Commercial Building Efficiency

Creating a low carbon future

Version	Draft 3.4
Team	Climate Change Task Force

Shropshire Council

www.shropshire.gov.uk

1 Introduction

This document is intended to support property management and maintenance for commercial buildings across Shropshire and considerations when planning a new build. It is also intended primarily as a resource for the Public Sector: Town and Parish Councils and schools, but also a resource for the commercial sector. Outlined are policy recommendations to support existing commercial strategies and assist the goal of reaching zero carbon by 2030. The Climate Change Strategy and Action Plan documents as well as technical annexes should also be referred to.

Reducing carbon can go hand-in-hand with reducing buildings operating costs. Other running costs include; staffing, management fees, maintenance costs which can also be reduced by choosing smart options. The government's electricity price forecast for the National Grid estimates a 12-25% rise in real prices by 2030 for residential, service and industrial users. With rising energy costs, this trend is set to continue.

There is a shift in Government policy towards 100% electrification across energy systems including building heating; which accounts for up to 40% of the UK energy demand. By 2030 most heating systems in both rural and urban settings will be electric; This shift reflects the "**greening of the grid**" with the high uptake nationally of renewable energy and subsequent reducing carbon factor for electricity.

Therefore, electrical power is a relatively low-carbon source of energy for heating, lighting and ICT equipment. It can be costly however, to use electricity for heating and cooling, unless efficiency measures are taken such as heat pumps or storage heaters. Choosing a "green tariff", is an easy-win method to achieve zero-carbon and shifting usage to off-peak hours using smart storage systems such as battery's or thermal stores helps reduce costs further.

In short, there are innovative and "green" opportunities for our assets to both power down and power up to secure financial savings and potentially extra sources of income.

Summary of drivers to ***Power Down*** by efficiency measures and ***Power Up*** with renewables:

- Reduce carbon emissions and fuel bills.
- Meet our climate change objectives (**climate emergency states a goal of zero carbon by 2030**).
- In line with the Governments **Clean Growth Strategy** for low to zero carbon economic growth.
- In line with the Councils **Commercial Strategy** to reducing service area costs and assist budgeting.
- Improve **comfort levels** for staff and public occupants.
- Improved **health and wellbeing** benefits linked to above and improved productivity of staff.
- Comply with statutory requirements such as **Part L of the Building Regulations**
- Comply with new statutory Government legislation **MEES (Minimum Energy Efficiency Standards)** for the Private and Public Rented Sector Regulations.

1. Power Down via Energy Efficiency: Energy costs depend on both the consumption of energy units (kWh) and the tariff price (pence per kWh) of primary heating fuel (gas or oil is typically 4-8p/kWh) and electricity (typically 10-20p/kWh). Water, recycling and consumables should be considered since commodities have both a financial and carbon cost. Running costs fundamentally depend on how the building is used, occupancy and user behaviour.

Soft interventions include site management, behaviour and staff wishing to champion the future. **Hard interventions** include designed measures commissioned (whether retrofitting or new builds). As part of the design process, whole-life-cycle cost should always be considered when designing, commissioning and procuring any new equipment; since the running cost of powered equipment's soon outweighs the capital expenditure.

***2. Power Up via* Renewable Heat and Power**: Solar PV (photo-voltaic) and wind power are effective ways to generating electric especially in rural locations. Solar thermal, air or ground-sourced heat-pumps or biomass are effective and efficient ways to heat buildings and generate hot water instead of oil or gas.

2 Shropshire Building Types

Shropshire's buildings vary in age from: from Tudor, Victorian to newly commissioned buildings. Efficiency in commercial buildings should be targeted based on locality (rural or urban settings), type, age and usage (e.g. office, leisure, catering). These measures are based on correct industry guidance such as CIBSE, BRE, Historic England and Carbon Trust. At present the heating fuel may typically be mains gas in urban areas and oil in more rural contexts and sometimes due to building constraints or choice electric may be used for space heating and hot water.

2.1 Heritage Buildings

Typically, older buildings cost a lot more to heat than new builds. Older or historic buildings shouldn't however "abandon all hope" in terms of reducing their running costs; since there is very good guidance to make these buildings more efficient sympathetic to the aesthetic and original building fabric. Using re-fit techniques, older builds can achieve an EPC C+. Although technically listed properties are exempt from EPC regulations, building improvements still secure lower ongoing running costs which is a concern especially for Shropshire Council.

Historic buildings (1950's and older) typically still feature single glazing and solid stone. Any signs of damp imply poor thermal efficiency and high heat loss should be addressed. Improved building fabric, windows and eradicating damp will reduce heat-loss though the thermal envelope: windows, roof and external walls:

1. Address any causes, sources of damp in external walls, damp course and drainage issues.
2. Ground floor, solid wall insulation, internal cladding and roof/loft insulation.
3. Bespoke sympathetic secondary glazing panels.

There are breathable insulation types across a range of materials from newspaper, sheep's wool, hemp and wood-fibre. Historic England guidance should be referred to for fabric improvements on heritage and listed properties. In addition there are very good case studies in historic cities such as Bath and from Centre for Sustainable Energy (CSE). Although now 10 years old; we still have excellent Historic Community guidance on our website.

2.2 Recent Builds (1960's and newer)

These buildings should be relatively efficient already and able to achieve an EPC of C-B. if not, they usually are easily uplifted to a higher EPC rating with plenty of opportunity to improve the building fabric with standard retrofits such as cavity wall insulation, secondary glazing, improved heating, efficient electrical equipment and control systems.

2.3 New Builds (good design principles)

It is important to get the design right first time and not only think just about the initial capital outlay but avoid expensive future improvements and ensure long-term savings (carbon and financial).

EPC Rating A (< £1m) and BREEAM Excellent for new builds with a value of > £1m.

