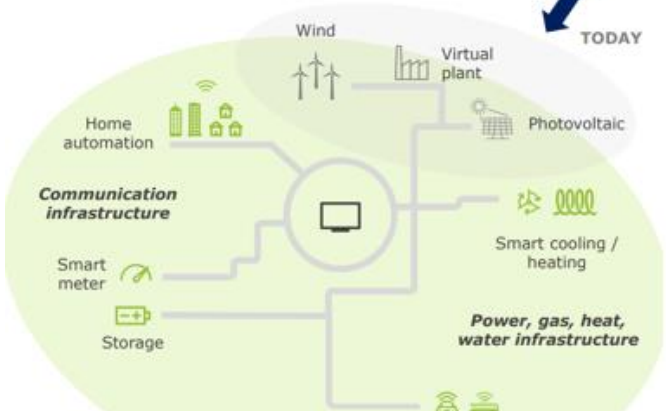
Building interactions and interrelations



ZEB BUILDING

Positive Energy Districs

New smart energy system
Energy management

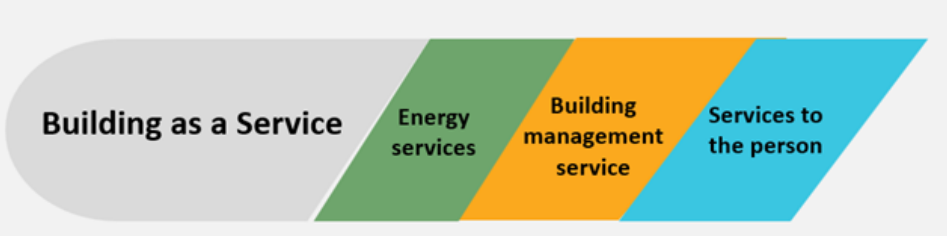


Energy and data flows
Interactions

City

Smart energy communities

Smart building “BaaS” concept

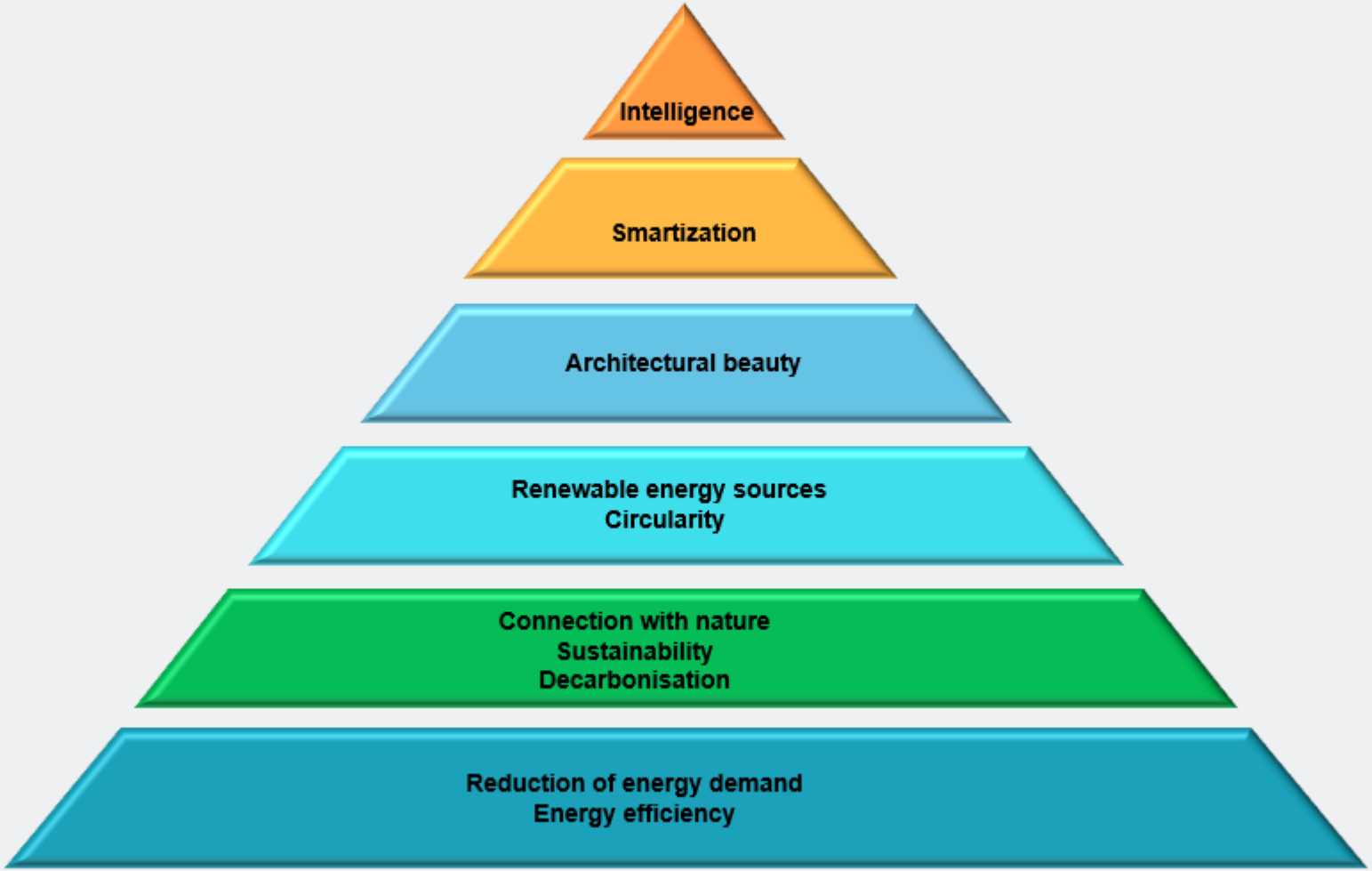


- energy services: management of energy consumptions and production, real-time monitoring, benchmarking, predictive analysis, forecasting, energy efficiency services, aggregation, flexibility

- building management services: security, space management, communication services, predictive maintenance and fault detection, personalized comfort, access control

- services to the person: safety, comfort and well-being, telemedicine, digital public services, EV charging, demand response

Smart sustainable building design process



Smart sustainable building design

Efficient envelope
Circularity
Whole life carbon
Energy demand reduction
Energy efficiency
Resilience
Architectural beauty

R.E.S.
Self-consumption

Storage

Flexibility
Demand Response
Dynamic rates
Electric market participation

Efficient equipments
Zero emissions
Electrification
Smartification
Systems integration
B.A.C.S.
B.M.S., B.E.M.S.
IoT infrastructure
Connectivity building infrastructure

Smart meters
Consumptions awarness
Real time energy monitoring
User communication

Smartness
Operational efficiency
Predictive mantenance and faults
A.I.
Machine learning
Responsiveness

User's need adaptability
Regenerate nature and biodiversity
Comfort and well-being
I.A.Q.
Usability
User interaction

