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Towards Environmental Sustainability: The Role of Climate Change Conferences and Building Retrofitting in Achieving Sustainable Development Goals

Eman K. Ahmed (Corresponding Author), Khaled M. Dewidar,
Youssef Abd El-Hakeem, Marianne Nabil Guirguis
Architectural Engineering Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt;
Architectural Engineering Department, Faculty of Engineering Thebes Academy, Cairo, Egypt,
Architectural Engineering Department, Faculty of Engineering,
The British University in Egypt, Cairo, Egypt.
Obour High Institute for Engineering & Technology, Cairo, Egypt.

ABSTRACT:
Environmental sustainability has become a central concern in global development policies, emphasizing the urgent need to balance economic growth, social equity, and environmental protection. Sustainable development and its associated goals (SDGs) offer a comprehensive framework to guide nations towards a more resilient and inclusive future. Climate change, as a pressing global challenge, has accelerated international efforts, particularly through climate conferences such as the Conference of the Parties (COP), to foster collaborative solutions and promote climate action. Among the most effective strategies for reducing carbon emissions and enhancing environmental performance is the retrofitting of existing buildings. This approach not only improves energy efficiency and resource use but also contributes significantly to achieving sustainability goals. This paper explores the background and principles of environmental sustainability and sustainable development, highlights the role and outcomes of major climate conferences, and discusses the importance of retrofitting existing buildings as a climate mitigation strategy. A case study is presented to illustrate practical applications and benefits of building retrofitting within the broader context of sustainable development and climate resilience.

keywords:
Environmental Sustainability- Sustainable Development- Sustainable Development Goals (SDGs)- Climate Change- Climate Conference -Building Retrofitting-Energy Efficiency-Existing Buildings.

1. INTRODUCTION

Environmental sustainability has emerged as a critical concept in recent decades, focusing on maintaining the health of ecosystems while meeting human needs. It emphasizes the responsible management of natural resources to ensure that environmental quality and biodiversity are preserved for future generations. This concept is foundational for addressing environmental degradation and promoting ecological balance in both urban and rural contexts. [1]. Sustainable development expands on the idea of environmental sustainability by integrating social and economic dimensions. Defined by the Brundtland Commission as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," it requires coordinated policies and actions that balance economic growth, environmental protection, and social inclusion [2]. To operationalize sustainable development, the United Nations adopted the Sustainable Development Goals (SDGs) in 2015, comprising 17 interconnected goals aimed at ending poverty, protecting the planet, and ensuring peace and prosperity by 2030. These goals serve as a universal call to action and provide a measurable framework for tracking global progress toward sustainability.[3]. In response to the accelerating threats of climate change, the international community has convened annually under the United Nations Framework Convention on Climate Change (UNFCCC) through the Conference of the Parties (COP). These climate conferences aim to build consensus and mobilize global action, particularly to reduce greenhouse gas emissions and support climate adaptation in vulnerable regions. Agreements such as the Kyoto Protocol and the Paris Agreement highlight the importance of international cooperation in combating climate change. [4]. One of the most impactful strategies for addressing climate change at the urban scale is the retrofitting of existing buildings. Buildings are responsible for a significant

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share of global energy consumption and CO_2 emissions. Retrofitting involves upgrading existing structures with energy-efficient technologies and materials to reduce environmental impact, enhance occupant comfort, and extend building lifespan . This process is especially crucial in cities where demolition and new construction may be less sustainable or economically feasible. . [5]. To illustrate these concepts in practice, this paper presents a case study of a retrofitted building project, demonstrating how environmental sustainability principles and climate adaptation measures can be integrated effectively. The case study highlights best practices and key challenges, offering insights into how building retrofitting can support broader sustainability and climate goals.