For new builds an EPC (Energy Performance Certificate) A is expected and BREEAM Excellent is expected for large commercial builds. These set design criteria up to Passivhaus standard (PHPP); whereby it is possible to heat a building by the occupants. Zero carbon is possible with exemplar thermal performance with onsite renewables. The cost is no longer prohibitive, with good design principles zero carbon can be achieved on a range of budgets. Options such as off-site prefabricated units and modular construction techniques are available to speed up construction and save costs. Please see our sustainable construction policy for more details on BREEAM.

3 Benchmarking (asset portfolio)

The first step is to rank the buildings (Table 1) and first prioritised by EPC and DEC ratings. Some historic Buildings underwent energy assessments in 2010 and further independent energy audits since have helped benchmark the asset portfolio. The sites should then be prioritized in Table 1 in terms of largest energy spend / floor area (£/m^2). This gives a true indicator of performance and efficiency.

Table 1 Benchmark Template (combining annual electric and gas costs)

					TOTAL ENERGY	TOTAL COST	COST/m2
Premises (building/asset)	postcode	Floor area	DEC rating	EPC*** rating	kWh	£	£/m2
Worst performer							> £25
							> £20 <£25
							>£15 <£20
							>£10 <£15
Best performer							>£5 <£10

3.1 Overarching Goal (2025 or 2030)

The next step is to rate the sites showing indicative savings (based on low to high capital spend interventions). Although these savings may be very much ball-park, % savings as provided by **Carbon Trust** and reputable manufacturers data are a reliable source of information to estimate this.

Table 2 Target Costs and Efficiency Improvements Template

		TARGET ELEC	TARGET HEAT	TARGET ENERGY (low capex)	TARGET ENERGY (deep re-fit)	POTENTIAL (Individual) SAVINGS
Premises (building/asset)	postcode	£	£	£	£	£
			Total Savings	**£XX,XXX**	**£XX,XXX**	

3.2 Savings and Payback Period

Calculate total annual savings based on 1. Low-cost and short-term interventions and 2. Higher spend and longer-term interventions and state assumptions (% savings and unit price of energy for heating and electricity). State the payback period and return on investment for each intervention. It is also prudent to state the total energy saving (kWh) and carbon saving (CO_2e) for each measure.

Table 3 Intervention Savings Summary Table

Interventions	Annual Savings	Assumptions	Payback Period & ROI
1. low capital outlay	£XX,XXX	For example, 40% electric, 20% heat efficiency.	XX yrs. XX%
2. higher capital (deep re-fit)	£XX,XXX	For example, an ideal building performance of **£10/m²**.	XX yrs. XX%

4 Efficiency Interventions

Please refer to latest Carbon Trust or previous (Government) Green Deal guidance and individual energy reports (DEC's, EPC's) for further information on appropriate measures which are wholly dependent on the individual site circumstances. Possible interventions range from standard to innovative (including renewable energy and storage).

4.1 Short Term Interventions

Typically include a zero spend approach which can be carried out by the responsible parties whether: Facilities Management, frontline service staff, site and branch managers, Building User Groups and staff themselves. Key measures involve optimising heating controls, lighting and electric systems. A lot of these "easy wins" are associated with staff behaviour. The **Climate Crisis** and high public agenda is an enabler to a culture of change and there should be very few now who dispute the drivers and incentives for change. The messages however need to be kept simple and backed up with evidence referencing leading industry guidance such as Carbon Trust. A holistic operational management approach should ensure equipment and lighting switched off after use and heating interventions such as boiler controls and thermostats are set correctly. This method relies on behaviour change and correct use by staff, site managers with accurate guidance.

Please also see the **Resource Management** interventions for recycling and repurposing 0, p22.

4.1.1 Zero-Cost Measures

<u>Recommended Responsible Parties:</u> Facilities Management, Frontline Service Staff, Building-User-Groups, Site/Branch Managers, Administrators, Responsible Officers and Green Champions.

Typically include a zero spend approach and no significant investment in building fabric or change of heating systems. However, it does involve operational changes, enforcement of procedure to encourage energy saving behaviour. This includes optimising heating controls, lighting and electric systems. It means a management approach to ensuring equipment and lighting switched off after use and boiler controls and thermostats are set correctly. This method relies on behaviour change, site manager intervention and correct guidance. Measures are listed in detail below and may involve "Green Champions" initiatives as outlined over the page.

4.1.2 Enlist Green Champions

Perhaps there already are "eco-warriors" within the organisation who wish to champion the future. Green Champions raise awareness and engage staff to encourage good environmental practice amongst colleagues, setting an example in their workplace. They should receive "**Carbon-Literacy**" training to answer questions on subjects such as climate change, energy efficiency, recycling and plastics. Green Champions help implement carbon-reduction activities by monitoring energy usage and identifying opportunities for reduction. Their scope covers energy, water, recycling, travel, and office consumables. It helps if they meet regularly and collaborate, sharing resources to create a roadmap towards achieving a big overarching aim or commitment such as zero carbon 2030.

4.1.3 Check your Energy Performance

1. Register the building with your local cloud-based energy monitoring service or smart meter monitor.
2. Once this is in place you should be able to monitor electric, gas and water consumption.
3. The site manager or designated officer should familiarise themselves with the energy monitoring service.
4. If no data is available, then *an AMR (automated meter reader) or smart meter may be fitted.*
5. Check your buildings EPC, DEC's (and advisory reports): https://www.ndepcregister.com/

4.1.4 Low-Cost Measures

Correct Heating System maintenance (via your on-site maintenance)

Heating systems and correct use has a high impact running costs. Common issues with little cost to implement include correctly setting the heating schedule (based on occupancy), equally thermostats, room temperatures and switching off equipment after use. These types of interventions are very simple and low-cost. Managers and staff alike should take control of their energy consumption by using smart meters to spot anomalies and become pro-active as opposed to reactive in keeping their utility costs down. This approach has very low cost to implement.