Distric approach
Smart districts
P.E.D.
Energy communities
Energy and data flows

adapted by Building Performance Institute Europe

UNI TC/058 Cities, communities and sustainable infrastructure
" Building integration and interconnection - Reference methodological model"

Future development

The smart building evolves towards the "smart-cognitive building" model, by the integration of an AI machine learning platform with IoT sensors, edge computing, 5G technology, and digital twins.

Artificial Intelligence allows advanced solutions for energy management, optimization, and integration in neighbourhoods or energy communities.

Such building, as an organism capable of learning adaptively from the surrounding environment and self-organizing itself, offers performances customized to users preferences and forecasted conditions, changing the assets, rather than adhering to a standardized approach.

To sum up

Smart sustainable building is an efficient ontology for building design and management, more effective and responding to city sustainability goals and to a user-centric approach.

This paper analysed the whole context for smart sustainable buildings concept and, with a scalable approach, the elements and interactions of the smart sustainable ecosystem in the city.

A holistic approach and a new sustainable buildings concept design are proposed to satisfy environmental, social and economic targets and to face cities challenges and to contribute to sustainability pillars.

THE 1ST SMART CITIES, TOWNS, RURAL AND MOUNTAIN VILLAGES INTERNATIONAL CONGRESS

SCIENTIFC PARTNERS

COMMUNICATION PARTNER