2. MATERIALS AND METHODS:

This study employed a mixed-methods approach combining literature review, framework analysis, and a case study methodology. Relevant literature on environmental sustainability, sustainable development goals (SDGs), and climate change was reviewed to build a theoretical foundation. The SDGs framework particularly Goals 7, 11, and 13, was used to assess the alignment of building retrofitting with global sustainability targets. A purposively selected case study of an existing building that underwent energy-efficient retrofitting was analyzed. Data were collected through documents, energy reports, and stakeholder interviews, and were evaluated to measure environmental impact and identify key challenges and benefits associated with the retrofitting process.

3. BACKGROUND OF ENVIRONMENTAL SUSTAINABILITY:

There is a direct correlation between environmental health and human well-being. The World Health Organization estimates that preventable environmental causes are responsible for 24% of fatalities worldwide. Humans require clean air to breathe, pure water to drink, and safe places to live that are devoid of dangers and harmful materials. As the long-term repercussions of exponential industrial growth and energy consumption become apparent, we must take action to stop the harm and reverse these effects so that future generations can live in healthy environments. [6].

3.1. Sustainable development:

- The concept of sustainability:
  The word “sustainability” has become a wide range term that can be applied to almost every facet of life on earth from local to global scale and over various time periods. [7].

  Definition of sustainable building:
  The building has the least impact on the surrounding natural environment, including the quality of environmental, social and economic performance, through the conscious use of natural resources and management of the building, contributing to saving energy and reducing its consumption, which subsequently leads to the provision of non-renewable sources of energy. [8].

3.2. Sustainable development goals:

In 2015, 195 nations agreed with the United Nation that they can change the world for the better. This will be accomplished by bringing together their respective governments, businesses, media, institutions of higher education, and local NGOs to improve the lives of the people in their country by the year 2030.
The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests, as shown Fig.1.[9]. The global Sustainable Development Goals (SDGs) commenced in 2016 and provide an evidence-based framework for sustainable development planning and programming until 2030.While the expert community is clearly emphasising the need to adopt evidence- and science-based approaches to SDG implementation, policymakers now face the challenge of implementing the SDGs simultaneously in a coherent and integrated manner.[10]. The targeted Sustainable Development Goals (SDGs) of Egypt 2030 can also be achieved, as the retrofitting of university buildings can contribute to achieving about five targeted SDGs, including (quality education, affordable and clean energy, sustainable cities and communities, climate action and life of land).

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Fig.1. Sustainable Development Goals (SDGs).[9].

4. BACKGROUND OF THE CLIMATE CONFERENCE AND THE IMPORTANCE OF CLIMATE CHANGE:

The United Nations Environment Program defines climate change as "any substantial change in climate parameters, extending over a long period of time." Throughout its history, the Earth's climate has fluctuated multiple times, originally as a result of natural phenomena like volcanic eruptions, the amount of Sunlight is the source of energy, but starting in the late 1700s, human activities related to the Industrial Revolution changed the composition of the atmosphere, which had an impact on climate. In a report released on August 8, the Intergovernmental Panel on Climate Change stated that human activity has warmed the climate at a rate that hasn't been seen in at least the last 2,000 years.[11].
It is discovered that the average global temperature is predicted to approach or surpass 1.5°C over the next 20 years. Therefore, international leaders are being cautioned that failing to take significant action toward resolving this dilemma may result in harsh judgment from future generations. [12].

A brief overview of the climate conferences:
The Climate Conference, often referring to the United Nations Climate Change Conference (COP - Conference of the Parties), is an annual global summit where world leaders, scientists, policymakers, and activists gather to discuss and negotiate actions to combat climate change. as shown Fig.2:

The Paris Climate Summit (2015): the participating countries set out the International Specific Contributions to reduce emissions

The Climate conference in Marrakesh (2016): Morocco report of the International Federation for the transformation of Buildings and construction, which set the roadmap existing buildings to sustainable buildings

The UN Climate Conference (2017): Its objectives focused on discussing and defining mechanisms for mitigating climate change. At the top of the goals are reducing carbon dioxide emissions and reducing the temperature of our planet, which is increasing in a way that threatens the melting of the polar regions. [13].

