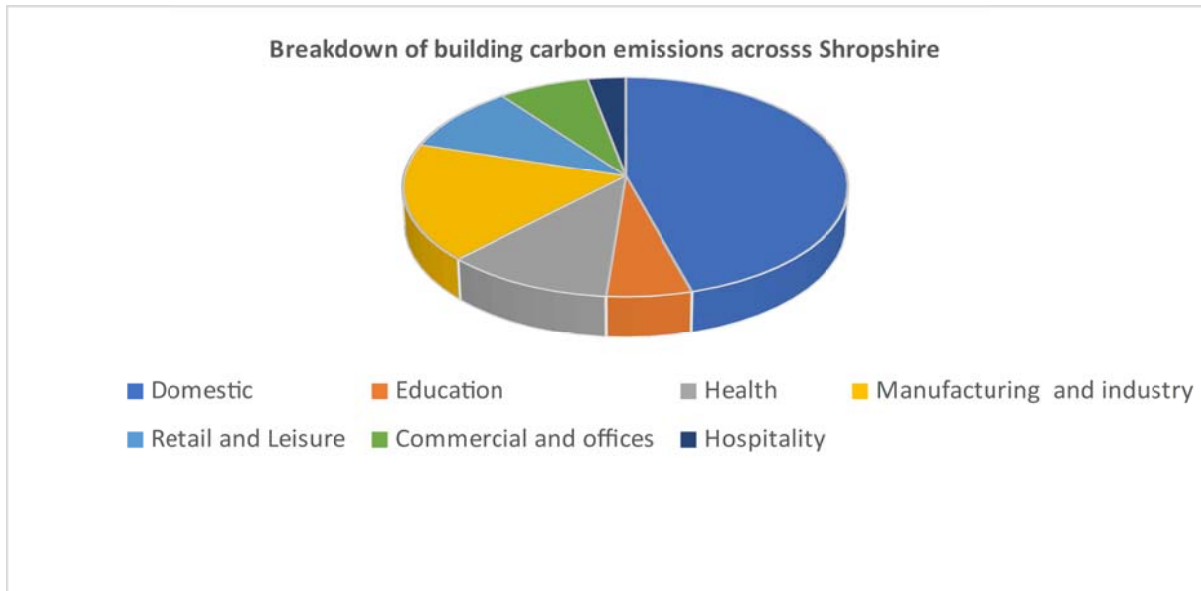


ZCSP Report – Buildings

WORK IN PROGRESS - This document may be incomplete and not peer reviewed.

Comments and corrections are welcome.

Building Sector Overview – John Ogle



The Shropshire Climate Action Plan recognises the imperative of moving away from all carbon emissions. The assessment of carbon emissions from building across Shropshire indicates the following:

Sector	Cat 1 Fossil			Cat 2 Electric			Total		
	MWh/year	t Co2	%	MWh/year	t Co2	%	MWh/year	t Co2	%
Domestic	2,497,185	501,934	53%	1,262,101	294,069	37%	3,759,286	796,004	46%
Education	189,658	38,121	4%	258,600	60,254	8%	448,258	98,375	6%
Health	487,000	97,887	10%	408,000	95,064	12%	895,000	192,951	11%
Manufacturing and industry	688,684	138,426	15%	712,000	165,896	21%	1,400,684	304,322	17%
Retail and Leisure	368,780	74,125	8%	425,120	99,053	12%	793,899	173,178	10%
Commercial and offices	386,000	77,586	8%	210,000	48,930	6%	596,000	126,516	7%
Hospitality	94,466	18,988	2%	145,755	33,961	4%	240,222	52,949	3%
Buildings total inc domestic	4,711,773	947,066	100%	3,421,576	797,227	100%	8,133,349	1,744,294	100%

It is these emissions that must be eliminated in order to reach zero carbon across the built environment.

Emissions from fossil fuels and electricity must be treated differently but firstly the demand for both must be minimised by improved energy management and efficiency measures.

There is a range of well established and emerging technology interventions and newly available financial support opportunities for individuals, the public and the private sector to reduce energy demand. The potential of these interventions is considered in a series of [proposed-developing](#) sub-reports covering each building sector: ↗

- Housing [Ref ZCS B1 Housing]
- Retail [Ref ZCS B2 Retail]
- Education [Ref ZCS B3 Education]
- Health [Ref ZCS B4 Health]
- Manufacturing [Ref ZCS B5 Manufacturing]
- Commercial [Ref ZCS B6 Commercial]
- Hospitality [Ref ZCS B7 Hospitality]

The urgency necessarily means every sector, every school, office, surgery, home, must begin examining their carbon emissions without delay. ZCS will provide support where possible beginning with awareness training and skills development. Many individual organisations are already committed to a range of carbon reduction targets.

ZCS plan to establish regional advice centres providing technical and financial support for all sectors across the county.