1. Keep boilers and heating system checked serviced and maintained annually.
2. Set the heating schedule to reflect building usage patterns and ensure managers know how to adjust.
3. Ensure summer/winter setting correct. (Newer systems have weather compensation).
4. Set correct room set-point temperature (18°C) and guidance to staff for winter clothing.
5. Ensure all windows and external doors are closed if the heating is running.
6. Avoid supplementary heaters – make sure main heating system works.
7. If night storage heaters fitted: Check and ensure controls are set properly and correct tariff.
8. If hot water tanks or small water-boilers for hot-drinks are fitted – ensure timers set correctly.
9. Electrical System (manual or automated) Interventions:
    a. Ensure all non-critical equipment: ICT or lights **are turned off outside operational hours**.
    b. Critical equipment: fridges, servers or security equipment left on according to requirements.
    c. When the buildings are temporarily closed or vacated please ensure all heating and non-critical electrical systems are deactivated (heating systems may need a 5°C frost protection in the winter).

4.2 Longer Term Measures

Parties: Asset Manager / Maintenance – raise business case and implement interventions appropriate to site.

Involve capital investment in building fabric and change heating systems to more efficient versions. Typically, a building retrofit includes interventions from standard to innovative solutions across building heating, lighting and other electrical systems. As outlined earlier there is a government led policy shift to electric for all energy provision.

4.2.1 Thermal Efficiency

Standard Carbon Trust measures have very quick payback periods. "Behind the scenes" plant room: thermal-lagging, heating controls. These typically achieve 20% saving for each measure. Interventions to improve building heating efficiency can either be individual retrofit solutions or a whole building solution. Energy Performance Certificates (EPC) and their recommendation reports should be referred to when scoping measures. For buildings over 250m2 floor area, Display Energy Certificates (DEC) and associated Advisory Reports should be referred to.

Building Fabric

Building fabric improvements include various insulation types tailored to the building age and construction type. For example, synthetic materials such as cavity wall polystyrene beads, extruded polystyrene foam, warm cell , polycell, Kingspan, rock-wool. Alternatively, natural wood or other organic fibre products such as hemp, sheep's wool, or newspaper are available. Insulation should be implemented on the thermal envelope; i.e. the roof, external walls and ground floor.

Historic England guidance should be referred to for fabric improvements on heritage and listed properties. In addition there are very good case studies in historic cities such as Bath and from Centre for Sustainable Energy (CSE). Although 10 years old; we still have excellent Historic Community guidance on our website.

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Windows

Window technology has advanced greatly in recent years, with films to reflect heat or compensate for solar gain and improve the thermal properties or U value (heat loss factor). Triple or even quadruple glazing now available. If working to a budget, high specification double-glazed units may be suitable. However, it pays to budget and specify higher thermal properties with effective seals.

For heritage buildings, due to planning restraints, choice is limited. There are however, now bespoke sympathetic double or triple glazed units. Also, it is common practice to fit secondary glazing panels just over the winter period in listed properties. Councils in world heritage sites such as Bath City have successfully implemented this policy.

4.2.2 Heating Systems

As outlined above address building fabric as a priority to bring the overall building heat requirement down. Following this, over the next 10 years we need to implement a gradual transition of existing buildings heated by boiler (wet) systems to lower carbon fuel such as biomass or if possible more efficient heat pump systems.

It is perfectly feasible to replace a gas or oil boiler by a biomass equivalent, but since boilers circulate at 80°C/60°C while heat pumps circulate at 40°C it is technically challenging to replace fossil fuel heat plants with heat pumps without stripping out all the pipework. The explanation for this is as follows: To transport the same amount of heat heat-pumps require much higher flow rates, meaning bigger pipes and pumps, and either bigger emitters or different emitters, e.g. fan convectors where noise is not an issue. This means a total heating strip-out and completely new system and given the high number of buildings with wet systems.

Considering this, if the building employs a pre-existing a wet system, then the following options are recommended:

1. Ensure boilers are high efficiency condensing types.
2. Using a water additive to improve the flow/return thermal transfer efficiency.
3. Employ a plant fuel supply regulator and full building management system (BMS) such as Trend.
4. Change high temperature (65C) wet systems to a low carbon fuel source: such as wood pellets.
5. Utilise Thermostatic radiator valves (TRV's) for wall mounted emitters.
6. Utilize individual thermostat zones with set-point temperatures (normally set at 18C).

If a new build or a complete retrofit or whole building approach is being considered:

1. Implement fabric improvements as outlined earlier to uplift the EPC to at least a B.
2. Replace a wet heating system to a more efficient low temperature heat pump system or storage heaters
3. Depending on the site this can be either an air sourced, ground sourced or water sourced heat pump.
4. If the site and budget allow a ground (GSHP) or water sourced heat pump is preferred for improved Coefficient of Performance (CoP) and Seasonal Performance Factor (SPF).

Heat Pumps

Heat pumps work like a refrigerator in reverse and extract latent heat from the ground, water source or the ambient air temperature. They pump latent heat into buildings and operate on an efficiency rating or Coefficient of Performance (CoP) and a Seasonal Performance Factor (SPF) based on locality. The use some electricity to operate, however the efficiency is such that the CoP factor is typically 2-2.5 for air source heat pumps (ASHP) and 3-4 for ground source heat pumps (GSHP); making heat pumps 2-4 times more efficient than conventional electric heating.

If considering a heat pump system; always as a pre-requisite building fabric issues should be addressed first to improve the overall building energy performance. Options need to be appraised considering specifics of the site, such as assessing the building heat requirement, and calculating the commercial payback of each option.

Furthermore, although some manufacturers have brought out "high temperature" air to water heat pumps, i.e. 65°C, however the CoP is poor, and at present they utilise a refrigerant with huge global warming potential (GWP 2100) which will be phased out of production in December 2023. Manufacturers, government and the like of CIBSE focus on the efficiency but fail to stress this is only in the low temperature range and choose to ignore the other environmental issues. Industry and manufacturers remain optimistic for improved efficiency on heat pumps and intend to substitute refrigerants with less environmentally damaging variants. Residential split and multi-split systems currently available now have a long-term future as they stand and are usable on small schemes.