The UN climate change conference(2018): Follow the negotiations on how countries can work together to reduce global warming, learn about the latest technologies available to reduce the harmful impact of human activities on the planet, and connect with change makers every day around the world. [14].

The UN Climate Change Conference (2019): various extensions to this treaty have been negotiated during recent COPs, including the Paris Agreement adopted in 2015, during which all countries agreed to step up efforts to limit global warming to 1.5°C above pre-industrial temperatures and boost financing for climate action.[15].

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Glasgow Climate Change Conference (2021): COP 26 produced new building blocks to advance the implementation of the Paris Agreement through actions that could put the world on a more sustainable and lower carbon path.[16].

UN Climate Change News, 20 November 2022: The United Nations Climate Change Conference COP27 closed today with a breakthrough agreement to provide “loss and damage” funding for vulnerable countries hit hard by climate disasters.[17].
Set against a difficult geopolitical backdrop, COP27 resulted in countries delivering a package of decisions that reaffirmed their commitment to limit global temperature rise to 1.5 degrees Celsius above pre-industrial levels. The package also strengthened action by countries to cut greenhouse gas emissions and adapt to the inevitable impacts of climate change, as well as boosting the support of finance, technology and capacity building needed by developing countries.

UN Climate Change Conference (COP28) 30 November 2023:
COP28 to the United Nations Framework Convention on Climate Change was held in Dubai, United Arab Emirates, Negotiators from nearly 200 countries recognized for the first time the need to transition away from fossil fuels, that the era of fossil fuels must end with justice and equity, and developing countries must be supported every step of the way.[18].

UN Climate Change Conference (COP29) 24 November 2024:
The COP29 conference primarily focused on climate finance, bringing together nearly 200 countries in Baku, Azerbaijan, where a historic agreement was reached that includes.[19].

- Tripling funding for developing countries, from the previous target of 100 billion dollars annually to 300 billion dollars annually by 2035.
- Securing the cooperation of all actors to increase funding directed towards developing countries from public and private sources, reaching $1.3 trillion annually by 2035.

These goals, officially known as the "New Collective Quantified Goal on Climate Finance," were agreed upon. (NCQG)

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Fig.2. A brief history of sustainable building retrofit.

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5. RETROFITTING OF AN EXISTING BUILDING:

5.1. Sustainability Retrofitting Definition:

The environmental impact of buildings has become increasingly apparent. Many organizations recognize the value of green buildings and sustainability as part of their responsibility to more than just the bottom line. Retrofits for existing buildings can therefore produce outsized environmental impact as compared to a focus solely on green design and construction practices. Today's leading building owners have actively engaged green building retrofits as the key to future models of sustainability.[20].

There are many definitions of sustainable retrofit, and we will mention some of these definitions:

- Apply energy efficiency improvement measures and procedures to increase energy efficiency in existing buildings, which leads to reduce the overall demand for energy in that sector.[21].
- Increasing the useful life of an existing building through adaptation, while retaining its foundation to provide a copy new upgrade from the original building.[22].
- The process of developing or re-modifying the existing building internally so that it becomes compatible with the requirements of green buildings, improve the building's environmental characteristics.[23].

5.2. Head to Retrofitting existing building versus new construction:

Although the rationale behind adapting an existing building varies from project to project, existing buildings account for the majority of development. It seeks to improve the building's performance first, then lower operating costs, and last minimize the return on investment. Making the building more sustainable, enhancing its future value, and subsequently boosting user productivity, occupancy rates, the property's market worth when it's sold, or rent value This is in line with a survey that McGraw (Hill) Construction carried out to investigate the fundamentals of sustainable retrofit projects for existing structures. as shown Fig.3.[24].

