# Energy Conservation: A Pathway to Net Zero

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# Overview

- Net Zero
- Energy Consumption and $CO_2$ Emission
- Energy Saving Interventions
- Summary

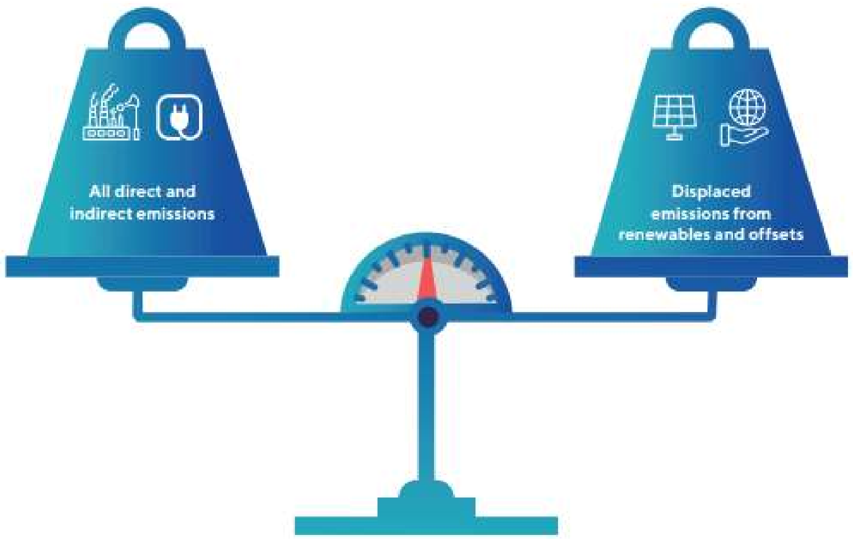
# NET Zero

The term Net Zero was first popularised by the Paris Climate Agreement in 2015.

The term Net Zero refers to **all greenhouse gas emissions**, from all sectors, and in all forms. We often use Zero Carbon as a shorthand since carbon is the dominant greenhouse gas, but Net Zero must include all emissions including methane and a number of other greenhouse gases.

Nearly all countries worldwide have signed the Paris Climate Agreement and created their own Net Zero plans.

This means that by 2050, we must balance any greenhouse gasses that we emit with an equivalent removal of greenhouse gasses from the atmosphere.




Net zero requires balancing all emissions with equivalent removals from the atmosphere.

Source BSRIA NZ G1 2022

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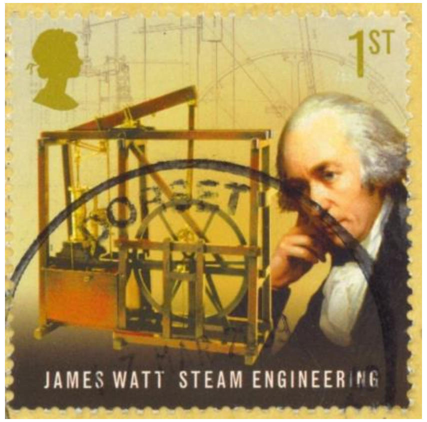
# Energy Conversion in the Past

- The first conversion of energy

- Capturing wind energy

- Using the energy of the water
- Modern civilization advanced because people have learned how to change energy from one form to another for their exploitation

