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Review Article

Overview a nearly zero energy building

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ABSTRACT

This article covers the Energy Performance of Buildings (EPBD) definition of Nearly Zero Energy Buildings (NZEBs). Improving the building efficiency to reduce the energy consumption achieving the cost-optimal was the major objective in this paper. This paper presents the common insulation material utilization during the operation process, besides the physical properties of materials. On the other hand, was compared the cost-effectiveness and the safety conditions of the material. Finally, this paper reviews the various software modelling and simulation tools to choose the easy interface comprehensive for design, analysis, and calculation of the energy required to preserve building performance criteria based on the inputs of building properties as well as the mechanical and dynamic systems.

Keywords: Nearly zero energy building; Renewable energy source; High performance building; Cost-Optimal, Energy-Efficiency

1. Introduction

The design strategy of Nearly Zero Energy Buildings (NZEBs) depends on a complex interaction of factors including the location, climate, costs, available resources, and materials. The NZEB targets to reduce energy demand as much as possible to zero against reference standard buildings and the establishment of cost-optimal levels of minimum energy performance requirements in buildings. Concerns about the importance of energy conservation efforts have been posed as a result of growing understanding of the world's population growth and the large environmental effects of existing resource depletion activities [1].

Buildings have an effect on long-term energy use; as seen thus far, the construction industry accounts for 40% of final energy usage and 36% of CO_2 emissions in Europe, a finding that necessitates massive refurbishment and upgrades of the built environment in order to minimize the ecological footprint and ensure energy sufficiency [2,3].

According to a recent IPCC report, globally, Buildings account for 32 percent of overall final energy usage (equal to 117 EJ) and 51 percent of global electricity demand [4], on the other hand, the report illustrated that the energy demand for the heating and cooling in the urbanization countries are foreseeable to rising globally by 179% and 183%, respectively, in 2050 above the 2010 levels for the residential and commercial buildings, as the data illustrate in figure 1. that taken from U.S. Energy Information Administration (EIA) Review of World Energy January 2020, expect the global consumption will grow by nearly 50% between 2018 and 2050. Consequently, by 2020, the esteemed “20-20-20” goals set out by the Climate and Energy Package seek to boost 20% of energy from renewable sources, reduce 20% of greenhouse gas emissions, and reduce 20% of primary energy use in homes. Due to the financial crisis of the building sector the growth rate annual new buildings is estimate at around 1%, thus, reduced energy demand in the European Union (EU) and the use of renewable energy in the construction industry are significant factors in lowering energy dependence and greenhouse gas (GHG) emissions. On the other hand, it could have other benefits, such as a reduction in gas imports, associated costs, and increased energy security. Starting with overall energy demand trends in residential and non-residential buildings [5].

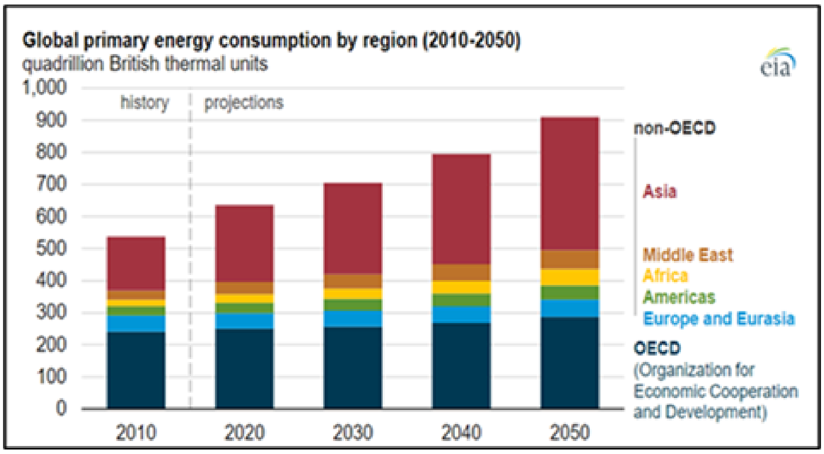

Fig. 1. Total primary energy use in the world from 2010 to 2050 [6]

2. Definition of Nearly Zero Energy Buildings

The adoption of Nearly Zero Energy Buildings (NZEBs) as a modern building goal is one of the most critical keys to reducing energy demand and achieving substantial savings in buildings. Over the last decade, EPBD (Energy Performance of Building Directive) is defined the ‘‘Nearly Zero Energy Building’’ as ‘‘a building that has a very high energy performance’’ and in which ‘‘the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby’’ [7], as show in figure 2 they tried to recast the inserting concept of Nearly Zero-Energy Buildings (NZEBs) in (EPBD recast, DIRECTIVE 2010/31/EU) in article 9 focus for the new building Apparent;

1. by 31 December 2020, all new buildings are nearly zero-energy buildings;
2. after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings, and in addition
3. according to the category of building …” reflecting their national, regional or local conditions, and including a numerical indicator of primary energy use expressed in kWh/m^2 per year” [8].

Nearly-ZEBs are buildings that respond to climatic and site conditions, reduce building heating, air conditioning, and lighting demands through passive design, improve energy equipment and system reliability through aggressive technological interventions, and make full use of renewable energy [10]. Furthermore, in comparison to today's modern buildings, NZEBs are supposed to use 2–3 times less energy, have a high-quality indoor atmosphere, have a long service life, and be simple to maintain and operate [11].

In reference [12], six key arguments The geographical boundaries, time and form of equilibrium, relation to energy infrastructure, metric balance, type of energy consumption, and sustainable supply choices are all highlighted by the NZEB, which illustrate in figure 3.