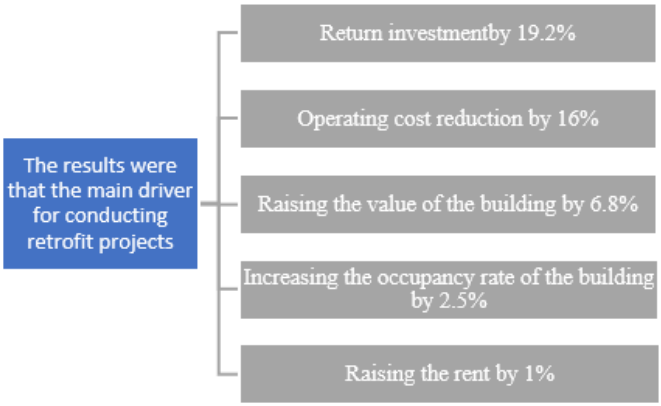

Fig.3. the main driver for conducting retrofit projects.[24].

More than 40% of energy use in the country is attributed to buildings, and it is estimated that the electricity used annually by all structures currently in use exceeds the total electricity used by all buildings built in the next 20 years. A potential remedy for all of these problems is energy efficiency, which can also directly link the dots between energy security, savings, industrial productivity, reducing climate change, health and social benefits, energy pricing, and increasing asset value. [25].

While adopting energy efficiency measures for buildings, the energy consumption in a building can be reduced further by maintaining or improving various levels of comfort in the building. Reducing heating and cooling demand, lighting, heating water, office equipment and appliances plays an important role, while taking each electrical component and its impact of energy optimization.

5.3. The benefits of retrofitting buildings instead of new construction:

we can be summarized into three main benefits: as shown Fig.4.[26].

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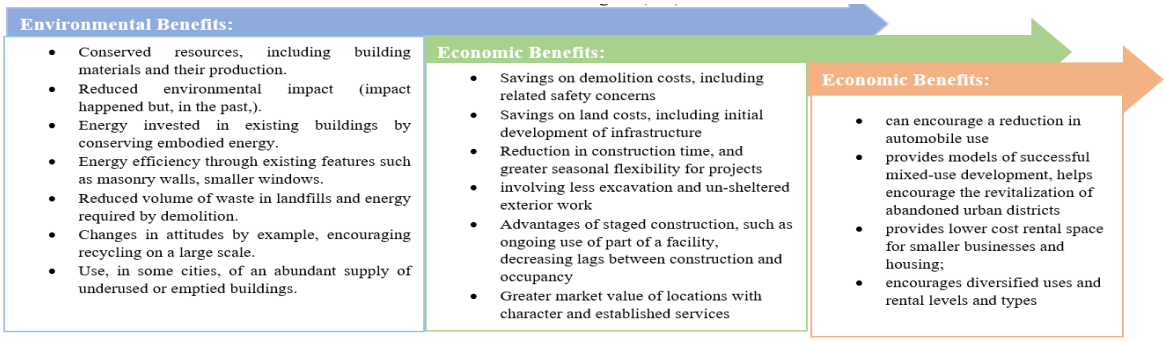

Fig.4. The benefits of retrofitting buildings.[26].

6. RESULTS:

- Case study: The Rural and Surveying Engineering Building, N.T.U.A., Athens, Greece:

Through the retrofitting of the existing building, the project aims to incorporate passive solar and basic energy conservation techniques to improve thermal and visual comfort for users while reducing energy consumption and the building's environmental effect.[27].

6.1. Existing Building Construction before retrofitting:

The retrofit measures address the building shell and the infrastructure, including lowering infiltration, increasing the U value of windows and external walls, using shading devices and day lighting components, improving night ventilation, increasing the levels of day lighting, controlling artificial lighting and space heating, and improving the microclimate.[28].

- Address of project: Athens, the capital of Greece is located on the Saronic gulf in a valley close. as shown Fig.5.
- Year of construction: 1965 Year of renovation: 2003
- Total floor area: 8,550 m2 Number of students: 900
- Number of classrooms: 16 Typical classroom size (m2):50 m2
- Number of students per classroom: 50

Fig.5. The Rural and Surveying Engineering Building, N.T.U.A., Athens, Greece.[28].