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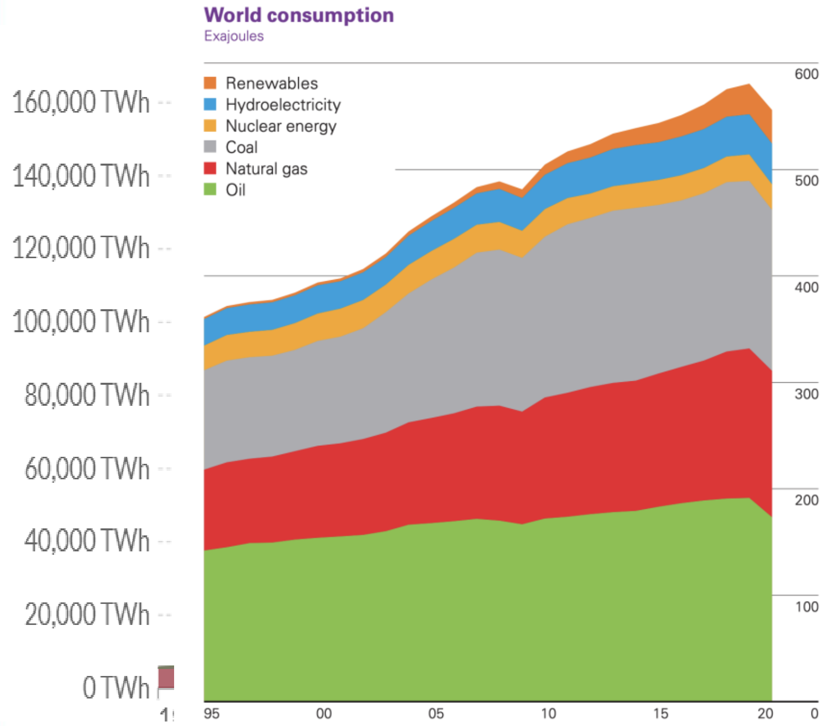
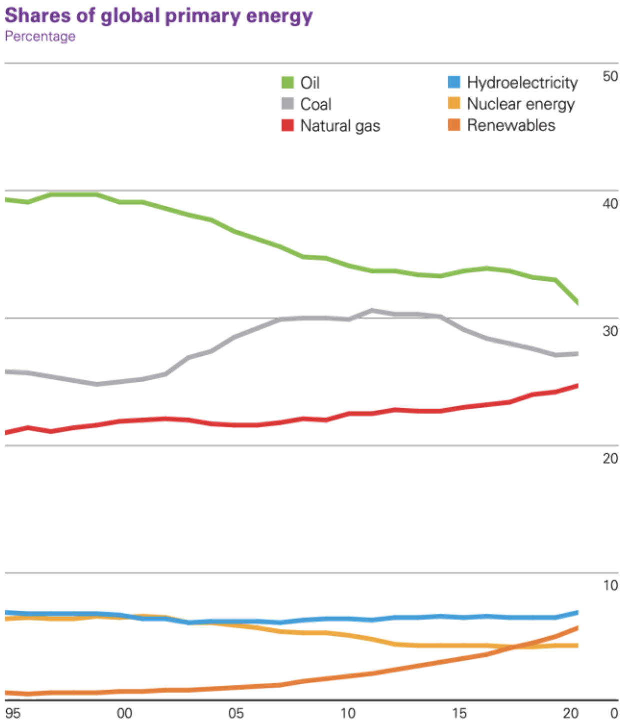
# Energy Consumption