Biomass

If for whatever reason it is prohibitive to install a heat pump system, then a biomass boiler could be considered. Biomass boilers are very effective (I use a pellet boiler at home working since 2015 and very happy with the way it operates). Biomass has the advantage for being able to replace a gas or oil boiler like for like; i.e. simply replace for the same heat requirement or power; since they operate in much the same way for wet systems at the same water temperatures (typically 60 or 70°C). Biomass feeds need to be proven sustainably sourced (replanted) supply chain (BSL accredited) this could be a crop locally grown on-site in rural locations such as short cycle coppiced willow. Fuel is not just limited to woody biomass; other sources include energy crops such as Miscanthus (elephant grass).

- Wood-Pellet domestic (typically < 50kW$_{th}$) and non-domestic plants (typically > 50kW$_{th}$).
- Wood-Chip domestic (typically < 50kW$_{th}$) and non-domestic plants (typically > 50kW$_{th}$).
- Wood-Chip CHP (combined heat and power) microgenerators (still quite rare in the UK).
- Woodchip or other biomass feed larger scale CHP generators (can be up to 1MW$_{th}$ or more).

Smart Heating Options (Storage Heating)

Storage heaters are still a viable option if used correctly; They normally work by charging up on an economy electric tariff overnight and storing heat to disperse during the following day. It is important to emphasise with storage heaters that the controls should set correctly, and timers set to make use of economy rate tariff. It should be noted that operating costs for heating by day rate electricity can be twice as expensive as night rate (~15-20p/kWh as opposed to ~5-10p/kWh economy rate). The downside of storage heaters is often users get confused by the controls and therefore don't set them correctly and it is challenging to retain heat to use in the evenings when it is needed in domestics (might not be an issue for commercial daytime use).

1. Night storage heaters (for example Dimplex Quantum or Econorad).
2. Ensure they are optimized to use the cheap overnight economy tariff or store renewable energy.
3. Set timer controls to reflect operational hours and stop charging heaters when not in operation.

Smart Heating Options (De-Strat Fans and Infra-Red)

- Warm air can be lost in high ceiling voids, then de-stratification fans can be appropriate to re-circulate air.
- Infra-red heaters are becoming popular for some applications where short-term instant neat is needed.
- New computer-controlled IR heaters on the market with public sector applications: offices, hospitals etc.
- IR heaters are ineffective at heating high volumes of air (they heat people or objects only).

4.2.3 Electrical Efficiency

Improvements in electrical equipment such as ICT and efficient LED lighting. Motion and daylight controls for sporadically used zones may be appropriate. LED lighting is 60% more efficient than older technologies. Adding controls make them 80% more efficient than fluorescents. Electrical efficiency improvements include:

1. Efficient electrical equipment (A or B rating) for offices including ICT.
2. LED lighting and motion and/or lux sensor controls (for areas of sporadic use and natural daylight).
3. AMR (automated meter reader) for commercial sub-tenanted areas (gas, electric or water).
4. **Further Electrical System Optimisations**: Voltage Optimization (regulates down voltage in high voltage areas), power factor correction and correction of load imbalances for three phase systems.

4.2.4 Innovative Efficiency

Whole building solution whereby multiple measures are recommended using innovative efficiency measures:

1. BEMS (Building Energy Management Systems) with weather compensation included.
2. Heat Ventilation Air Conditioning (HVAC) systems with heat exchangers and heat recovery.
3. Variable Speed Drives (VSD) for any large motors (e.g. pumps or fans in air handling units).
4. Night Storage heaters with smart flexible controls and PV optimisation; e.g. Dimplex Quantum.
5. Thermal accumulator (hot water store) combined with a load diverter to optimize solar energy.
6. Heat or Thermal Batteries (phase change materials), used in conjunction with renewable energy.
7. Battery Storage (lithium-ion) sized for building demand to optimize tariff and renewable energy.

4.2.5 Renewable Sources of Energy

Responsible Parties: Specialist contractor(s) renewable installer(s) via maintenance.

Balancing a mixed renewable generation portfolio against energy demand will be crucial to our future resilience.

In urban areas mains gas is often used for primary heating, in rural areas oil may still be used. For both scenarios solar PV (photovoltaics) or solar thermal or a combination are effective to offset heating costs. For urban settings mains gas CHP (combined heat and power) is a good solution due to the low cost of natural gas to cover both electric and heat demand. CHP has been adopted by some leisure centres due to the low cost of gas (~4p/kWh as opposed to 15p/kWh for electric). For rural locations heat pumps (air source or ground source) are candidates to consider, especially for new builds. Low-carbon generation (offset energy costs only if standard efficiency is done):

Electric Renewable Generation

- Solar PV (suitable in urban or rural locations if there is suitable roof/aspect).
- Wind turbine in suitable flat or elevated rural locations with appropriate wind speeds.

Renewable Heat Generation Summary

- Solar Thermal for hot-water (suitable in urban or rural locations if there is suitable roof/aspect).
- CHP (combined heat and power) – **urban locations only** utilizing mains natural gas or biomass (rural).
- Heat Pumps Air Source (in urban or rural settings) Ground Source more suitable for rural locations.
- Biomass boilers or CHP - for **rural locations** – if access for fuel deliveries (wood pellets/chip).
- **District heat networks –** these may be linked to low carbon sources of heat generation such as ground or water source heat pumps (low temperature), CHP or waste to energy plants (high temperature).
- Industrial processing high heat and low heat and how these blends with renewables
- Lower temperature blended solutions (<300°C) include solar thermal and deep geothermal, heat pumps.
- Higher temperatures (>300°C) blended solutions, biomethane, biomass and hydrogen combustion.

Hydrogen Economy

- Hydrogen is manufactured using electricity (by electrolysis) from renewables or synthetically from anaerobic digestion (AD) or Pyrolysis (using bio or industry waste) as part of the future energy mix.
- Hydrogen will likely be key to supporting future transport (trains, air, freight) in fuel cells whist electricity used direct to run motors in personal vehicles.