The existing structure has recently been expanded with two additions that house more offices and classrooms. The building's reinforced concrete framework and uninsulated brick infill walls make up its construction. Windows have only one pane of glass. as shown Fig.6.[27].

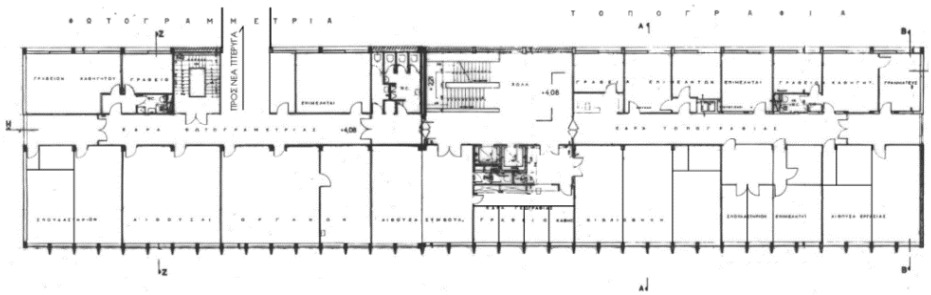

Fig.6. Typical floor plan of the building.[27].

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Source: “Energy Conservation in Buildings and Community Systems”

- Previous heating, ventilation, cooling and lighting systems:
- Heating system: Central boiler Fuel: oil
- Ventilation: Natural ventilation
- Cooling: Local split type heat pumps (for offices and laboratories)
- Lighting: Fluorescent centrally or locally controlled (~17W/m2)

6.2 Energy saving the Rural and Surveying Engineering Building:

Following an auditing and survey procedure, during which temperature and daylighting measures were recorded in representative spaces of the building, while questionnaires were distributed to the users, it was decided to proceed to the following measures of immediate applicability :as shown table.1.

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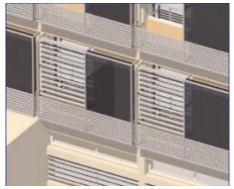
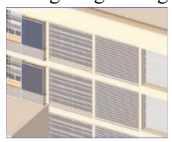
Table .1. The treatments before and after the building's retrofitting.[28].

Retrofitting methods	Construction components Existing building condition before retrofitting	Results of suggestion for retrofitting methods
Building envelop & HVAC	**Building envelop** - Improvements to external wall insulation. - Improvements to U-Value of openings. - Reduction of infiltration through window frames. - Use of shading devices. - Use of simple passive solar systems. - Use of daylighting components. as shown Fig.7&Fig.8. **HVAC** - **Heating/Cooling** - Control of space heating - Control of air conditioning - Improved efficiency of fans or pumps - Insulation of ducts and pipes - Improved heating and cooling supply system - Replacement of filters and air humidifier unit (ahu). - Reduced hot water temperature **Ventilation:** Natural ventilation - Night ventilation - Ceiling fans - Other ventilation devices - Evaporative coolers - Solar chimneys - Ground cooling - Thermal mass - Microclimate improvement	**Heating:** Currently, 49.1 kWh/m2 is used for heating. According to calculations made with the TRNSYS program, the energy consumption for heating will drop to 26.5 kWh/m2, or about 46%, after a combination of basic energy saving measures. **Cooling:** The current cooling energy consumption is 41.5 kWh/m2. The energy consumption for cooling can be decreased to 11.1 kWh/m2 by combining retrofitting scenarios based on building construction, heating/cooling, and ventilation. 73.3% less energy will be needed for cooling, according to calculations made with the TRNSYS tool
Building envelop & HVAC	 **Fig.7.Section of the South façade before Retrofitting**	 **Fig.8.Combination of retrofitting interventions - shading devices and thermosiphonic panels**
Lighting System	- Reduction of indoor illumination levels - Task lighting - Control of indoor lighting equipment - Improved effectiveness of luminaries - Use of efficient lamps or ballasts - Control of outdoor lighting. as shown Fig.9.	The estimated electrical energy consumption for lighting in classrooms is 17 W/m2, in offices and labs it is 18.2 W/m2, and in service areas and corridors it is 14 W/m2. Around 45% less electrical energy will be used when the energy-saving techniques for artificial lighting suggested in this research are put into practice, along with lower indoor lighting settings and better lighting controls. 