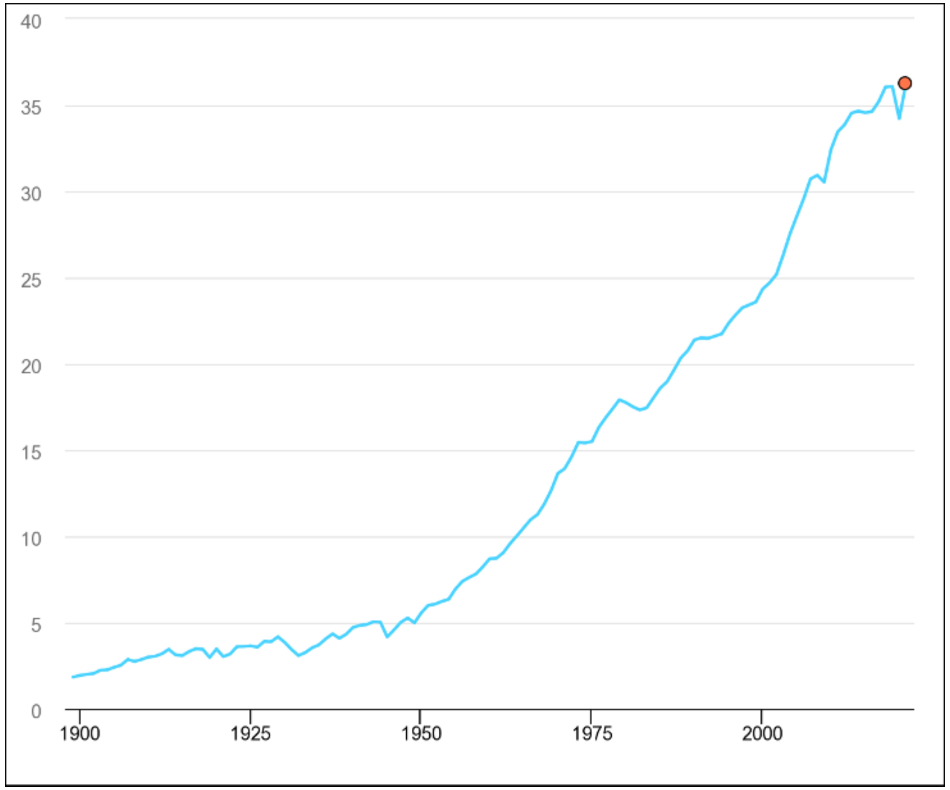
World primary energy consumption




CO2 emissions from energy combustion and industrial processes

**36.3 Gt $CO_2$- 2021**




[Source: BP Statical Statistical Review of World Energy 7th Edition]

Source Global Energy Review: CO2 Emissions in 2021

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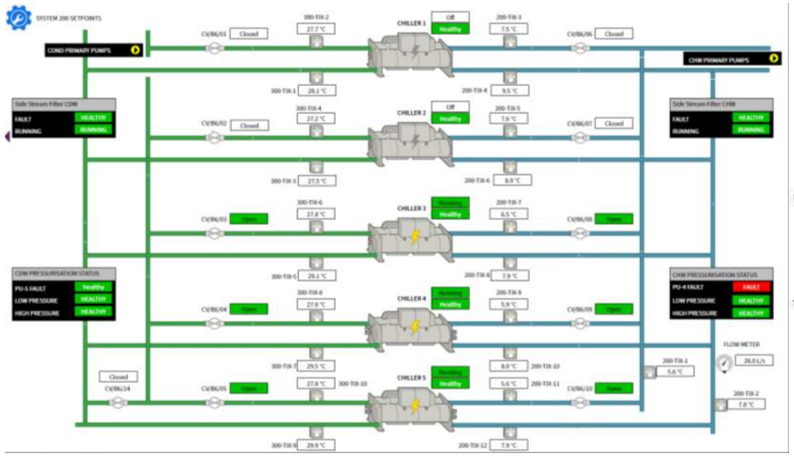
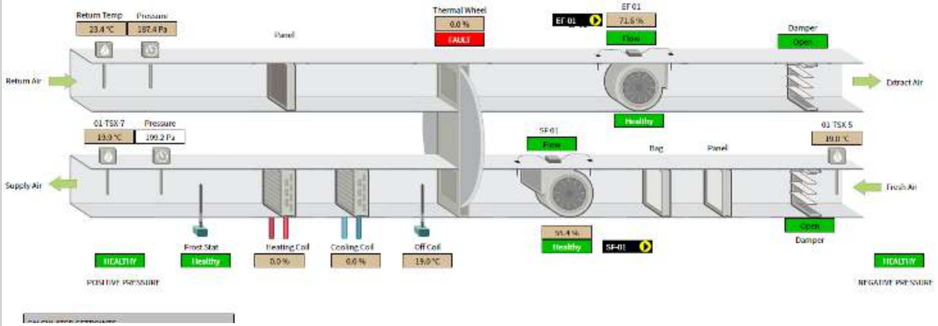
# Energy Systems in Current Days



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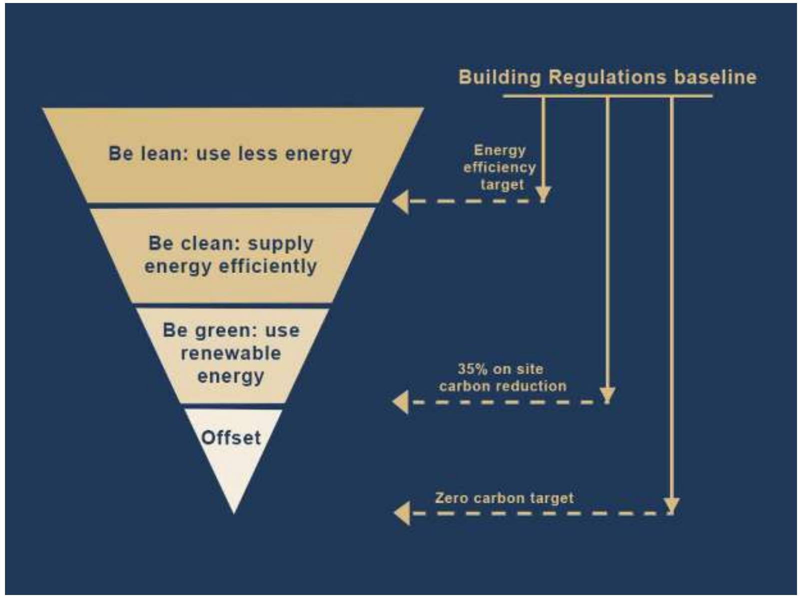
# Our Duty

