Energy resilience in buildings for hot tropical climate conditions: A review

300

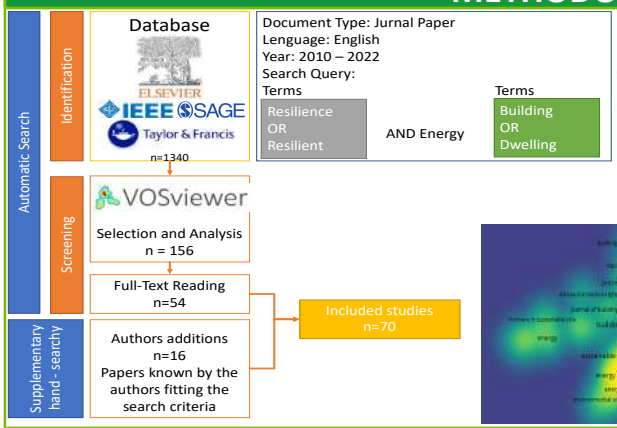
J. Florez-Reyes
G. Osma-Pinto
Department of Electrical, Electronic and Telecommunications Engineering
Universidad Industrial de Santander (UIS), Bucaramanga (Colombia)
florezjulian@correo.uis.edu.co, gealosma@uis.edu.co

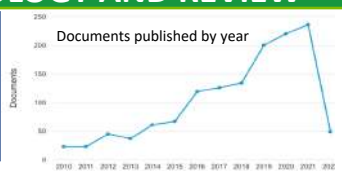
ICREPQ'22

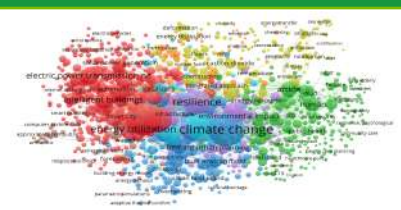
INTRODUCTION

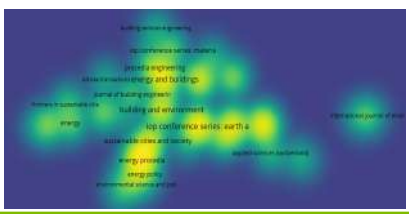
- According to the International Energy Agency, buildings account for approximately 36% of global energy consumption and 24% of greenhouse gas emissions
- Buildings should aim to control the usability conditions of the interior spaces (e.g., temperature, illuminance, and humidity). These comfort conditions are affected by external events. The BAS/BMS are oriented to ensure the comfort of users and the safety of people and facilities [7,9]. Therefore, the main variables monitored are micro-climatic conditions in the surrounding area.
- The versatility of building management and automation favours the resilience or responsiveness of a building to changes in expected or normal operating conditions
- This paper presents the methodology used for the literature review concerning the measurement and analysis of energy resilience associated with buildings

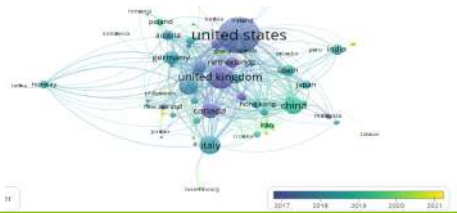
METHODOLOGY AND REVIEW











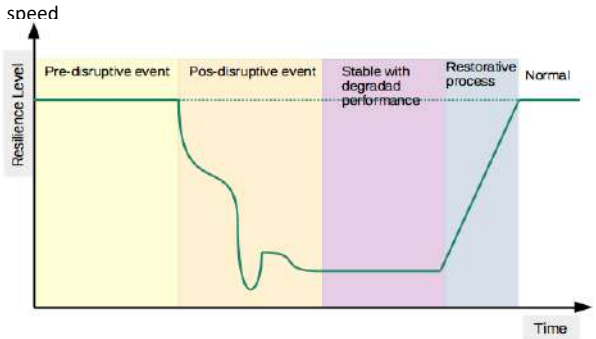
DEFINITIONS

Resilience: characterize certain behaviors of physical systems with respect to actions that may disturb the correct operation of the system. The four characteristic components of resilience are robust-ness, redundancy, resourcefulness, and speed

Energy Resilience: (stage of self-definition) allows studying the ability of a system to predict, prevent and resist all possible disas-ters, such as loss of supply, and recover quickly and effi-ciently

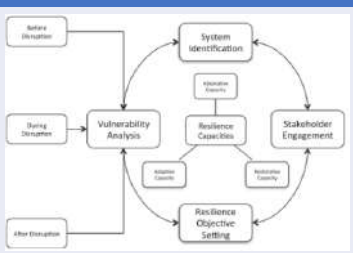
Resilience in buildings: ability to recover critical infrastructure already control systems as these have a direct impact on the health, safety and communities of the building

Resilience in control systems: is considered to be a computer and cybersecurity along with robust control, tolerant to faults and fluctua-tions, thanks to its design, parameters or system operating under a given range of disturbances



Stage		Features
I	Anticipation and preparation Preparation Pre-perturbation	Pre-event prediction and preparation through planning, which may include the location and estimation of the severity of the event.
II	Absorption Disturbance progress Resist and absorb	The system seeks to absorb the initial impact and avoid an unwanted effect. The greater the robustness and redundancy, the less the affectation will be.
III	Degraded state Respond and adapt	The system reaches a stable but degraded operation, whose duration will last until there is a response from it.
IV	Recovery Restorative state Get it back	The restorative actions tend to return the normal operating conditions of the system.
V	Adaptation Post-restoration End operation mode	Post-event and restoration of performance to a resilient or balanced state.

RESILIENCE ANALYSIS PROCESSES

Resilience analysis process	Resilience Assessment Framework	Resilience Assessment Process
		
Define resilience goals	System identification	Define a resilience metric
Define system and resiliency metrics	Vulnerability analysis	Characterizes the threat
Characterize Threats	Establishment of resilience objectives	Define and apply damage scenarios
Determine the level of disruption	Stakeholder engagement	Carry out proactive management
Define and apply system models	Resilience capacities	Find System Degradation
Calculate the consequence		Recover the system affected by events
Evaluate resilience improvements		Evaluate the level of resilience

BUILDING OPERATION IN TROPICAL

In the tropical context, the resilience of buildings is subject to a greater extent to the increase in global temperature. Then, the prompt adoption of:

- An updated or new building code that considers indoor thermal comfort requirements
- the use of more resilient envelopes as a strategy to mitigate climate change.
- the union of resilience in design and systems.

CONCLUSIONS

- Resilience is easily extrapolated from natural events to other types of events, mainly those that may have high repercussions and uncertainty of occurrence
- Resilience in buildings has been studied from a seismic-resistant and structural approach. However, since the acceptance of the definition of resilience for dynamic systems, it is evident that the analysis of energy resilience in buildings should be expanded to the definition and consensus of methods of analysis, calculation and evaluation of all the systemic actors of a building
- Using resilience as an evaluative element of the systems is possibly the next step in the analysis of their management and efficiency.