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Other environmental design elements	- P.V. systems - Other energy sources - Microclimate improvement. as shown Fig.10.

Fig.9.Combination of retrofittinginterventions - light shelves, shading devices

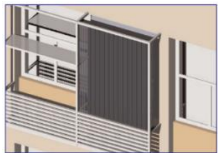

Fig.10.Combination of retrofitting interventions - light shelves and PV panels

- The TRNSYS 14.2 software was used to test a number of scenarios for energy performance scenarios. The energy savings for heating and cooling are shown in the results below. as shown Fig.11.

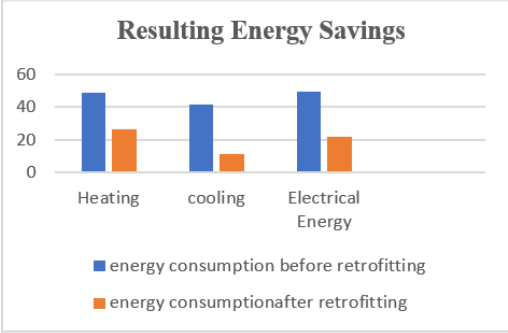

Fig.11.Energy consumption before and after retrofitting

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If the initial cost is not an issue—for example, if a building renovation is chosen—a combination of some or all of the methods listed would be the most effective course of action. However, even if implemented one at a time, several inexpensive solutions, particularly those pertaining to passive cooling and electric lighting upgrades, can significantly increase comfort and energy efficiency. These methods often include HVAC and lighting control and maintenance plans. [28].

- Impact on indoor climate
  Since users will be able to regulate their own spaces' lighting, heating, and cooling, it is anticipated to be significant.
- Practical experiences of interest for a broader audience
  If an outside shading device's size, weight, or mechanism make it difficult for the user to manage, it may be difficult to use and bulky. Users in this instance really opted to put on artificial lights and keep shutters closed during the day. This should therefore be considered if movable shade or insulation devices are used.
- Renovation costs:
  The expected total cost is €90,000 for modifications to the heating and cooling systems and €45,000 for retrofitting the building shell.

7. CONCLUSION:

Environmental sustainability and climate change have become defining challenges of our era, requiring integrated and practical responses across all sectors. This study highlighted the critical connection between sustainable development goals (SDGs), the outcomes of global climate conferences, and the retrofitting of existing buildings as a key strategy for environmental resilience. Retrofitting not only contributes to energy efficiency and emissions reduction but also supports urban sustainability in alignment with SDGs 7, 11, and 13. The case study demonstrated how retrofitting can translate theoretical sustainability principles into tangible, measurable outcomes. As the global community continues to address the climate crisis, building retrofits offer a scalable and impactful solution, particularly in rapidly urbanizing and resource-constrained contexts. Future policies and investments should prioritize sustainable retrofitting as a core component of national and local climate action plans.

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9. DECLARATIONS

Competing interests the authors declare no competing interests.

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10. REFERENCES:

1. Goodland, R. (1995). The Concept of Environmental Sustainability. Annual Review of Ecology and Systematics, 26, 1–24. https://www.annualreviews.org/content/journals/10.1146/annurev.es.26.110195.000245 [Online] 3 Feb 2024.
2. World Commission on Environment and Development (WCED). Our Common Future. Oxford University Press. https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf [Online] 8 sep2024
3. https://sdgs.un.org/2030agenda [Online] 5 Dec 2024
4. United Nations Framework Convention on Climate Change (UNFCCC). (2016). The Paris Agreement.
5. Ma, Z., Cooper, P., Daly, D., & Ledo, L. (2012). Existing building retrofits: Methodology and state-of-the-art. Energy and Buildings, 55, 889–902.
6. https://sphera.com/glossary/what-is-environmental-sustainability/ [Online]:28 Dec 2021
7. Eng. Ahmed Mohamed Rafik Kalil: "IMPLEMENTING SUSTAINABILITY IN RETROFITTING HERITAGE BUILDINGS CASE STUDY: VILLA ANTONIADIS, ALEXANDRIA, EGYPT", M.SC, Fine Arts college, Alex university,2015, p4
8. Mohamed Abdel Fattah Ahmed El-Eisawy, "Economics of Environmental Design – A Model for Economical Environmental Design and Its Impact on Buildings," PhD Dissertation, Faculty of Engineering, Cairo University, p. 30.
9. https://sdgs.un.org/goals[Online] 20 Mar 2025.
10. Cameron Allen, Graciela Metternicht, Thomas Wiedmann," Initial progress in implementing the Sustainable Development Goals (SDGs): a review of evidence from countries: Sustainability Science, (2018)
11. Dr. Neama Zahran, 2021."Worst Economic Scenario for the Climate Threat in the World" , Article, published, Future Center for Research and Advanced Studies.
12. United Nations," Human Activity Drives Global Warming "Unambiguously", Article, published. 9 Aug 2021.
13. https://www.un.org/sustainabledevelopment/cop23/ : [Online] 4 Apr 2022.
14. https://news.un.org/ar/events/cop24 :[Online] 4 Apr 2022
15. https://news.un.org/ar/story/2019/11/1044641 :[Online] 4 Apr 2022
16. https://www.un.org/ar/climatechange/cop26 :[Online] 4 Apr 2022
17. https://unfccc.int/news/cop27-reaches-breakthrough-agreement-on-new-loss-and-damage-fund-for-vulnerable-countries :[Online] 15 Jan 2023
18. https://www.un.org/ar/climatechange/cop28 :[Online] 25 Dec 2023
19. https://unfccc.int/ar/news/cop29-un-climate-conference-agrees-to-triple-public-finance-to-developing-countries-protecting-lives :[Online] 6 Nov 2024
20. https://blog.senseware.co/top-10-retrofit-methods-for-sustainable-buildings :[Online] 29 Mar 2024
21. UK (GBC) Green Building Council. Retrofit. https://www.ukgbc.org/ukgbc-work/retrofit-for-the-future-innovate-uk/ :[Online] 2 May 2022.
22. Riley, M., & Cotgrave, A: (2011)"The technology of refurbishment and maintenance". Macmillan International Higher Education, Construction technology, 3.
23. Zakaria, R. B., Foo, K. S., Zin, R. M., Yang, J., & Zolfagharian, S. (2012). "Potential retrofitting of existing campus buildings to green buildings". In Applied Mechanics and Materials (Vol. 178, pp. 42-45). Trans Tech, Publications.
24. Construction, M. H. (2011). Green outlook: "Green trends driving growth. Bedford, MA": McGraw Hill Construction.
25. Roadmap for Incorporating Energy Efficiency Retrofits in Existing Buildings",2023, paper, published, TERI Press, The Energy and Resources Institute, India. https://www.osti.gov/biblio/974319
26. Eng. Ahmed Mohamed Rafik Kalil: "IMPLEMENTING SUSTAINABILITY IN RETROFITTING HERITAGE BUILDINGS CASE STUDY: VILLA ANTONIADIS, ALEXANDRIA, EGYPT", M.SC, Fine Arts college, Alex university,2015, p14-15
27. http://www.brita-in-pubs.eu/bit/uk/03viewer/case_studies/gr_3_data.html :[Online] 27 Nov 2023
28. "Retrofitting of the Rural and Surveying Engineering Building, N.T.U.A., Athens, Greece", Energy Conservation in Buildings and Community Systems, Annex 36 Case studies overview. IEA