- **Conserve energy-**
- **Use efficient system**
- **Use renewable resources**
- **Consider the embodied carbon of the system, its emission and its end of life**




The Greater London Authority (GLA) set out the hierarchy

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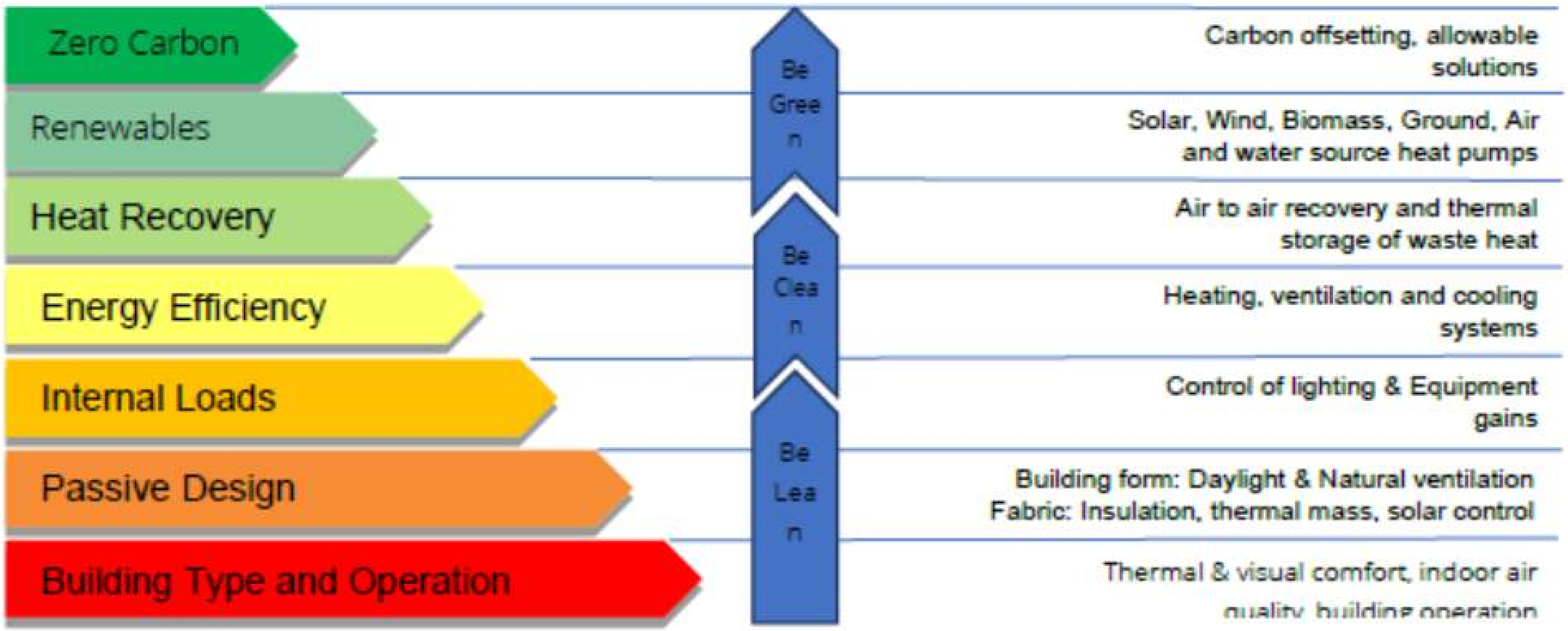
# Energy hierarchy




