THE FUTURE OF ENERGY IN HEREFORDSHIRE

PROPOSAL OVERVIEW

Contents

Subgroup members

Name	Organisation	Contacted / Agreed
Gareth Williams	Herefordshire Business Board / Caplor Energy	Y
Gordon Coppock	Herefordshire Green Network / Great Collaboration/KLEEN	Y
Tim Yair	Midlands Energy Hub / Marches LEP	Y
Danny Lenain	Herefordshire Council	Y

Wider Engagement

In developing this chapter, we have engaged a wider range of stakeholders. These stakeholders have provided much of the data and information used in the development of the action plan.

Name	Organisation	Contacted / Agreed
Ben Godfrey	Western Power Distribution	Y
Tom Bradley	Cadent Gas	Y
Claire Haigh	Good Energy	Y
Mark Simpson	CO2Balance	Y
Jeremy Spencer	GaiaTogether	Y

Executive Summary / Remit of the Report

The following discussion document is part of the wider county climate emergency plan being developed by Herefordshire Council and multiple stakeholders in 2020. It will be included in that plan but can also be used in isolation for energy-focused discussions. It aims to set out the background to energy use in Herefordshire now and dovetail with the ultimate target for the county to become carbon neutral by 2030. The document will make various recommendations based on the current understanding of energy use within the county. There will be a timetable over coming years with actions that are both practical and pointing to required policy and or support changes.

This report provides a snapshot of the energy situation in Herefordshire. We have tried to document the latest trends in energy consumption, production and generation.

There are, of course, recent trends such as the increased production of energy via renewables. Assumptions will be made and documented where necessary where these are or are not considered at the beginning of chapters and further referenced in actions where needed.

In addition to a countywide declaration for which this document is intended, the Council has its own target to be carbon neutral by 2030/31.

Data shared will be used as target figures in the actions in the document. The authors accept that whilst not ideal, we will be unable to drill down any further into the data for the County of Herefordshire without in-depth research. That is beyond the current capacity of this group, but that requirement is itself a recommendation of this report.

We have focused on establishing the data and the actions required and not on the 'route to market' for implementation as this forms a separate piece of work entirely. Again, essential and recommended.

It cannot be understated the vast enormity of this task and the significant capacity in manpower and investment that will be required in the county to achieve these actions and in this timescale coupled with the inward investment that will be required. Whilst Herefordshire Council cannot supply all the capacity required - either physical or financial - clearly in the declaration of the emergency, and their unique leadership positioning, their central involvement is expected and a key to the declaration's success.

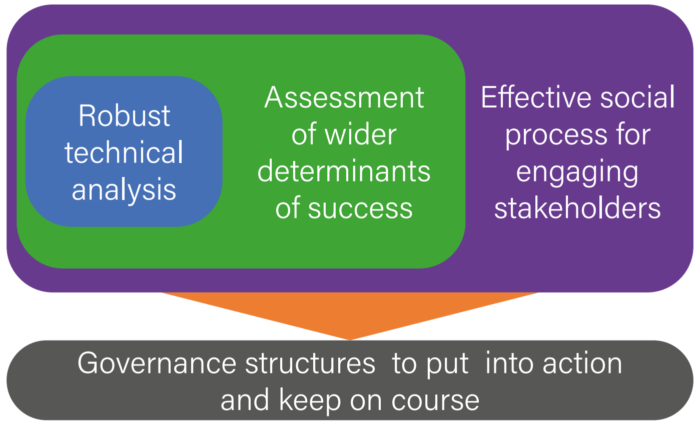


Figure 1 –The 4 key elements to local area energy planning

In 2019, only 116GWh of electricity was generated within the county. Current understanding from engagement with Western Power suggests a further 149GWh may be possible. Various forms of Low Carbon generation can be connected in the county as quickly as 2 years. Public/private finance could provide an early step change in our Net Zero ambition. Other sources of energy will have to become available to enable heating and transport fuel conversion to non-fossil fuel and from the importation of green energy from outside Herefordshire. It is, therefore, essential that a reduction in consumption from all sectors is achieved. This will include changing the way we all use energy as well as the benefits achieved from improved efficiency of goods and services.