Each sector has different drivers, financial constraints and technical opportunities and these are considered in the Plan. The technical interventions considered are:

- Fabric measures [Ref ZCS M1 Fabric]
- Heat pumps [Ref ZCS M1 Fabric]
- Direct electric heating [Ref ZCS M1 Fabric]
- Hydrogen fuel [Ref ZCS M1 Fabric]
- Bio mass [Ref ZCS M1 Fabric]
- Heat networks [Ref ZCS M1 Fabric]
- Smart control [Ref ZCS M1 Fabric]
- Thermal storage [Ref ZCS M1 Fabric]

In addition significant reductions are possible from energy management, efficient use of space and behavioural change.

Over the coming ten years some older less energy efficient buildings will be disposed of and new highly efficient new buildings constructed. There are well established materials and techniques to build to zero carbon such as PassiveHaus housing design and the now abandoned Code for Sustainable Homes would have required net zero carbon by 2017.¹

The Plan assesses the likely results of these measures over the period.

Fuel Carbon Factors

A further factor impacts on carbon emissions. Each fuel has a defined “carbon factor” That’s is the amount of CO2 or CO2 equivalent produced to provide energy. These factors are expressed as tonnes of CO2 per Mega Watt hour of energy used and at 2020 are as tabulated below:

Grid electricity	0.233	t CO2/MWh
Nat Gas	0.184	t CO2/MWh
Fuel oil	0.268	t CO2/MWh
Coal- domestic	0.345	t CO2/MWh
LPG	0.214	t CO2/MWh

The only route to eliminate the fossil fuel emissions is to avoid using such fuels for heating and cooking other than bio-fuels, [These fuels](#) such as [bio-](#) gases [are](#) generated from non- fossil sources. It is not thought that bio gases will be available in significant quantity to serve more than a minor demand which could be limited to remote off grid sites and some industrial processes. For the sake of this plan up to 5% assessed

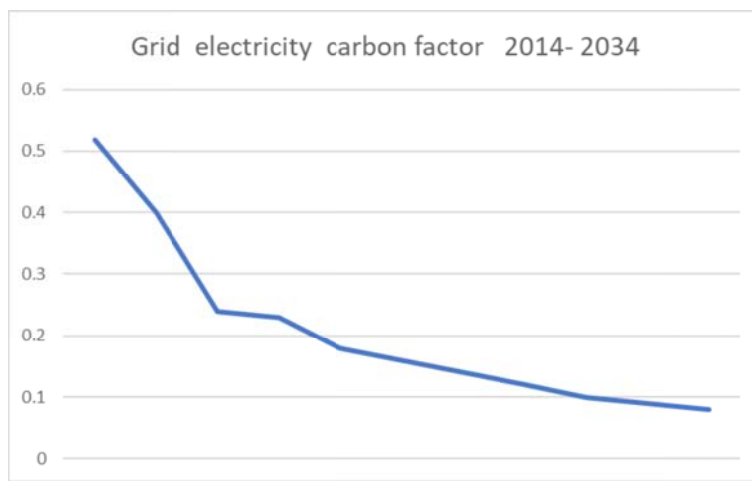
Bio-mass, energy from waste and bio – fuels are considered elsewhere.

The balance of fossil fuel demand must be replaced by grid electricity or on site renewable generation.

The Government fully recognise the need to move away from fossil fuel heating as emphasised by Committee on Climate Change .[www.theccc.org.uk]

The electricity grid is being steadily decarbonised over recent years the carbon factor for grid electricity has fallen steadily as more and more renewable generation has come on stream.

Year	t CO2/MW
2014	0.519
2016	0.4
2018	0.24
2020	0.23
2022	0.18
2024	0.16
2026	0.14
2028	0.12
2030	0.1
2032	0.09
2034	0.08



This trend may well accelerate under commercial or central government demands.

With buildings energy demand reduced and the balanced transitioned to electricity the decarbonisation of the grid together with on site renewable energy generation provide the final essential stage of the route to zero carbon.

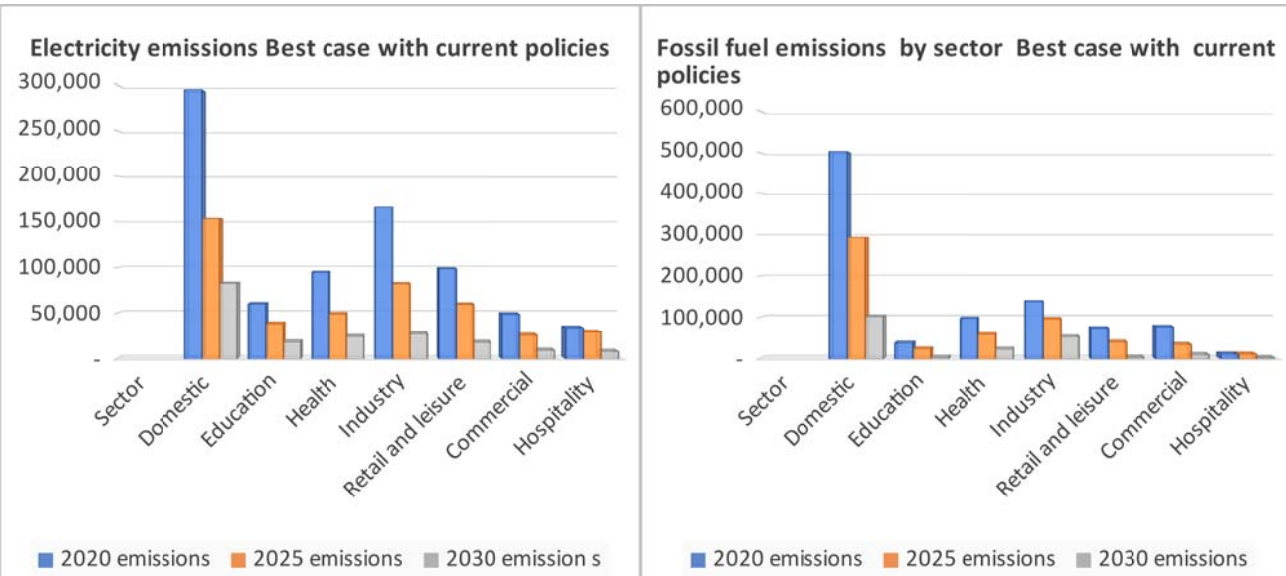
Overall Building Sector Carbon Reductions