Adopted from the Greater London Authority (GLA) energy hierarchy

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# Challenges to Net Zero

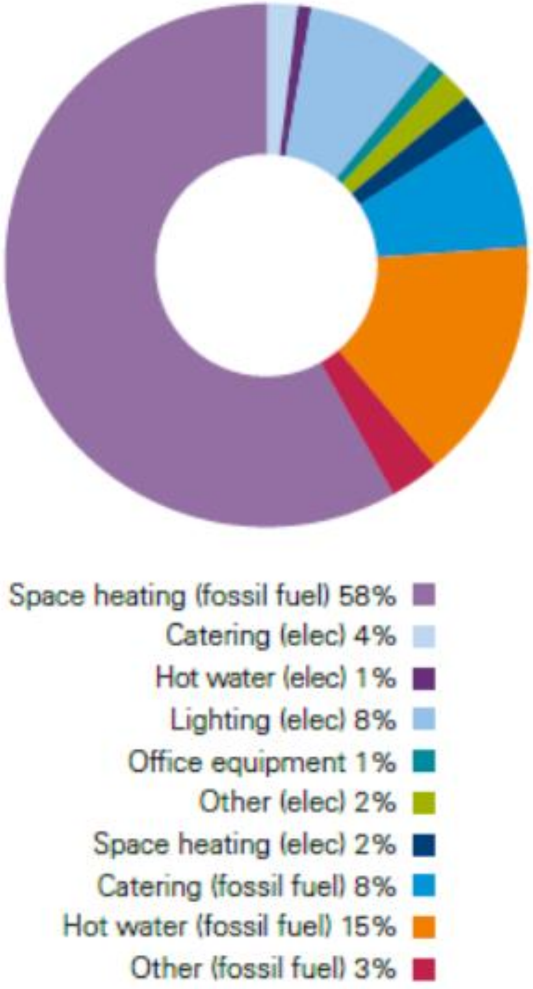
1- Where to start!

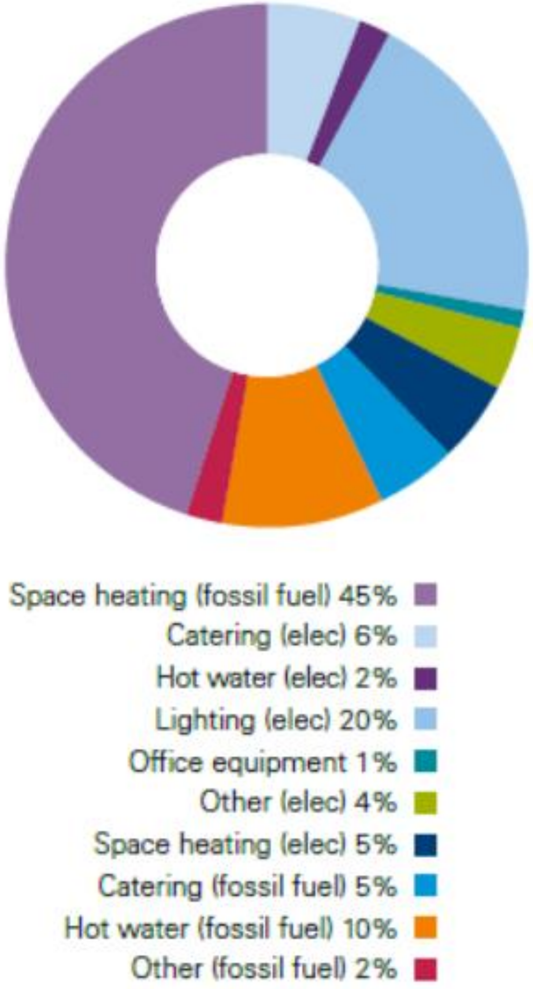
2- Lack of understanding of energy, its quantity, cost and emission.

3- Lack of understanding of the operation of energy-consuming systems.

4- Lack of connectivity between demand and availability.