In 2019, the **Low Carbon Goods and Services Sector** of the economy was estimated to be worth over £1.79Bn to the Marches local economy. This area of the economy has performed strongly in recent years, seeing an 8% year-on-year increase last year alone. Although the pandemic has impacted growth, it is expected that this area of the economy will continue to grow rapidly.

In December 2020, the **Climate Change Committee** (CCC) report highlighted the investment potential and how decarbonisation would be expected to cost 0.5-0.6% of GDP and indeed would ultimately boost UK GDP by some 2% within a decade.

In the UK - This would involve increasing low-carbon investment from around £10bn in 2020 to around £50bn by 2030, "primarily" from private companies and individuals, the committee says. It notes that the total economy-wide investment in the UK last year was £390bn.

"This investment generates substantial fuel savings, as cleaner, more-efficient technologies replace their fossil-fuelled predecessors," writes Lord Deben in his introduction to the report.

In achieving net zero energy we have in essence adopted the **ARSO model** of Avoid, Reduce, Substitute, and then Offset.

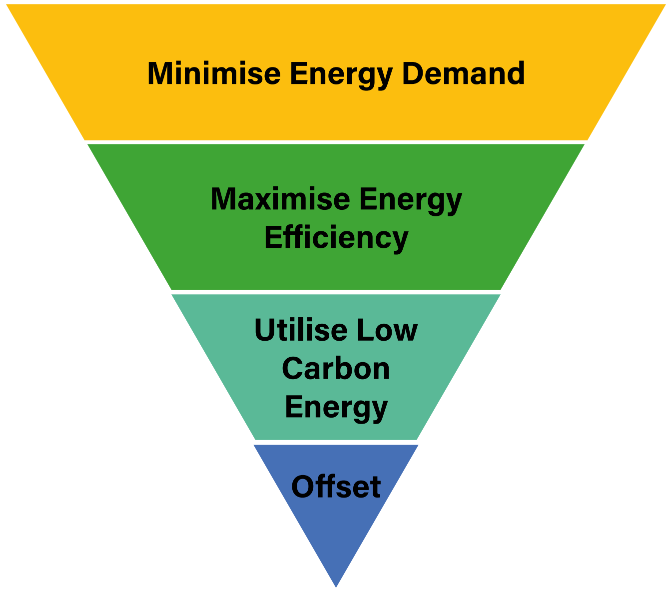
The authors acknowledge that growth in **energy demand** must fall (at least 2.5% per annum) - travel and property energy use need to drop a staggering 50%. It is assumed that buildings will achieve a 20% improvement in efficiency during the time frame. Vehicles switching to electricity use one-quarter of the power per mile. Increasing EVs and other forms of clean energy provision does however drive greater energy demand as a whole, but Smart networks can offset this somewhat.

Efficiency improvements go hand-in-hand with the drive to lower overall consumption. Mostly achieved with heating and travel and in this document, it is accepted by the switch to electric from fossil oil and gas. In both being more efficient with energy and in helping to facilitate more renewable generation onto the constrained grid – SMART technology will have a significant contribution and role to play. The combination of central and local government grants, coupled with an element of private investment would stimulate the transition to this future state.

Substituting the required power is not achieved by green gas or green hydrogen as it will simply not be available in quantity in the time frame presented. Green Power generation, currently at a county scale of 120Mw installed capacity must be grown to its maximum. That would currently give a further circa 150Mw allowing for the present grid constraints. WPD policy changes and investment may allow this figure to grow and so a growth of 5-20% may be possible. In any event, the total is still only a small percentage of total power needs.

The balance of substitution can come from the widespread adoption of Green tariffs and purchasing power from outside of the county.

