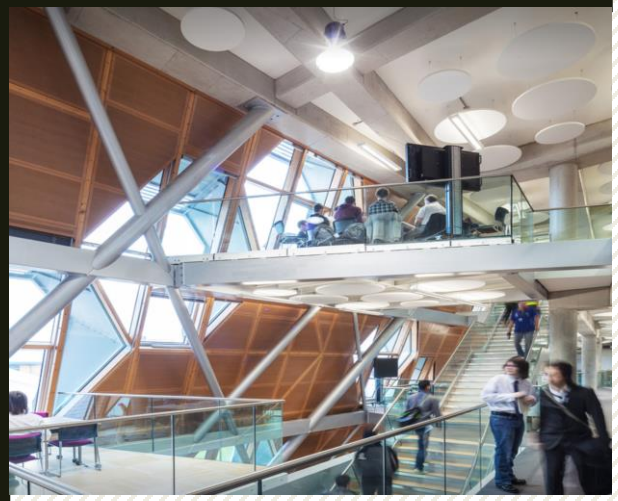

Designing Building Services Engineering Curriculum to meet net zero targets

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Motivations

- Around 40% of carbon emission come from Building.
- The UK target for delivery net zero is 2050.
- 80% of the buildings needed by 2050 already exist or are in planning stage.

The growing demand for energy as well as the drive towards attaining a **net zero** carbon emission have led to significant developments in environmentally friendly energy solutions across the globe

What we need to do!

Building Services Engineering Curriculum across different levels (Technicians, Engineers, etc) must be re-designed, focusing on the principles governing the design of low energy buildings and their associated their technologies:

- *Understand energy use in the building type.*
- *Using the form and fabric of the building to minimise energy demand.*
- *High efficiency Insulation and Air-tightness*
- *Use high efficiency building services with low carbon fuels*
- *Deploying Renewable Energy Solutions*
- *Implementing energy management strategies within the building*

This redesign must also satisfy the Engineering Council's requirements by covering the following key areas:

- Science and mathematics
- Engineering analysis
- Design and innovation
- The engineer and society
- Engineering practice

Therefore, we must get the correct balance!

Understanding Energy Use in the building type

Some key aspects include, but not limited to:

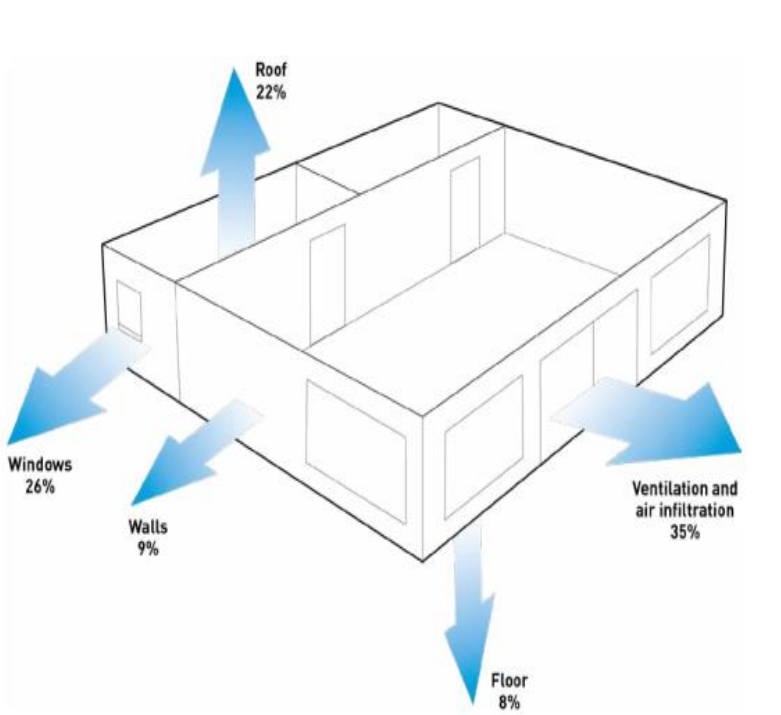
- *Building Performance Assessments (at design stage and/or post-occupancy stage)*
- *Energy Surveys and Energy Audits*
- *Simulation Studies and use of case studies*
- *Building Energy Analysis*
- *Embodied and Operational Carbon and calculation methodology*
- *Energy Monitoring*
- *Energy Consumption Profiles*
- *Building Occupancy patterns, etc*
- *Degree Day Concept, etc*
- *Type of fuel used in the building.*

- The first step is to identify and understand the energy use in the building type: such as type of energy for HVAC, lighting, etc; The type of Fuel (Natural Gas, etc), or renewable sources.
- The Energy demand: such as for HVAC, Water Heating, etc
- The factors that determine the energy usage: such as the building design itself, occupancy pattern and profiles
- Identify opportunities for deploying sustainable solutions.