# Understanding Energy Consumption




Percentage of energy use (left) and percentage of energy cost (right

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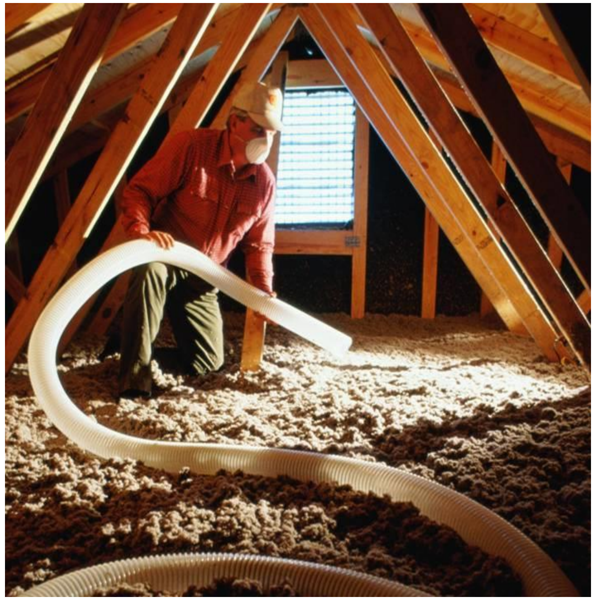
# Insulation and Glazing



- **Improved Insulation:**
  - Upgrading insulation in walls, roofs, and floors
  - Maintains desired indoor temperatures
  - Reduces heating and cooling demands

  (Source: Building Research Establishment, 2021)

- **Double/Triple Glazing:**
  - Reduces heat loss
  - Enhances energy efficiency

  (Source: BRE Group, 2019)

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# Technological Upgrades- Efficient and Smart Lighting Systems

- **Energy-LED Efficient Lighting**
- **LED Lighting:**
  - Lower energy consumption
  - Longer lifespan
  - Reduced maintenance costs

- **Smart Lighting Systems:**
  - Sensors and automation
  - Optimized based on occupancy and natural light

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# Examples 1- Reading University

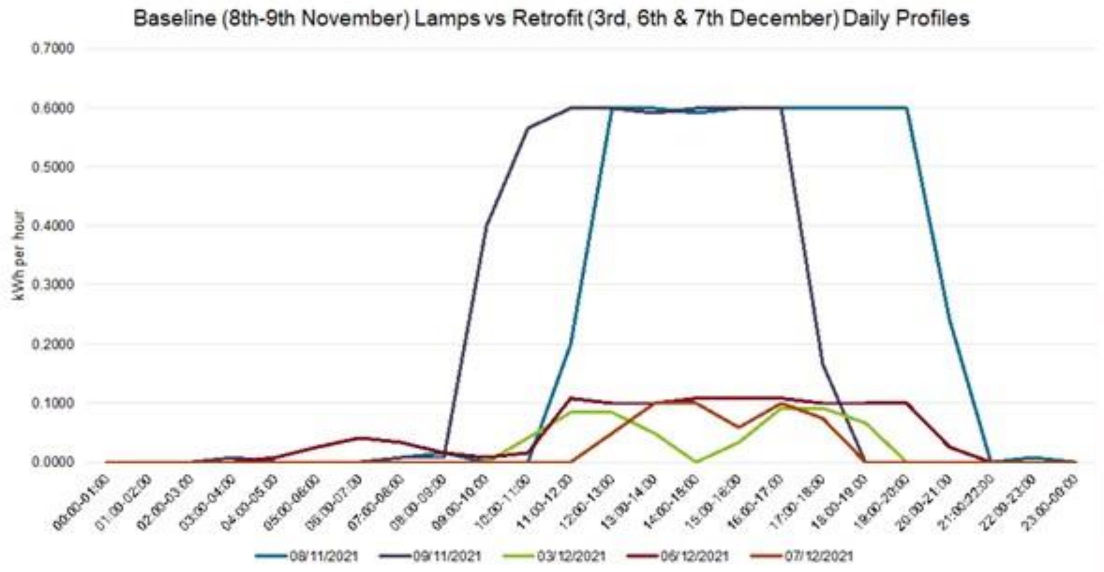

Figure 1: Daily profile data baseline vs retrofit (Meteorology 1U07)