Offsetting - Finally, and it is the least preferred option, the balance of carbon will at this time have to be offset through the purchase of reliable and accredited projects. These are mostly not just out of the county but likely in developing countries. There is scope for county-based sequestration such as tree planting and soil techniques for farmers – but this does not have current availability and very hard to create sufficient scale given the current net zero gap in power needs.



Capacity - Whilst reducing energy use is generally accepted as good in terms of economic as well as carbon gain, initial action will incur a huge capital cost. Excluding the grid requirements, hundreds of millions of pounds are required. For example, building efficiency improvements will require in the region of £500m and with some 120,000 cars in the county, a total switch to electric will cost some £2.4b plus charging infrastructure. Herefordshire does, however, have a gross value-added income in the region of £3.7b and this challenge is over 10 years. However one views it, the **timescale and the investment required is staggering!**

Electric Grid in terms of capacity – One of the biggest constraints the county faces is the limited grid capacity to feed the increasing need for power and to accommodate more local and nationally produced green power. Working with WPD on this and wider policies is of major importance. In terms of capital investment, this alone will run into hundreds of millions.

Local DNOs are incentivised for innovation and net zero, examples of this local energy market approach can be seen in Cornwall with the L03 Scheme supported by the local councils, WPD and Centrica.

Selling Net Zero - The groups taking on the energy plan for the county in coming years will not just need to find methods to speed up the availability of significant capital but a major imperative for success will be to inspire action in all sectors of society. There are some 190,000 people in the county with some 11000 businesses, over 2000 farmers, and countless community buildings. All will need to move towards carbon zero.

It cannot be underestimated the amount of 'marketing' and related work that will need to be done in the coming years to make this a reality. A very significant team will need to work on all aspects of this from legal to financial to engagement. This capacity will come at a cost and cwould be best placed to come from the Council at this stage.

Carbon Emissions – the Role of Energy

There is a direct link between the amount of energy used and the level of carbon emissions, and it is therefore easy to calculate carbon emissions. As shown by the following graph, the use of energy in Herefordshire is responsible for the largest proportion of carbon emissions in the county. It is therefore critically important to understand how we can tackle this.

The majority of these energy emissions for Herefordshire come from the use of electricity, gas, and oil. It is important to note that this carbon footprint does not include the "embedded emissions" of goods that are imported and consumed within Herefordshire. These scope three emissions are very significant and will be addressed during the development of the net zero plan in Herefordshire in the coming years. In this report, we are focussing on the energy used directly in the county.

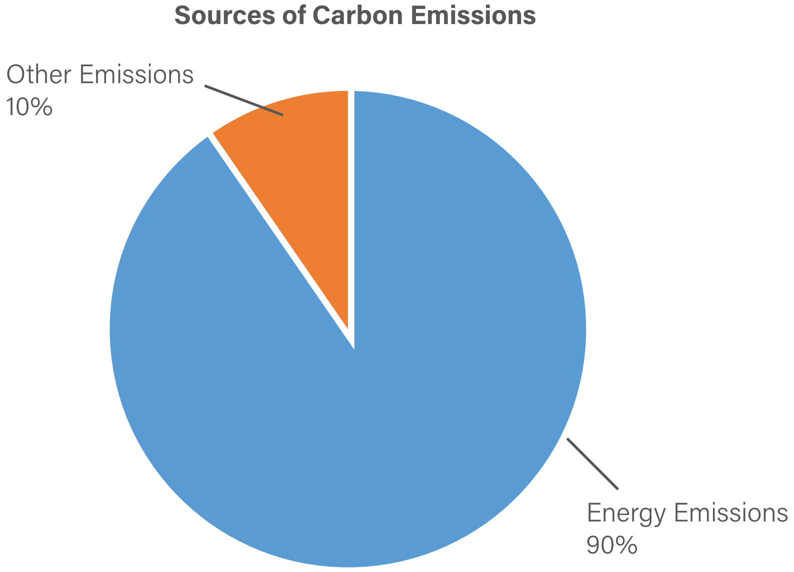


Figure 2 - Source of Carbon emissions for Herefordshire (SCATTER)

The carbon emissions from energy can be broken down further to show the sector they originate from. This highlights two areas that require specific attention; Buildings (both domestic and commercial) and transport. Improving these areas will enable progress towards net zero to be made.