5 Building Efficiency Standards and Ratings

5.1 BREEAM Standard (new builds)

BREEAM (Building Research Establishment Environmental Assessment Method) applies to new buildings, any significant extension (over 100m^2) and refurbishment of existing buildings. It is based on BREEAM's underlying approach to sustainability, which is divided into key areas:

Management • Commissioning • Construction site impacts • Security.

Health and Wellbeing • Daylight • Occupant thermal comfort • Acoustics • Indoor. air and water quality • Lighting.

Energy • CO_2 emissions • Low or zero-carbon technologies • Energy sub-metering • Energy efficient systems.

Transport • Public transport network connectivity • Pedestrian and Cyclist facilities • Access to amenities • Travel plans and information.

Water • Water consumption • Leak detection • Water re-use and recycling.

Waste • Construction waste • Recycled aggregates • Recycling facilities.

Pollution • Refrigerant use and leakage • Flood risk • NOx emissions • Watercourse pollution • External light and noise pollution.

Land Use and Ecology • Site selection • Protection of ecological features • Enhancement of ecological value.

Materials • Embodied life cycle impact of materials • Materials re-use • Responsible sourcing • Robustness.

Innovation • Exemplary performance levels • Use of BREEAM Accredited Professionals • New technologies and building processes.

Please see our sustainable construction policy for more details on BREEAM.

5.2 SBEM (Simplified Building Energy Model)

SBEM is a software tool developed by BRE that provides analysis of a building's energy consumption for new and existing builds. SBEM is for non-domestic buildings in support of the National Calculation Methodology (NCM), the Energy Performance of Buildings Directive (EPBD) and the Green Deal.

The tool is currently used to determine CO2 emission rates for new buildings in compliance with Part L of the Building Regulations (England and Wales) and equivalent Regulations in Scotland, Northern Ireland, the Republic of Ireland and Jersey. It is also used to generate Energy Performance Certificates for non-domestic buildings on construction and at the point of sale or rent.

SBEM was developed by BRE for the Department for Communities and Local Government. The latest version of the SBEM tool and its accompanying user interface, iSBEM, can be downloaded free of charge from the dedicated National Calculation Methodology website at http://www.ncm.bre.co.uk/
A special version – cSBEM – was created to accompany the recent consultation on the 2013 revision of Part L of the Building Regulations in England and can be accessed at http://www.2013ncm.bre.co.uk

5.3 EPC's and DEC's (new and existing buildings)

It is a legal requirement to have a current EPC (Energy Performance Certificate) registered with MHCLG (Ministry of Housing Communities and Local Government) for both domestic and commercial properties. This applies to new builds, any property which is leased or to be sold and any heated building that has significant works done such as retrofitting. For the council, it is a legal requirement to display an EPC in any newly commissioned publicly owned buildings. Any existing commercial properties with a floor area over 250m^2 are required to display a DEC (Display Energy Certificate). This information is readily available on our public website, with a link the national register.

The **EPC (Energy Performance Certificate):** reflects building energy performance considering heating, hot water and lighting only and **2) DEC: reflects total energy consumption (electric plus primary heating fuel if any)**. Both certificates rate the property between A and G (A being the best performance) and are freely available online https://www.ndepcregister.com/ . These will have been undertaken by a suitably qualified EPC assessor for domestic or EPC/DEC assessor for commercial properties. The advantage of these documents is they are evidence-based prioritizing recommended improvement measures, cost and payback period. EPC's and DEC's are a reliable way to quickly rate a building and determine achievable savings. They provide useful evidence for prioritising improvements where funds are limited.

However, there are some caveats to EPC's: EPCs do not model financial payback effectively since they do not account for actual ongoing energy use. Additionally, EPC's have some way to catch up with recent developments in Passivhaus technologies. DEC's are more effective reliable way to measure commercial building performance (financial and carbon ongoing). To determine the payback period and develop an outline business case (OBC), the next steps generally for any design and build intervention are:

1. Seek independent quotes to determine the capital costs.
2. Calculate the savings made based on the proposed interventions and optimised energy tariff (p/kWh).
3. EPC's, direct utilities or smart meter data or DEC's (if available) may be used to evidence the business case.

5.3.1 EPC (Energy Performance Certificate) – more detail...

The EPC (Energy Performance certificate) considers heating, hot water and lighting only. The energy performance reflects the thermal properties of the building and heat-loss as determined by roof, exterior walls, and ground floor materials otherwise known as the "thermal envelope" or building fabric. An EPC is also defined by the floor-area, room volume, building type and occupancy. It is a legal requirement for any new build or building which is to be leased or sold. EPC's are necessary for any non-dwellings >50m^2 or commercial buildings >500m^2 (valid for 10 years). EPC reports make recommendations to improve building fabric and implement renewables where appropriate. The A to G scale is a linear scale is based on the actual building dimensions but with standard assumptions for fabric, glazing and building services and is based on two key points:

a) The zero point on the scale is defined as the performance of the building that has zero net annual CO2 emissions associated with the use of the fixed building services as defined in the Building Regulations. This is equivalent to a Building Emissions Rate (BER) of zero.

b) The border between grade B and grade C is set at the Standard Emissions rate (SER) and given an Asset Rating of 50. Since a linear scale, the boundary between grades D and E corresponds to a rating of 100.

5.3.2 DEC (Display Energy Certificate) more detail...

Display energy certificates (DECs) show the actual energy consumption of a building, the 'operational rating'. This is composed of electricity and primary heat energy (normally oil or gas). All buildings over 250m^2 and open to the public require a DEC and should always be displayed clearly visible to the public. A DEC is accompanied by an advisory report (AR) that lists cost-effective measures to improve the buildings performance. Public buildings over 250m^2-999m^2 require a DEC and AR that will be valid for ten years. Buildings over 1000m^2 will need an annual DEC and an AR that is valid for seven years once issued. The A-G scale rating shows the energy performance of the building as it is being used by the occupants. A building with performance equal to one typical of its type would therefore have an Operational Rating of 100. A building that resulted in zero CO2 emissions would have an Operational Rating of zero, and a building that resulted in twice the typical CO2 emissions would have an Operational Rating of 200.