Source, Mudie, Reading University (2023),
Accessed: 1 July 2024

| Calculation | Salix Application | Actual |
|---|---|---|
| Annual kWh Pre-Project | 1,264,258 | 1,309,582 |
| Annual kWh Post-Project | 369,985 | 216,504 |
| Annual Savings (kWh) | 894,273 | 1,093,078 |
| Annual Savings (% kWh) | 70.74 | 83.47 |
| Project Cost (£) | £1,579,144 | £1,625,430 |
| Annual Financial Savings (2020-2021) | £135,929 | £166,148 |
| Annual Financial Savings (2022+) | £226,251 | £276,549 |
| Payback (Years, 2020-2021) | 11.62 | 9.78 |
| Payback (Years, 2022+) | 6.98 | 5.88 |
| tCO2e Pa | 226.25 | 254.84 |

Total savings across all four LED projects compared with the initial estimates, across reading Greenlands, London Road and Whiteknights campuses including Minghella studios.

Source, Simpson, Reading University (2023),
Accessed 1 July 2024

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# Other case Studies

•York University
•Replacement of over 2,000 fluorescent lights with LED lights.
• Estimated 15-20% reduction in total energy usage in completed buildings.

Source - York University

Cardiff Met

- Reported spend of about £850k per year on electricity across their estate.
- Of this total, approximately 40% is attributable to lighting costs.
- They reported energy savings up to 85% in some areas, with an average of almost 70%.
- Potential maintenance savings of up to 100% due to LED lamps having an operating life of up to 50,000 hours.
- Qualitative benefits of LED lighting include increased productivity and alertness, more even lighting, improved mood, and standardised colour rendition and temperature (daylight).

The project delivered the following benefits over the completed programme of upgrades:

| | |
|---|---|
| 69% | Overall electricity reduction |
| £77k | Annual savings in electricity costs |
| 80t | Reduction in tonnes of CO2 per year |
| 1,725 | Total number of fittings removed |
| 1,355 | Total number of LED fittings installed |
| 21.5% | Reduction in number of LED fittings installed |
| 4yrs | Payback period |

Source - Cardiff Met (2023) , Accessed 1 July 2024

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# Technological Upgrades-2

- **Heating, Ventilation, and Air Conditioning (HVAC) Systems**
- **Modern HVAC Systems:**
  - Use of heat pumps and high-efficiency boilers
  - Optimal heating and cooling with minimal energy
- **Building Management Systems (BMS):**
  - Centralized control of HVAC and lighting
  - Optimizes energy use

  Source: Carbon Trust, 2020

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# Smart Meters

- Smart meters enable consumers to track their energy use, automatic meter reads and accurate billing.
- At the end of December 2021 there were 27.8 million smart meters operating in Great Britain. Of these, 23.6 million were smart meters operating in smart mode or advanced meters.
- At the end of 2021, 50% of all meters in domestic households were smart, compared to 49% in smaller non-domestic sites.
- Source- UK Energy in Brief 2022 (publishing.service.gov.uk)

# Renewable Energy Integration

- **Solar Panels:**
  - Harness renewable energy
  - Reduces reliance on grid electricity
  - Lowers overall energy costs
  - Source: Energy Saving Trust, 2020
- **Wind Turbines:**
  - Generates renewable energy on campus
  - Source: Energy Saving Trust, 2020
- **Ground Source Heat Pumps:**
  - Uses stable ground temperatures for heating and cooling
  - Efficient alternative to traditional HVAC
  - Source: Sustainable Energy Association, 2021