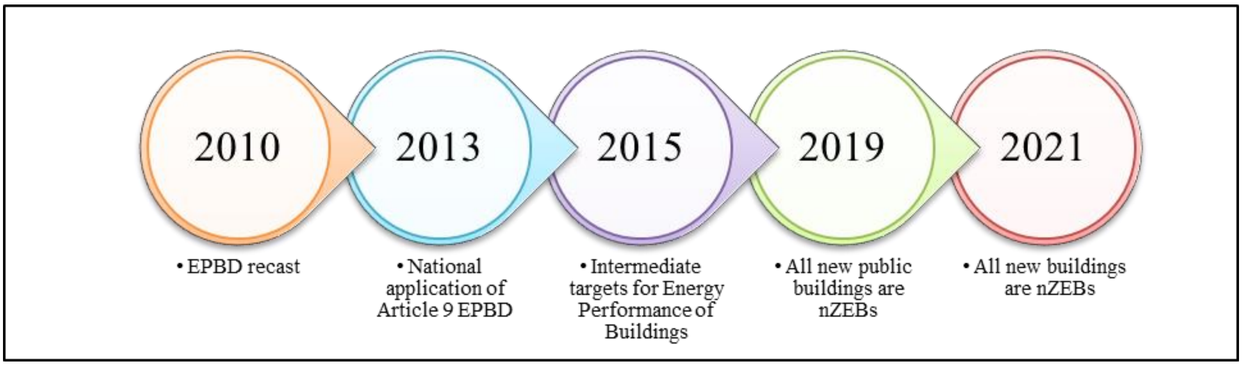

Fig. 2. According to the EPBD recast, the timeline for implementing NZEBs [9]

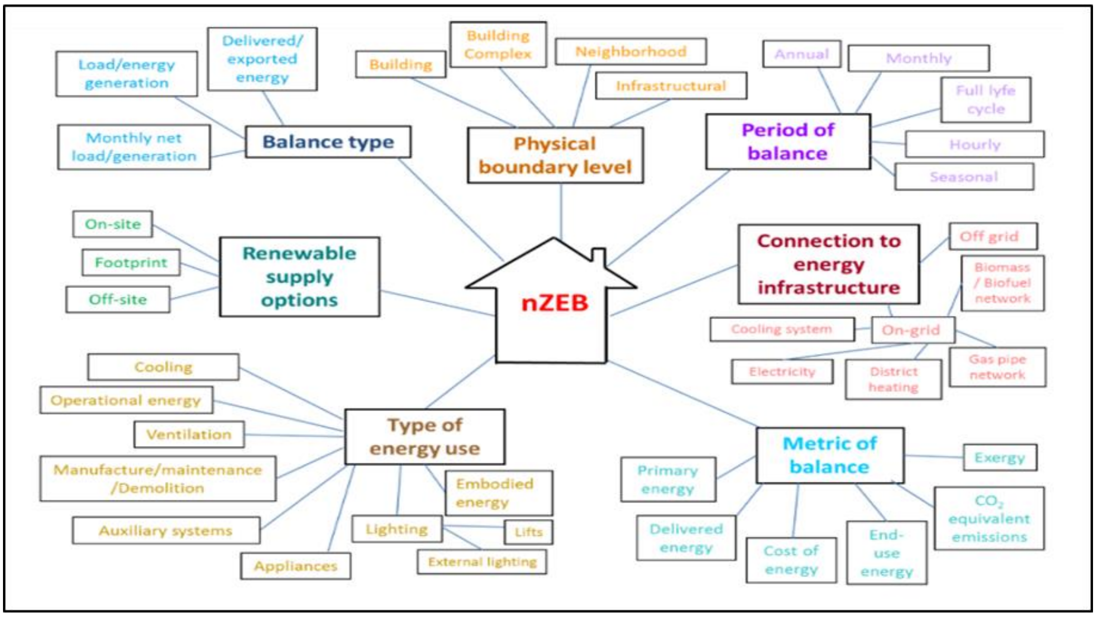

Fig 3. schematized the main arguments around NZEBs [12]

2.1. Cost-Optimal energy performance

Building energy cost is one of the major cost types during building life span. As a result, increasing construction efficiency concerns not just global climate change, but also high operating costs and the resulting economic resource dependence [13], in this context, the other significant EPBD recast was related about the introduction of the cost-optimality, which defined as "the energy performance level which leads to the lowest cost during the estimated economic lifecycle".

By 2021, a cost-optimal, nearly zero-energy building will be defined as that of a heating and cooling energy supply of less than 30 kWh/m^2/y [14], whereas, multifamily houses are required to have an $EPPET$ value less than 78 kWh/m^2 and offices to have a value less than 65 kWh/m^2 [15]. The theory of cost optimality, which provides guidelines for the energy efficiency criteria of new construction, existing buildings undergoing significant renovations, and retrofitted or replaced building envelope components [14]. According to (Article 5) Energy-related investment costs, repairs, operational costs, and, where applicable, disposal and maintenance costs will all have been included in the analysis [2], in addition, selected reference buildings like climatic conditions, (the size, shape, compactness and share of window area) are playing important role in cost-optimal results. The cost-optimal can be expressed as the lowest costs maintaining a high performance. It can be seen in the curve's lower portion, which shows global costs (V/m^2) and energy consumption (kWh/m^{2}y) [2] which illustrate in figure 4. As already noted, various factor can effect of the curve format like geometrical building characteristics, technical systems, data on energy price, discount rate, and costs.

According to [14] has been shown in figure 5 that virtually zero-energy buildings are situated beyond cost optimality in 2011, on the other hand, it is expected that increasing energy costs with decreasing primary energy factors for power, coal, district heating, and so on would result in a reduction of the gap in relation in 2021, which illustrate in figure 6.