5.4 MEES (Minimum Energy Efficiency Standards)

The Minimum Energy Efficiency Standards (MEES) was introduced by the government to help improve the carbon footprint of some of the UK's more inefficient properties. Any office or any occupied building requiring heating is required to meet the Minimum Energy Efficiency Standards (MEES). Around 75,000 commercial premises are likely to be affected. There is an obligation to landlords to continually evaluate and reduce energy usage on properties to be sold. This is done via pre-existing Energy Performance Certificates (EPC) based on the thermal performance for non-domestic buildings. Combined with existing building regulations, they require a proactive approach to incrementally improve building fabric and implement efficiency measures. The aim is to bring poor performing properties up to the required EPC rating and reduce bills. Legislated from April 2018 landlords with properties based in England and Wales must ensure they achieve an EPC rating of at least an **E** before they can grant or renew a lease. From April 2023 properties with existing tenancies must have an EPC rating of E or above, or the lease wont legally be allowed to continue.

5.4.1 Who does MEES apply to?

MEES applies to all privately rented commercial or domestic properties (including dwellings) that are legally required to have an Energy Performance Certificate (EPC).

5.4.2 What are the penalties for non-compliance?

The consequence of failing to comply with MEES is a financial penalty. Dependent on the type of infringement and the length of non-compliance, this could reach from £5,000 up to £150,000 per commercial unit.

5.4.3 MEES Plan

Please refer to CCS1 Evidence where a summary analysis has been made on both commercial and domestic EPC's across Shropshire. A strategy to evaluate properties at risk under MEES legislation should include the following:

- Site Audit
- Full Recommendations
- Funding Options
- Implementation and Maintenance Plan

The cost for improvements should be evaluated across the asset portfolio and individual works assessed on a site by site basis. Payback periods for works are typically <5years and can be captured back in rents and savings (if the landlord pay's the utilities costs). The valuation procedure of properties should reflect reduced running costs and uplifted EPC's and be updated accordingly. Whether residential or business tenants; reduced running costs make the properties more attractive.

6 Conclusions

Managing utilities costs is an imperative for reducing building running costs as well as tackling its carbon performance. So, the focus for both new and existing buildings should be to ***Power Down*** (electricity, primary heating and water) and reduce scope 1 and 2 carbon footprint. Further opportunities to ***Power Up*** may be exploited with building attached renewable electricity and heat.

Short Term Recommendations

Zero and low-cost measures listed should be implemented right away in line with agreed zero carbon objectives for 2030. Easy win measures implemented by:

- Building and site managers.
- Building users including groups to make change happen such as Green Champions.
- Behaviour change facilitated for building users and tenants.

Longer Term Recommendations

Where new builds or retrofitting design interventions (heating system adjustments or other changes are necessary) requiring capital investment (with specified payback periods):

- Asset Management, Landlords
- Business managers, Finance and account holders
- Maintenance Teams

New Builds

All new builds should use SBEM to achieve an EPC Rating of A.

Retrofitting

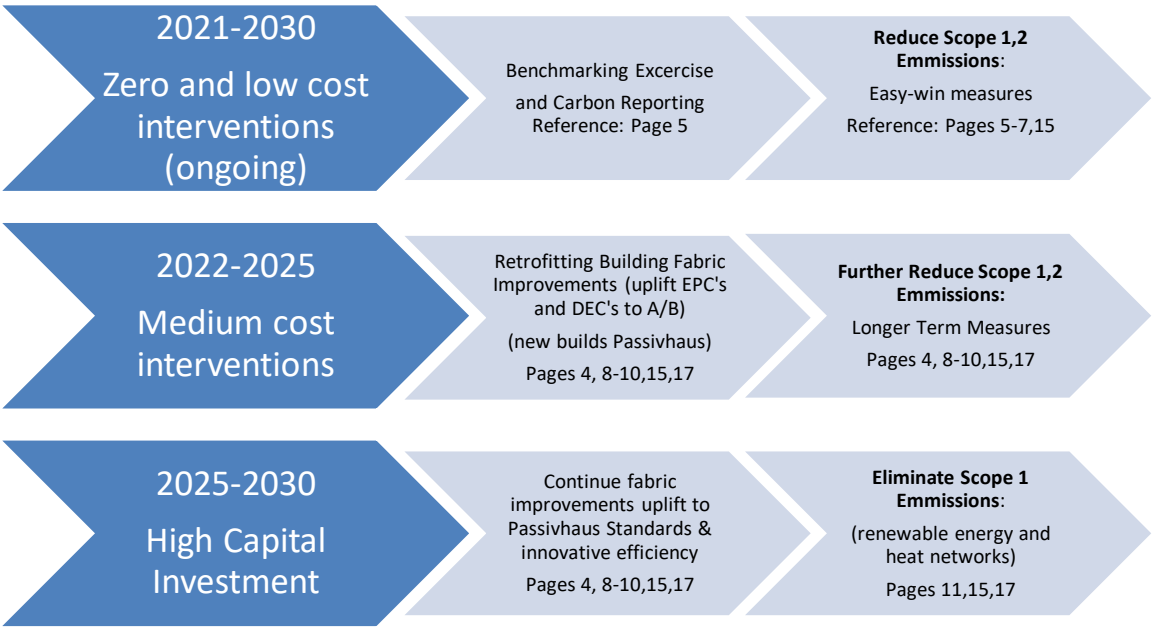
- Use SBEM to achieve an EPC Rating of at least a C (ideally B+).
- DEC's of at least a B are expected for buildings with a floor area > 250m^2.

MEES Plan

Landlords should implement works to incrementally uplift of building performance of tenanted properties and properties sold on the open market. The expectation is that leased and sold properties should not just meet the MEES criteria but exceed minimum standards in preparation for the next uplift of standards by the Government.