Using the “form” and “fabric” of the building to minimise energy demand including high efficiency Insulation and Air-tightness

Some key aspects include, but not limited to:

- *U-Value (Thermal Transmittance)*
- *Thermal Insulation*
- *Heat Loss and Heat Gain*
- *Fabric Heat Loss*
- *Infiltration and Ventilation Heat Losses*
- *Avoid Thermal Bridging*
- *High-Performance Building Facades*
- *External Conditions*
- *Building Orientation and Layout*
- *Sun Paths Analysis*
- *Weather and Climatic Conditions*
- *Building Form (direct sunlight, humidity, rain, prevailing wind, shading, and self-shading of buildings)*



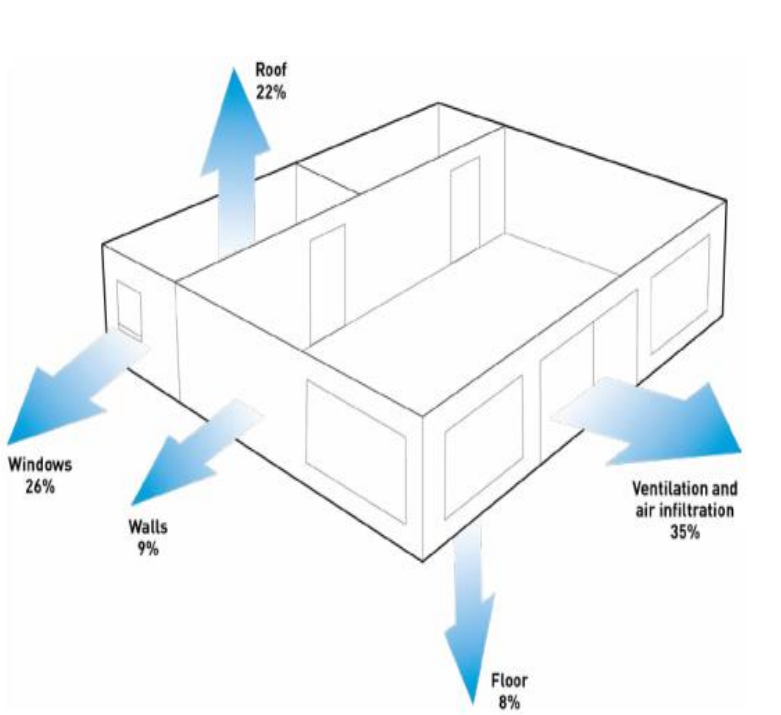
Adopting a “fabric first” approach strategy is fundamental to the energy performance of a building

- Roof
- Wall
- Window
- Floor
- Door

Using the “form” and “fabric” of the building to minimise energy demand including high efficiency Insulation and Air-tightness

Some key aspects include, but not limited to:

- *Adopting Natural Ventilation*
- *Maximise Solar Gain*
- *Increase Air – Tightness*
- *Composite walls*
- *Construction Technology*
- *Construction Materials*
- *Passive Building Design*
- *Passive Solar Design*
- *Thermal Mass*
- *Daylighting*
- *Material Selections, Space Utilisations, etc*



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Using high efficiency building services with low carbon fuels and consideration for Renewable Energy Systems

Some key aspects include, but not limited to:

- *Critical evaluations of the different Energy Efficient Building Services, Systems, and their technologies*
- *Variable Speed/frequency drives*
- *Refrigerant choices, etc*
- *LED Lighting, etc*
- *Solar Hot water Systems*
- *Heat Pumps: Types, technologies, configurations, etc*
- *Photovoltaic electricity generation, Micro-Wind Turbine, etc*
- *Biomass Systems, etc*

Following passive measures, designers should consider energy-efficient building services and the deployment of renewable solutions as much as possible.

Building Energy Management Systems

Some key aspects include, but not limited to:

- *Deployment of intelligent Control Systems*
- *Artificial Intelligence & Internet of Things*
- *Lighting and HVAC controls*
- *Data Loggers and data analytics*
- *Control Panels and Dash Boards*
- *Sensors and Detectors*
- *Controllers and actuators*
- *Communication networks*

Studies have shown that smarter use of building controls via the Building Management systems could improve energy savings by a significant margin (more than 20%) in non-domestic buildings

Summary

(ADDRESSING THE CHALLENGES ASSOCIATED WITH MEETING NET ZERO TARGETS)

- Learners should be educated on the importance of sustainable practices in building services design and the application of these principles through real-world scenarios. This education should include adequate practical training to provide students with hands-on experience in sustainable building practices and technologies.

- Additionally, learners should be informed about the latest building codes, standards, policies, and guidance documents, as well as how to access these resources, such as CIBSE Guides, Building Regulation Approved Documents, BSRIA documents, application manuals, and technical memoranda.

- We should encourage interdisciplinary collaboration among learners, including participation in local or regional professional groups, such as the CIBSE Young Engineers Network.

- Professionals from the industry should be invited to deliver guest lectures and workshops to share their real-world experiences and knowledge.

Summary

(ADDRESSING THE CHALLENGES ASSOCIATED WITH MEETING NET ZERO TARGETS)

- Future engineers, academics, graduates and apprentices must be equipped with appropriate tools and technology, and expertise to meet these challenges.
- Investors, systems developers, regulatory bodies and policy makers must also be adaptable to these challenges. All stake holders (Universities, Industries and professional bodies, etc) must collaborate to address these issues effectively
- Curriculum must be designed/ re-designed and continuously updated to meet these challenges. The curriculum should align with industry needs to reflect current industry standards and practices.
- Assessment components should be designed so that learners naturally incorporate renewable solutions and low energy solutions into their MEP design task
- Building Science and Building Physics, including low-carbon retrofitting strategies and technologies, should be key components of the curriculum. Simulation tools, case studies, where possible, including energy consumption data should be made easily accessible for student use

Further readings

- Back in control: making savings with BMS optimisation - CIBSE Journal, November 2023
- Building fabric guide | The Carbon Trust
- Climate Change Mitigation | UKGBC
- Energy efficiency in buildings – from commercial to residential | UKERC | The UK Energy Research Centre
- Passivhaus Retrofit (passivhaustrust.org.uk)
- Principles of Low Carbon Design and Refurbishment, RIBA, 2nd Edition