Seven steps should be followed to take into account the systematic and high cost-optimal energy efficiency [11];

1. The reference building; reference building shall be selected carefully in order to have comparable results from different analyses.

According to [4], real and virtual buildings are two major approaches can definition for a reference building; The first one is a standard building with a known floor area, form factor, envelope, technical systems, and a particular type based on occupancy pattern, while the second is a collection of common materials and technical systems for each parameter.

2. Building envelope optimization for set specific heat loss thresholds is used to define design principles;
3. Specifying the technological infrastructure of a building;
4. Simulations of energy consumption with specific building principles;
5. The simulation results are post-processed to quantify supplied, exported, and primary energy;
6. Economic calculations; construction cost and net present value (NPV),

Where, construction component including Windows, air processing units, and heat source solutions are examples of thermal insulation (which has cost effects for other structurer, boilers, heat pumps etc.);

7. Sensitivity analyses; discount rate, oil price escalation, and other variables [11].

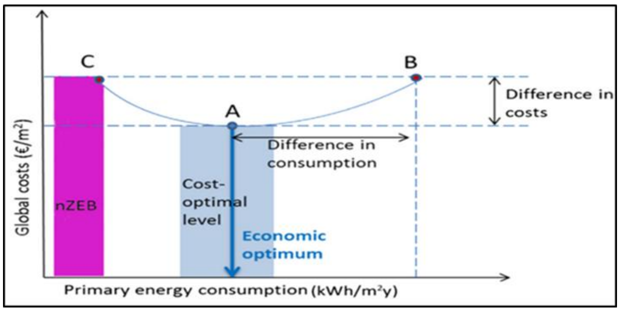

Fig. 4. Global cost curve (A=economic optimum, B=force requirement, C=cost neutral in comparison to force requirement) [2]

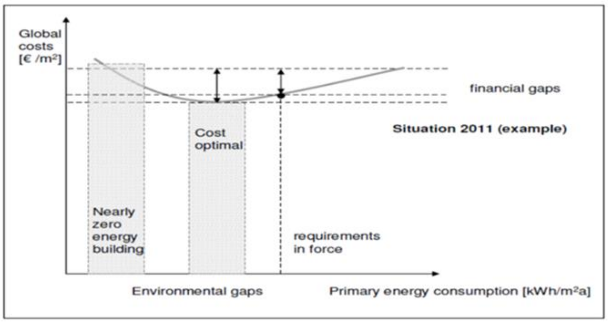

Fig. 5. Example: in 2011, financial and environmental differ between virtually zero-energy buildings and cost optimality [14]

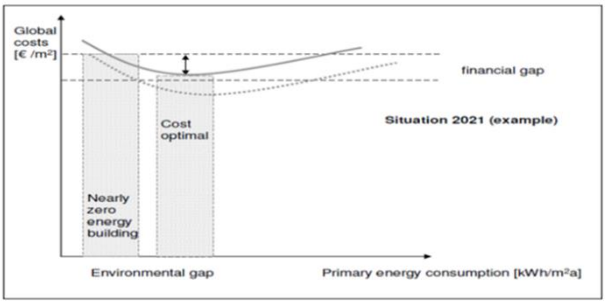

Fig. 6. Example: in 2021, financial and environmental differences between virtually zero-energy buildings and cost optimality [14]

2.2. Energy efficient measures (EEMs)

Energy efficiency is defined as the ratio of energy required to perform a specific service to the amount of primary energy used for the process [16].

Energy-efficient developments in the residential and industrial sectors are increasingly evolving and reducing construction-related operational energy usage, as well as alleviating the ever-increasing demand for energy by more energy-efficient building designs and proper building energy efficiency programmers, based on industry dynamics and standard levels [17-19].

Energy efficient measures in NZEBs There are three types of energy efficient measures: passive architecture, operation structure, and power generation from renewable energy sources (RESs), which can be categorized into three groups.

1-Building envelopes; reflective/green roofs, thermal insulation systems, thermal mass, high-performance windows/glazing (including delighting, heat transfer coefficient, solar heat gain coefficient window-to-wall ratio), and thermal insulation systems.

2-Internal conditions; Internal heat loads (due to electric lighting and equipment/appliances)
and indoor design conditions.

3-Building services systems; HVAC (heating, ventilation and air conditioning), electrical
services (including lighting systems) and vertical transportation (lifts and escalators) good airtightness and fresh air heat recovery systems, DHW (domestic hot water) systems [20-22].

2.3. Renewable energy sources (RESs)

Renewable energy plays a key role in the nearly zero-energy concept, which aims to achieve the bare minimum of energy requirements in buildings while minimizing the use of conventional energy supplies and reducing emissions issues. Take into account the directive 2010/31/EU recent EPBD recast definitions 'The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby' [23].

NZEB is a concept that refers to a balance between a building's energy use and the energy created by its renewable energy systems, where the usage of renewable energy in the building industry, such as solar, geothermal, and wind energy, is heavily influenced by its geographical distribution [20, 22].

3. NZEB Design Strategies

Building energy consumption plays a crucial role in global energy requirements; significant energy savings can be achieved in buildings if they are properly designed, constructed and operated , to minimization of the energy needs includes energy efficient technologies , an effective grid integration and available RES in order to accomplish the appropriate balance between consumption and production also improving the high operational costs and consequent economic resource dependency [24, 25, 12, 4, 3] .

Thereby, NZEB Designing would optimize (passive) building architecture, increase energy efficiency of active structures to reduce building energy consumption, and eventually include on-site renewable energy production to cover the remaining energy needs [1].