7 Delivery Pathway to Reach Net Zero

The following illustrates suggested timescales for an implementation plan to mobilise and deliver works at the scale required to reach net zero carbon across the built environment.



8 Next Steps: Retrofitting

These next steps listed are generally for Retrofitting in terms of the procedure for design and costing out and procuring works to be mobilised and implemented.

1. Obtain past 4-5 years billed data for electric, gas, oil, water as applicable.
2. Obtain DEC's where available and prioritize worst performers (£/m2).
3. Find out repairs and maintenance cost and any other utilities costs or management fees.
4. Carry out technical assessments: benchmark whole building energy costs as above (data as available).
5. Model and carry out an **options appraisal** across the different short term and longer-term energy efficiency and renewable energy interventions as outlined earlier in this document.
6. Estimate the annual savings, capital spend, and payback period based on each intervention.
7. Select the most effective options in terms of lifetime running costs, annual £ savings and carbon savings.
8. Prepare an Outline Business Case or Expression of Interest based on above and funding source.
9. Use industry guidance on pricing to help cost out works (Government DBEIS for example).
10. Raise a tender or quotations to obtain offers with necessary quality assurance for the public sector.
11. Commission (efficiency or renewable energy) via local installers through a competitive process.
12. As a reference point you may find the following helpful to assist with public sector delivery:
    Carbon Trust: https://www.carbontrust.com/home/
    Energy Saving Trust: https://energysavingtrust.org.uk/
    Re-fit Scheme: http://localpartnerships.org.uk/our-expertise/refit/
    Save Money Cut Carbon: https://www.savemoneycutcarbon.com/
    Both Re:fit and SALIX finance help public sector retrofitting at scale and in short timescales.

9 Next Steps: Sources of Funding

Government grants, 0% SALIX or capital on an invest to save basis may be used towards efficiency measures. Additionally, local communities are often keen for environmental to invest in improvements.

- SALIX (zero interest loan): https://www.salixfinance.co.uk/
- Community match (crowd sourcing) following public consultation exercise:
- Shareholders or Trust Scheme such as Sharenergy: https://www.sharenergy.coop/
- Business grants as advised by Carbon Trust, or Government grants may be applicable.
- Central Government Grants may apply if these buildings come under public sector.
- MarRE (Marches Renewable Energy Programme).
- BEEP (Business Energy Efficiency Programme), BEEP
- Low Carbon Opportunities Programme (Innovation)
- The BECCI Project: The BECCI Project benefits Small and Medium Enterprises (SMEs) in the West Midlands, providing free support in the development of products and services that reduce carbon usage.
- Please see the **RE EE Funding Opportunities** website for the latest list of funding opportunities.

10 Next Steps: Further Information

Resources for the public: Climate Change and Sustainability. Please see web resources over the page and the Climate Change Task Force in relation to **Buildings Efficiency and Renewable Energy: climate@shropshire.gov.uk**

11 Glossary

- SAP (Standard Assessment Procedure) generates EPCS for domestic dwellings (not covered here).
- SBEM (Simplified Building Energy Model) used for commercial new builds and retrofitting.
- SAP and SBEM model the property construction, heating, lighting and hot water to generate EPC's.
- BREEAM (Building Research Establishment Environmental Assessment Method) is a methodology for more complex large exemplar builds with capital value £500k+
- DEC (Display Energy Certificate) – displays actual usage and is a legal requirement over 250m2 GIA.
- EPC (Energy Performance Certificate) – measure building predicted (designed) performance.
- GIA – Gross Internal floor area.
- kWh – Kilowatt hour is 1,000 watts (units of power) for the period of one hour or a single unit of energy.
- MEES – The Governments Minimum Energy Efficiency Standards
- AMR – automated meter reader (generally for electric, gas or water meters) – like smart meters.

12 International Sustainability Standards

There are several internationally recognised standards from the International Organization for Standardization, that can assist Operational Improvements Towards Zero Carbon. Additionally, there are many British standards that bridge directly into specific areas of legislation such as Part L of building regulations, building control, electrical, mechanical and civil engineering. Some of the newer standards cross into multi-discipline technologies including renewable energy, such as the Micro-generation scheme (MCS) for small scale generation for solar, wind, hydro and heat pumps. A full list of these standards is given in the references section from page 18.

12.1 Energy Management System - ISO 50001:2018

ISO 50001 is based on the management system model of continual improvement also used for other well-known standards such as ISO 9001 or ISO 14001. This makes it easier for organizations to integrate energy management into their overall efforts to improve quality and environmental management.

ISO 50001:2018 provides a framework of requirements for organizations to:

- Develop a policy for more efficient use of energy
- Fix targets and objectives to meet the policy
- Use data to better understand and make decisions about energy use
- Measure the results
- Review how well the policy works, and
- Continually improve energy management.

13 Further References - Web Resources

In conjunction to this document the Climate Change Strategy, Action Plan should be referred to.

13.1 Building Efficiency

BRE, Building Regulations Part L : Building regulations in England setting standards for energy performance.

BREEAM (Building Research Establishment Environmental Assessment Method)

BREEAM recognizes and reflects the value in higher performing assets across the built environment lifecycle, from new construction to in-use and refurbishment.

Please also see our sustainable construction policy for more details on BREEAM.

Carbon Trust - An independent expert in carbon reduction and commercializing low carbon technologies.

CIBSE: The Chartered Institution of Building Services Engineers.

DEC (Display Energy Certificate): provides evidence for commercial and public buildings.

EPC (Energy Performance Certificate)

An Energy Performance Certificate is required for domestic or commercial properties when constructed, sold or let. It provides details on the energy performance of the property and what can be done to improve it.

Domestic: https://www.epcregister.com/ **Non-Domestic:** https://www.ndepcregister.com

Energy Saving Trust: "We are a leading and trusted organization helping people save energy every day"

OFGEM: Consumer protection and government regulation household and business energy.