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# Whole System thinking

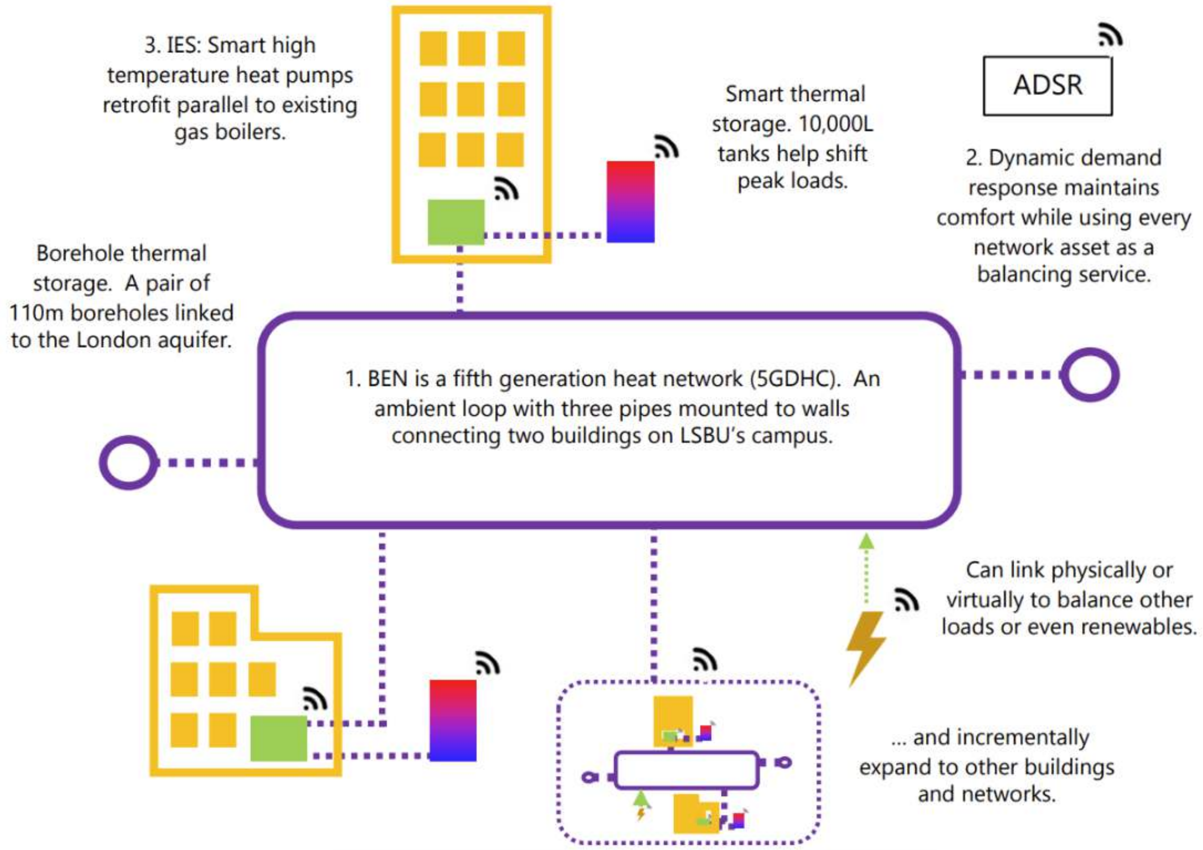


Diagram representation of the BEN network, Gilich et al (2022)
https://doi.org/10.1016/j.energy.2021.122843

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# Behavioral Changes and Education

- **Energy Awareness Programs:**
  - Workshops, campaigns, and curriculum integration
  - Fosters a culture of sustainability
- **Energy Champions:**
  - Appointing individuals to promote energy-saving practices
  - Monitors and encourages behavioral changes

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# Policy and Funding

- **Government Policies and Incentives:**
  - Energy efficiency: guidance for the school and further education college estate - GOV.UK (www.gov.uk) (2022).
  - Carbon Reduction Commitment (CRC) Energy Efficiency Scheme
  - Frameworks and financial incentives for reducing carbon emissions

  (Source: Department for Business, Energy & Industrial Strategy, 2021)
- **Funding Opportunities:**
  - Grants and funding programs from government and private sectors
  - Supports energy-saving projects

  (Source: Carbon Trust, 2020)

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# Challenges

- **Initial Investment Costs:**
    - High upfront costs for technological upgrades
- **Maintenance and Management:**
    - Resource-intensive regular maintenance
- **Behavioral Resistance:**
    - Difficulty in achieving consistent behavioral change among students and staff

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# Summary

- Understanding the prime sources of energy could give a better understanding of the economic and environmental impacts.
- Check all energy-consuming equipment for their efficiency and long-term maintenance.
- Energy efficient systems and smart meters are only the first steps to saving energy- the rest is to how you use energy across your workplaces.
- There are lots of energy-saving tips. But they need to research verified energy-saving tips.
- Diverse and effective energy-saving methodologies incl. technological upgrades. renewable energy, and behavioural changes.
- Future outlook: Addressing challenges through policies, funding, and education, ensuring the long-term sustainability of energy-saving practices

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Thank you for your attention!

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