Accorded in [26] a NZEB design is an iterative process between energy and environmental analyses that requires a comprehensive evaluation of the whole 'building-plant 'system. In the context, designing buildings for energy efficiency requires paying attention to complex interactions between the exterior environment and the internal conditions separated by building envelope complemented by building systems [13].

While energy-efficiency measures reduce the actual energy demand of the buildings (and accordingly the required energy supply), the self-supply energy measures reduce the need for purchased energy [27] because of the dynamic nature of building energy activity, as well as numerous influential elements and contradictions in design goals such as energy, economy, environmental efficiency, and user comfort, hence , The National Institute of Building Sciences (NIBS) of the United States described six fundamental principles for sustainable architecture to achieve high performance buildings in their Building Design Guide: Optimize Site Potential, Optimize Energy Use, Protect and Conserve Water, Optimize Building Space and Material Use, Enhance Indoor Environmental Quality (IEQ), and Optimize Operational and Maintenance Practices , as a result, entire Building Design considers the structure as a whole rather than a set of parts, and it necessarily requires a multidisciplinary approach that effectively incorporates all facets of site planning, building design, construction, and operations and maintenance [13, 28].

3.1. Building enveloped

A building envelope is what break up the exterior environment (weather) from the interior of a building. It is the most important element in determining the temperature of indoor air and controlling indoor temperatures regardless of changing outside conditions; it also offers sunshine, views to the outside, and aesthetics. Walls, fenestration, glazing, roof, base, insulated, floor, thermal insulation, thermal conductivity, thermal mass, exterior shading systems, etc. [29, 30, 19].

The primary feature of the building envelope is to hold the elements out while allowing the positive factors in. The longevity of a house, its indoor air quality (IAQ), the size of its heating, ventilation, and air conditioning (HVAC) system, structural architecture, and maintenance, among other factors, are all influenced by the materials used in its construction [31]. Building envelopes can be improved in two ways: by lowering thermal transmittances (U- values) and combining these with passive heating or cooling [24]. By minimizing heat gain/loss, U-values have an effect on building energy usage.Heat transfer coefficients (HTCs) for walls, roofs, and floors can range from 0.1 to 0.2 W/(m^2K),but the better windows can have U-values of 0.7 to 1.0 W/(m^2K) [32].

External insulation, shading, solar heat gain coefficient (SHGC), and window-to-wall ratio (WWR) plays a vital role to energy savings for heating and cooling in the walls and roofs by reduce the U-values, thus, improving building energy efficiency. Further, materials used for thermal insulation have low thermal conductivity and low density. They have an organic or inorganic nature and they are presented in forms of blocks, plates or mattresses [33]. In this respect, highlighted by [34] cellular insulation, fibrous insulation, granular insulation, and reflective insulation are the four types of building insulation materials. Light weight, low thermal conductivity, high tension, excellent acoustic resistance, flexibility, and low manufacturing cost are all advantages of using vegetable fibers insulation for near zero energy houses.

3.1.1. Windows / Glazing

Windows are a key component in constructing energy-efficient structures. Since windows usually account for 30–50% of transmission losses across the building envelope, much attention has been paid to reducing the effect of windows on building energy usage by minimizing total heat gain/loss for maintaining comfortable indoor conditions, which can be accomplished by lowering the WWR (window to wall ratio), which, utilize lowering window frame and glazing materials with low U-values, as well as, the section of an external wall that consists of Windows [35, 36].

Foreseeable, the compositing fiberglass or Vinyl as window frame “shells” have been feature slow heat transfer due to this Insulating frames provide much better thermal resistance than aluminum, metal window frames and solid wooden frames.

In this regard, window glazing can be classified as static or dynamic, with static glazing having a single constant optical and thermal property and dynamic glazing having three main features: The dynamic glazing involves optical switching systems (chromogenic technologies - gas chromic, etc.) as well as the overall heat transfer coefficient (the U-value), visible transmittance (Tv), and solar heat gain coefficient (SHGC), photochromic, and electrochromic , thermotropic, liquid crystal, and suspended particles [37- 41].

In the context, advanced glazing, multilayer glazing, suspended films, evacuated glazing, low-emissivity (low-E) coatings, solar control coatings, smart glazing, photovoltaic glazing, aerogel glazing, krypton glazing, PCM glazing, gas filled glazing, and self-cleaning glazing, tinted glass, reflective glass, and self-cleaning glazing are examples of novel window innovations, [11, 30, 42], whereas, the main benefits and drawbacks of reviewed glazing technologies are highlighted by [43].

Şişecam group was based to meet Turkey’s requests for basic glass products. Today they player in all key areas of the glass industry either within Turkey or internationally. Below in figure 7 show how to reduce U-value; use 16 mm gap width, using argon gas, coated insulation glass or triple insulation glass, Low-E or Low-E coated glass with solar 2 times compared to ordinary double glazing and thermal insulation with triple insulating glasses are 4 times more effective.