Potential carbon reductions have been assessed to 2025 and from 2025 to 2030 for fossil fuel and electricity. The tables below referred to as Scenario 1 assesses the maximum likely carbon reduction that can be achieved applying existing and anticipated Central Government policies and likely access to funding

Class 1 Fossil Fuels	2020 emissions	2025 emissions	2030 emissions
Domestic	501,934	293,652	102,778
Education	38,121	24,016	3,602
Health	97,887	58,732	23,493
Industry	138,426	96,898	53,294
Retail and leisure	74,125	40,769	4,077
Commercial	77,586	34,914	10,474
Hospitality	11,393	11,393	2,848
Total	939,471	560,373	200,566

Class 2 Electricity	2020 emissions	2025 emissions	2030 emissions
Domestic	294,069	153,460	82,868
Education	60,254	38,502	18,481
Health	95,064	49,272	24,537
Industry	165,896	82,450	27,456
Retail and leisure	99,053	59,778	17,934

Commercial	48,930	26,055	9,380
Hospitality	33,961	29,477	8,138
Total	797,227	438,995	188,794



Routes to carbon reduction

Each Building Sector report identifies options for carbon reduction through efficiency measures and these measures vary between sectors. The various measures and technologies are summarised below ,

Domestic Property	Technologies
Reduction through efficiency measures	<ul style="list-style-type: none"> • Roof insulation • Cavity wall insulation • Double and triple glazing • Draughtproofing • LED lighting • Controlled ventilation with heat recovery • Smart controls
Shift away from fossil fuels	<ul style="list-style-type: none"> • Air source heat pumps • Ground source heat pumps • Ground source heat pumps via shared heat networks • Low carbon heat and energy networks • Direct electric heating • Hydrogen fuels • Bio- mass fuels
Impact of use, occupancy and behavioural change	<ul style="list-style-type: none"> • Energy awareness • Reducing temperatures and run times • Efficiency use of space
Effect of new build	Impact of new build minimal as near zero carbon construction standards take effect
Effect of disposals	Under pressure for non sale or let of poorly performing homes the properties will be renovated or disposed of

Non-domestic Property	Technologies
Reduction through efficiency measures	<ul style="list-style-type: none"> • Improved fabric • Controlled LED lighting • Smart controls • Heat recovery • Variable speed drives • IT system operations • Thermal storage
Shift away from fossil fuels	<ul style="list-style-type: none"> • Air source heat pumps • Ground source heat pumps • Low carbon heat and energy networks • Hydrogen fuels for process loads
Impact of use, occupancy and behavioural change	<ul style="list-style-type: none"> • Space optimisation • Reducing temperatures and run times

The measures are generally listed in order of cost benefit but each building different.

The balance of supply and demand

Identified reductions and a shift away from fossil fuels leaves energy demands to be met, and a probable balance of emissions which must be eliminated through:

- Additional Local Authority policies and support
- Wider use of low carbon heat networks and further efficiencies
- Local use of bio-fuels

The final balance of more rapid grid de-carbonisation and on by site generation necessary to off-set remaining fossil fuel demand to achieve the goal of a fully zero carbon building sector across Shropshire can then be evaluated.

These figures take no account of energy demand in manufacturing process

Sector	On or off site generation to decarbonise remaining electrical demand MWh	On site generation to off-set remaining fossil fuel demand MWh
Domestic	370,253	178,967
Education	70,505	6,273
Health	94,779	58,440
Industry	100,161	132,572
Retail and leisure	69,271	8,113
Commercial	34,218	26,055
Hospitality	31,434	5,668
Total	770,622	416,088

Over the period of the zero carbon plan a balance will evolve between energy demand reduction and renewable energy production. This balance will be determined by relative costs and availability of resources. As local renewable generation increases there comes a point where Shropshire moves from zero carbon to being a net exporter of carbon free energy.