Marches Energy Agency: Deliver practical solutions to reduce fuel poverty and cold homes, promote energy reduction and encourage the uptake of renewable energy

SBEM (Simplified Building Energy Model)

SBEM is a software tool developed by BRE that provides an analysis of a building's energy consumption. For non-domestic buildings in support of the National Calculation Methodology (NCM): http://www.uk-ncm.org.uk/

MEES (Minimum Level of Energy Efficiency' standards)

Guidance to landlords of privately rented domestic and non-domestic properties.

Heritage Building Thermal Efficiency Guidance

Historic England guidance should be referred to for fabric improvements on heritage and listed properties. In addition there are very good case studies in historic cities such as Bath and from Centre for Sustainable Energy (CSE). Although 10 years old; we still have excellent Historic Community guidance on our website.

13.2 Marches LEP Energy Strategy

Herefordshire MarRE (Marches Renewable Energy Programme)

Shropshire MarRE (Marches Area renewable Energy programme)

BEEP (Business Energy Efficiency Programmes).

Low Carbon Opportunities Programme (Innovation)

The BECCI Project: The BECCI Project benefits Small and Medium Enterprises (SMEs) in the West Midlands, providing free support in the development of products and services that reduce carbon usage.

13.3 Renewable Energy

Solar PV (Photo-Voltaic) - MCS

https://www.energysavingtrust.org.uk/renewable-energy/electricity/solar-panels

https://www.gov.uk/government/publications/power-to-the-pupils-solar-pv-for-schools

Wind:

https://www.gov.uk/guidance/onshore-wind-part-of-the-uks-energy-mix

Hydro

http://www.british-hydro.org/

https://www.gov.uk/guidance/harnessing-hydroelectric-power

13.3.1 Renewable Thermal Energy

RHI (Renewable Heat Incentive)

https://www.ofgem.gov.uk/publications-and-updates/domestic-renewable-heat-incentive-product-eligibility-list-pel

https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/contacts-guidance-and-resources/tariffs-and-payments-domestic-rhi/current-future-tariffs

www.energysavingtrust.org.uk/scotland/grants-loans/renewables/renewable-heat-incentive

https://renewable-heat-calculator.service.gov.uk/

Biomass - MCS

http://www.energysavingtrust.org.uk/renewable-energy/heat/biomass

https://www.gov.uk/find-fuel-supplier

https://www.carbontrust.com/resources/tools/biomass-decision-support-tool/

Heat Pumps - MCS

http://www.energysavingtrust.org.uk/renewable-energy/heat/ground-source-heat-pumps

http://www.energysavingtrust.org.uk/renewable-energy/heat/air-source-heat-pumps

Solar Thermal (Hot Water)

http://www.energysavingtrust.org.uk/renewable-energy/heat/solar-water-heating

CHP (Combined Heat and Power or co-generation)

https://www.gov.uk/guidance/combined-heat-and-power

13.4 National Grid Live Energy Mix

Watch the **"Greening of the Grid**" as we increase our renewable and low carbon energy sources and decarbonize our electricity towards the 2030 target https://gridwatch.templar.co.uk/

13.5 Government Departments - Climate Change

DEFRA Department of Environment, Food and Rural Affairs (DEFRA)

25 Year Environment Plan and related directives in waste, natural resources and agricultural.

DBEIS (Department for Business Energy & Industrial Strategy)

For the Government Latest guidance: including The Clean Growth Strategy, and regional statistics:

UK local authority and regional carbon dioxide emissions national statistics

The aim of these statistics is to provide the most reliable and consistent possible breakdown of CO2 emissions across the country, using nationally available data sets going back to 2005.

Ministry of Housing Communities & Local Government (MHCLG)

Directives and guidance for built environment: commercial and domestic sectors and communities to live and work, and to give more power to local people to shape what happens in their area.

13.6 ISO Standards – Environmental and Energy Management

https://www.iso.org/iso-50001-energy-management.html

https://www.iso.org/iso-14001-environmental-management.html

13.7 UK Energy Statistics

The digest, sometimes known as DUKES, is an essential source of energy information. It contains tables, charts and commentary. Separate sections on coal, petroleum, gas, electricity, renewables and combined heat and power a comprehensive picture of energy production and use over the last 5 years, with key series taken back to 1970.

13.8 Resource Management

Please refer to our website and recycling policy for further information including reference to single-use-plastics. Both domestic and commercial recycling is delivered by our service provider: Veolia Shropshire Location of Household Recycling Centres

DEFRA Waste Strategy , Veolia Shropshire

WRAP – Waste and Resources Action Programme - At the forefront of the circular economy

Find out how you can achieve economic benefits and resource efficiency.

Plastic Free Communities (Hosted by Surfers Against Sewage). It's about kicking our addiction to avoidable single-use plastic and changing the system that produces it. We are creating the Plastic Free Community network to free where we live from single use. Together we are tackling avoidable single-use plastic, from the beach all the way back to the brands and businesses who create it.

Reuse:

Warp-it: (Waste Action Re-use Portal) We have initiated a re-use distribution network for repurposing stationary, furniture and other office equipment. This service helps to repurpose and relocate office furniture and equipment to where it is needed. This service is available for use by Shropshire Council service areas, Town and Parish Councils, schools and academy trusts, charities, and not-for-profits. It is not available for personal use (for which there are services like Freecycle and Freegle).

Please follow the links above depending on the type of organization:

- Town and Parish Councils sign up here
- Schools sign up here
- Charities sign up here
- Further information for schools and not-for-profits here
- Business Partners sign up here
- Short instructional videos on how to list and claim items

Make sure you bookmark the correct link. Hit the big green button which says 'register' now. Once you register, you'll get further instructions. You can browse items on Warp-it by hitting the search button.

- Learn how to add an item here.
- Learn how to claim an item here.

If you want to know more about the system in general, go to www.getwarpit.com where there are examples of how the system is working well in other organisations just like ours.

You can also check out the Frequently Asked Questions here.

If you have any other questions, please contact. **WarpIT@shropshire.gov.uk**