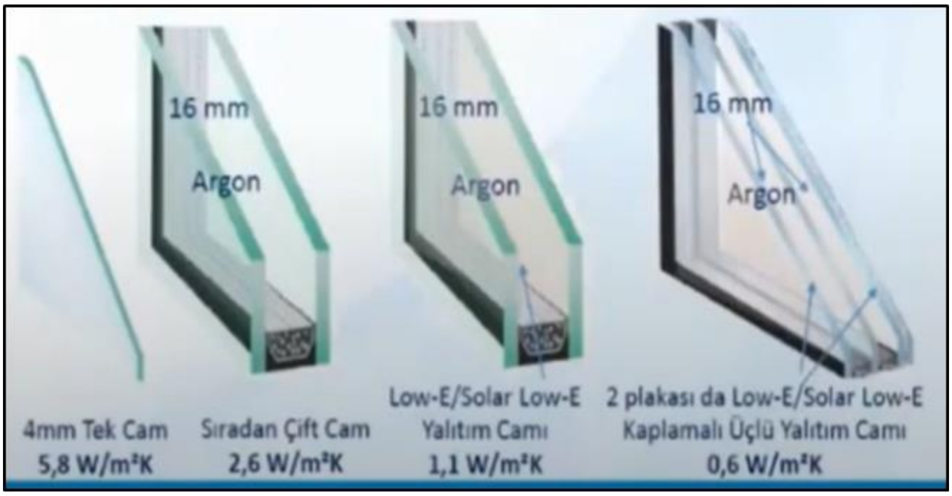

Fig. 7. Reduce glazing U-value;
form left; 4 mm single glass 5.8 W/m^{2}K; 16 mm, Argon gas,
Standard double glass**;** 16mm Argon gas,
Low-E/Solar Low-E insulation glass 1.1 W/m^{2}K,
2 plate Low-E/ Solar Low-E coated triple insulation glass 0.6 W/m^{2}K [44]

3.1.2. Walls / Roofs / Floors

External walls and roofs have a major impact on reducing energy usage demand in buildings. In this regard, various insulation materials were examined in Table 1 shows the materials, by regulating the insulation of walls and ceilings, they can improve thermal quality, comfort, and save and store more energy than usual [45, 46]. As matter of fact , local climatic conditions are the significant factors that shall take into account when selected the roofs and wall HTCs materials beside the cost optimal, hereof , NZEB standard U-value illustrates about 0.20- 0.25 in the severe cold region and cold region , where in the hot summer cold winter regions and hot summer hot winter regions the U-value shown between 0.35-0.40 , thus , the cold regions have more need on the Heat transfer coefficients (HTCs) than the hot, which illustrate in figure 8.

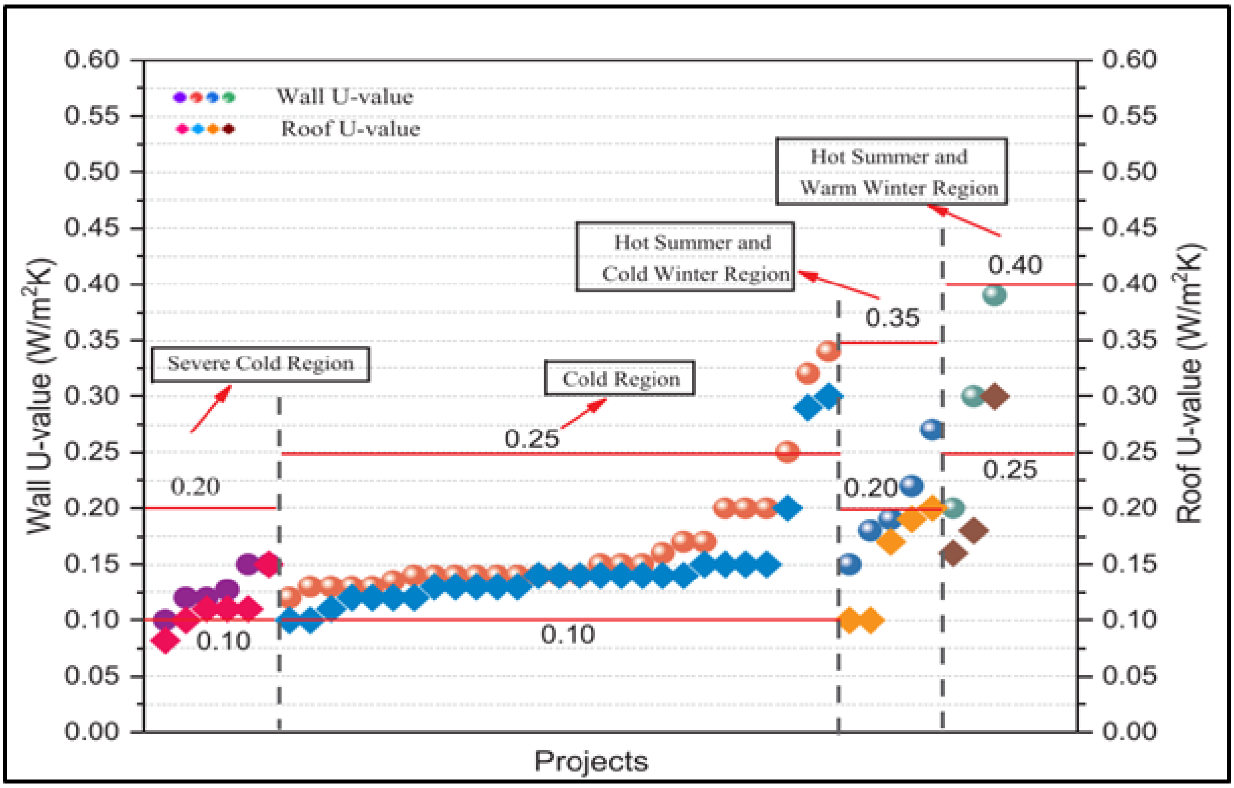

Fig. 8. Wall and roof U-values of NZEBs [22]

Table 1. Main characteristics of the insulation material

Material	ρ(kgm^{-3})	κ(W m^{-1}K^{-1})	Feature	Cost[a] $/m^3	Safety	Reference
XPS	28–45	0.029 -0.039	- Compressive Strength - Water resistant - Durability - Sustainability - Expands significantly and warps at higher temperatures. - Used in crafts and model building	70.00-150.00	-Combustible	[72] [56]
EPS	34	0.033–0.057	- Constant thermal resistance - Dimensional stability - Chemical inertness and sustainability - Being hydrophobic - Zero compressive - Strength	85.00	-No toxicity -Incombustible	[57] [58] [59] [60] [61] [62]
PU	35	0.028-0.022	- Durability - Compressive stress - Extremely lightweight - High strength - Resistance to water and moisture - Immune to mold and rot	0.10-3.00	-Incombustible	[63] [64]
Mineral Wool	100	0.035	- Porous material traps the air - Sound insulation - Immune to mold	40.00-70.00	-Incombustible	[63] [65]
Stone Wool	30-200	0.032-0.044	- Short fiber - High elasticity - High tensile - Immune to mold and rot - Sound insulation	40.00-70.00	-Incombustible -Cause skin irritation	[65-66]
Glass Wool	11-45	0.035 -0.039	- Long fiber - Low tensile strength - Low elasticity	1.30-16.00	-Incombustible -Cause skin irritation	[65-66]

[a]:The cost taken in January, 2021 from www.alibaba.com, κ- Thermal conductivity, ρ-Sample density

4. Building Energy Performance Simulation

The building energy simulation (BES)-also known as building simulation, building energy modeling, or energy simulation tools are complex applications it is impact to the energy saving designing and achieved cost optimal without consuming excess resources, as evident, it is play an important role in the design high performance buildings and optimization.

Comparing the cost-effectiveness of energy-conservation measures (ECMs) both at the design and operating stages using building data such as data from meters, sensors, heating costs, weather, energy usage and demand, temperature, humidity, and building characteristics, etc. [67- 69].

The future of the building construction process depends on the automated exchange of data between the architect's design tools and the energy consultant's building energy simulation application [70]. Building energy simulation (BES) models are divided into two types: prognostic Law-Driven (or white box) and Data-Driven (or black box) models (or black box). The first is often over-parameterized since it is focused on mathematical simulation of building physics phenomena and is used to simulate the behavior of a complex system given a series of well-defined laws (e.g., energy balance, mass balance, conductivity, heat transfer, etc.). In contrast, the second is focused on statistical or machine learning formulations, which apply to approaches that use building information to create models that can correctly predict system behavior [67, 71] as shown in figure 9.

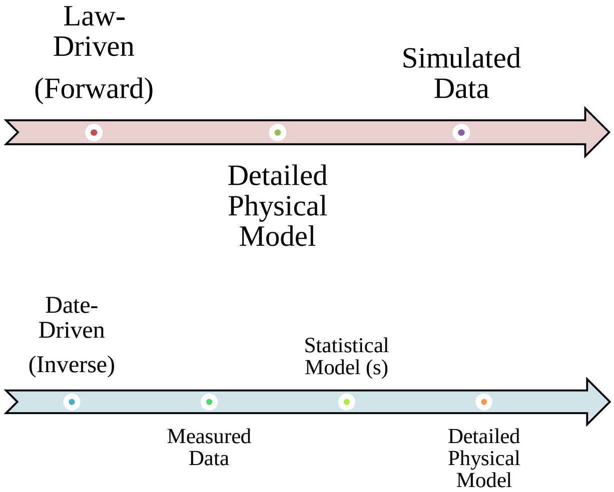

Fig. 9. Building energy simulation (BES) models classification [67]

Highlight by [73] overview of how the various tools approach the solution of general modeling functionality, zone loads, building envelope and day lighting, infiltration, ventilation and multi zone airflow, HVAC systems equipment, renewable energy systems, electric systems and equipment, environmental emissions, and economic assessment, explained in a user's perspective., climate data availability.

The reference [71] presents a thorough and systematic analysis of the most recent literature on the implementation and characterization of ANN-based metamodels for BPS, as well as the type of building and its inputs (building construction variables or indictors to make a decision) and outputs (energy consumption, comfort index, climatic condition, and environmental performance) in addition, the tables and graphs that showed the distributions of different alternatives and trends.

4.1. Energy modeling, simulation and analysis tools

This section offered the major tool utilization to modeling then simulation the NZEBs, in fact there are a lot of tools investigated by architect to calculate the energy building performance in designing process as well as the post-construction phases of the building life cycle (BLC).

As seen so far, this tool is useful for incorporating and making available to practicing professionals new skills, analytical processes, materials and component data, standards, design information [74].

To sum up, blow offered some of the common modeling and simulation tools, further, the definition of tools had been summery due to it was taken from their official web site and for more knowledge feature can access their web site.

1. Design Builder; It's a dynamic simulation platform that includes advanced modeling tools for HVAC, daylighting, airflow, price, energy, and carbon emissions [75].

2. Open Studio; is a cross-platform (Windows, Mac, and Linux) open source, graphical interface series of software tools to support whole building energy simulation with Energy Plus and sophisticated daylight measurement with Radiance. For geometry development, Open Studio also supports the import of gbXML and IFC files. The envelope, loads, schedules, and HVAC features allow you to browse, plot, and compare simulation performance data, especially time series [76].

3. Green Building Studio; is a scalable cloud-based service that helps you to run building performance models early in the design process to maximize energy conservation and move against carbon neutrality. It's possible to use it as a stand-alone online service. It also drives the whole-building energy measurement tools in Autodesk® Revit® [77].

4. Revit; is a multidiscipline design platform that includes detailing and construction. Its features enable consistent, organized, and full modeling for multidiscipline design [78].

5. Energy Plus; is a free, open-source, and cross-platform operating system that runs on Windows, Mac OS X, and Linux. The Building Technologies Office of the US Department of Energy (DOE) is funding its growth (BTO). With Open Studio, you can model energy use for heating, cooling, ventilation, lighting, and plug and process loads, as well as water usage in buildings, amongst many other things [79].

6. DOE-2; is a commonly used and widely recognized freeware building energy analysis software that can forecast energy consumption and expense for a variety of building styles. DOE-2 performs an hourly simulation of the building and estimates utility bills using a summary of the building configuration, constructions, use, cooling systems (lighting, HVAC, etc.) and utility rates provided by the owner, as well as weather details [80].

7. ESP-r; is a building performance simulation modeling platform. The framework is developed for Linux, but it can also run on Windows systems, either directly or via the Cygwin environment. The device will model heat, air, moisture, light, and electrical power flow at user-specified spatial and temporal resolutions while conducting assessments [81].

8. eQUEST; It is an easy-to-use building energy analysis platform that was created to enable you to do comprehensive analysis of today's state-of-the-art building construction technology using today's most advanced building energy use simulation techniques. eQUEST helps users with little or no simulation expertise to create 3-dimensional simulation models of a specific building design. Building location, alignment, wall/roof structure, window properties, HVAC systems, day-lighting, and multiple control methods are all included in these models, as well as the opportunity to determine design alternatives for either single or combination of energy saving measures (s) [82-83].

9. Ecotect; Analysis green building program is a robust sustainable analysis application that uses desktop and web-service tools to provide a broad variety of modeling and analysis capabilities. Web-based whole-building energy, water, and carbon analysis combine with desktop applications to run comprehensive environmental simulations and simulate the outcomes [84].

10. TRNSYS; is a graphically oriented computing environment for simulating the actions of transient structures that is highly scalable. While most simulations are used to evaluate the efficiency of thermal and electrical energy systems, TRNSYS can also be used to model other complex systems such traffic flow or biological processes [85].

11. TABLER; The software, developed by University of Tennessee at Chattanooga engineering professor Prakash Dhamshala, uses building knowledge to predict the structure's energy needs, as well as the ability to re-run simulations with improvements such as solar power systems, wind turbines, energy storage units, and building design improvements, among other things. Often measures peak cooling and heating loads for HVAC sizing and breaks down monthly energy consumption and utility expenditures with simple bar and pie chart outputs [86-87] comparative simulation tools which have been developed in IEA SHC Tasks 8, 12 and 22 and ASHRAE's ANSI / ASHRAE

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Standard 140-2001 that named (Building Energy Analysis Computer Programs Standard Test Method) These programs are used as a comparison base within the BESTEST method, which has been standardized and accepted as a valid test method and whose reliability is accepted by the standard, as illustrate in table 2 as well as the table 3 overviewed the main NZEBs papers.

Table 2. Building energy performance simulation programs comparison [87]

Integrating Simulation	**ECOTECT**	**e-QUEST**	**Energy Plus**	**Esp-r**	**TRNSYS**
Architectural modeling of alternative solutions with sun shade Analyses	+	+	+	+	+
Analysis based on the sunshine duration of the surfaces	+	-	+	+	+
Modeling for daylight factor and illuminance levels	+	-	+	+	+
Air flow simulation (CFD) with natural ventilation analysis	-	-	+	+	+
Modeling building envelope	-	-	+	+	-
Performance analysis of alternative materials	+	+	+	+	+
Investigation of component integrations that enable renewable energy sources	-	-	+	+	+
Enabling the performance of the heating and cooling system design simulation analysis	-	+	+	+	+
HVAC system design that enables simulation Applications	-	+	+	+	+
Analysis of indoor air quality, CFD analysis	-	-	+	+	+

Table 3. Literature review on a nearly zero energy buildings

Year	**Author**	**Title**	**Study Type**	**Building type**	**Used Tools**	**Material**	**What did the literature do ?**
2019	Hasan Yildirim	Nearly Zero Energy Building Design and Comparison	Design and Simulation	Public	-Energy Plus -Design Builder	**Window glass**; Low-E glass **Wall/roof;** EPS, XPS, Stone wool, glass wool	Compared the public building which was built by conventional methods, with the being able to nearly zero energy building.
2020	Halit Beyaztaş	Redefining Building Envelope Based on Different Urban Texture for The Goal of Achieving Near-Zero Energy Residential Building	Simulation	Residential / Apartment	- Energy Plus - Open Studio	**Window glass;** double glazed with argon, triple glazed with air, **Wall/roof;** XPS , Rock wall **Lighting ;** Fluorescent, LED	Effect the solar energy production capacity of buildings to the urban texture and building typology.
2018	Waleed Aldajani	Towards Nearly Zero-Energy Buildings Renovation	Simulation	Complex	-PVSOL -EED -Excel	N/A	Investigate the potential for a nearly Zero-Energy Building (nZEB) renovation.
2020	Sasan Rafii-Tabrizi	Smart Electrical and Thermal Energy Supply for Nearly Zero Energy Buildings	Model and Simulation	Laboratory	TRNSYS	N/A	Develops an EMS using certainty equivalent (CE) economic model predictive control (EMPC) to optimally operate the building energy system with respect to varying electricity prices.
2016	Joel Anderson	Modelling and Performance Evaluation of Net Zero Energy Buildings	Modeling	Virtual	-Design Builder	N/A	Investigates the effects of different building design and operation principles in relation to net zero energy buildings.
2015	Burcu Sağlam	Zero Energy Building Design for Different Types of Climates	Design	Residential	- Energy Plus - PVsyst	**Window/glass;** Film coated double glazing **Exterior wall;** XPS, Exterior Plaster EPS Insulation Board Perlite Added Concrete Internal plaster **Roof;** Polyurethane foam Reinforced concrete Internal plaster Ytong Plate **Floor;** Soil, lean concrete, Protection Concrete , EPS Insulation Board , Screed , Ceramic , Ytong Plate ,EPS Insulation Board , Screed Wooden.	Emphasizes that the climate conditions have a major effect on the design conditions and to show the solution packages must be cost effective.
2011	Andrew Frye	Energy Efficiency‟s Role in a Zero Energy Building: Simulating Energy Efficient Upgrades in a Residential Test Home to Reduce Energy ConsumptioN	Simulation	Residential Test House	-MatLAB -TABLER	N/A	Evaluate energy efficient upgrades related to residential lighting, infiltration mitigation, advanced insulation, advanced windows, and plug and process loadS

2019	Salih Habib Najib	A Proposal for an Energy Efficient School Building Model in Kirkuk/Iraq	Design	School	-Revit -Green Building Studio - PV * SOL software	Polystyrene for insulation wall/roof	Suggestion different building design as well as taking various thickness and size for the wall and Window areas of the school building sample assumed in Kirkuk.
-	Wijesuriya Arachchige Sajith Indika Wijesuriya	Experimental Analysis and Validation of a Numerical Pcm Model for Building Energy Programs	Application	Residential building	- Energy Plus - MATLAB - ESP-r	▪OSB, Cellulose cavity, Nano-PCM wallboard wall layers. ▪a BioPCM in plastic foil/white plastic sheeting pouches . ▪PCM hydrate–salts (hydratesalts)encapsulated in thermoplastic foil/ multilayer white polyfilm pouches	Different parametric study of a residential building located in hot-and dry climate one them located in Phoenix with time-of-use electric rates and two different interior convection modes.
2012	Kemal Özgen Birol	Design and Analysis of Energy Saving Buildings Using The Software Energy Plus	Design	Office	- Energy Plus - Open Studio	**Window/glass;** -Clear , Air Gap **Wall;** PVC, Aerated Concrete, Glass Wool, GypsumBoard **Roof;** Aluminum, Polystyrene,Ceramic, Finishing Concrete, Finishing Fill **Floor;** Lean Concrete, Sand Fill, Slag Fill	Introduced guidelines to reduce energy needs of buildings and to bring in the green building design concept by enhance the building and system parameters .
2007	Tobias Maile, Martin Fischer ,Vladimir Bazjanac	Building Energy Performance Simulation Tools – a Life-Cycle and Interoperable Perspective	Design	Public	-RIUSKA - e-QUEST -DOE-2 -Design Builder -Energy Plus	N/A	Discusses the graphical user interfaces of simulation engine their functionality, models, limitations, usage within the life-cycle and the usage of data exchange possibilities are being addressed
2012	Shady Attiaa, Elisabeth Gratiaa, André De Herdea, Jan L.M. Hensenb	Simulation-Based Decision Support Tool for Early Stages of Zero-Energy Building Design	Design	Residential	- Energy Plus - ZEBO	polycrystalline and mono-crystalline panels	Presented energy-oriented software tool that both accommodates the Egyptian context and provides informative support that aims to facilitate decision making of zero energy buildings.
2014	Mahmud Sami Arpaci	Performance Analysis of Passive Solar Buildings	Modeling	Residential	-Ecotect	Roof; saltbox use to insolation	Buildings from places with similar weather conditions in Turkey were analyzed with different methods by computer software as the output report of the analyses were compared and evaluated to lay out the results of passive use of the sun in conditions of Turkey.

5. Conclusion

A complex interaction of factors influences a NZEB building design approach, including location, environment, prices, available resources, and materials. In fact, because of this, indoor air quality is mainly determined by outdoor air quality as well as pollution from the building and its equipment. this study highlights the necessity to implement have a clean environment from the carbon emissions sources as well as the good ventilation system to have a comfortable and healthy indoor environments.

This paper investigates the toward nearly zero energy building studying impact factors achieving the minimum energy consumption in building, otherwise, aimed to Investigation high performance building by low amount the energy requirement for instance control and monitors the mechanical and electrical equipment such as air conditioning, lighting, power systems which providing to reduce energy usage during the operation.

The three main axes there are discussion; the building enveloped, cost effect and computer package programs. As evident, the main insulation materials feature in building applications is to be lower thermal conductivity, this will reduce the energy consumption of the HVAC systems saving energy and money. In context, take into account the safety first we exclude stone and glass wool, for this reason Extruded polystyrene (XPS) have been highly susceptible to combustion however it is lower thermal conductivity, further the thermal conductivity and the cost of the material we suggesting the Polyurethane (PU) and Expanded polystyrene (EPS).

Its various to excellent choice until developed a lot of modeling and simulation tools as well as to sure the accuracy of the resulted, the same input date can measure different output when tested the accuracy the simulation tools. About the modeling tools it is important to be easy interface able to architects, engineers to preliminary design phase NZEB in different urban contexts beside that it support the HVAC system design, an hourly energy calculation delivered and exported energy, daylily hourly analysis of sun shine, energy combustion and the lighting system. To sun up, evaluation suggest the Energy Plus and The ESP-r as a simulation tools which supporting the vital needs for users. Whereas, Open Studio and the Design Builder as a modeling tools favorite by researchers and designer.

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Nomenclature

ASHRAE	American Society of Heating, Refrigerating and Air- Conditioning Engineers
BES	Building Energy Simulation
BLC	Building Life Cycle
DHW	Domestic Hot Water
ECMs	Energy-Conservation Measures
EEMs	Energy Efficient Measures
EPBD	Energy Performance of Building Directive
GHG	Green House Gas
HVAC	Heating, Ventilation and Air Conditioning
HTCs	Heat Transfer Coefficients
IAQ	İndoor Air Quality
NZEBs	Nearly Zero Energy Buildings
RESs	Renewable Energy Sources

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