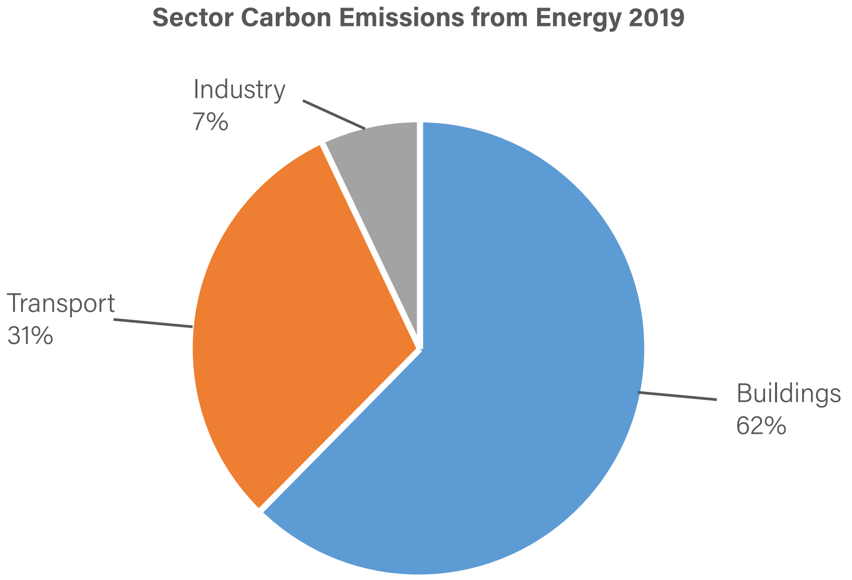


Figure 3 – Herefordshire carbon emissions by overall sector (SCATTER)

Significant changes have already taken place in reducing emissions from energy over the last 20 years.

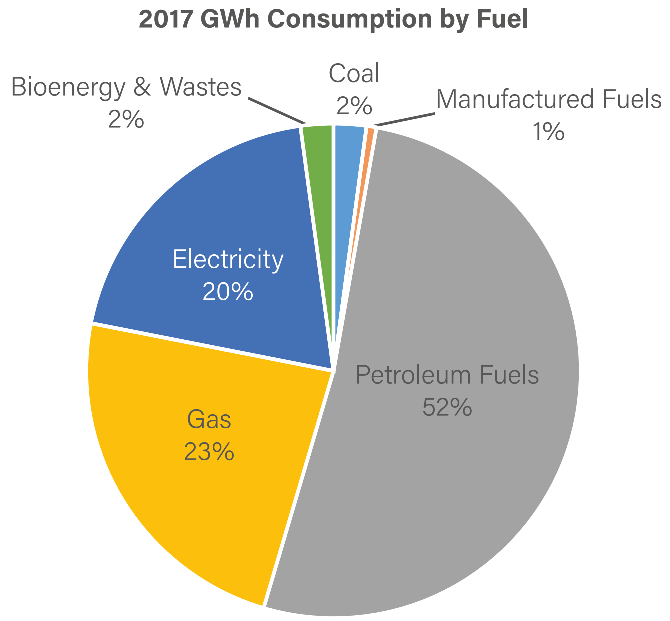
- **Emissions would have been twice as large today** if underlying factors had not changed. Emissions from the electricity sector would have been nearly four times higher.
- **The largest driver** has been a **cleaner electricity mix** based on gas and renewables instead of coal. This was responsible for 36% of the emissions reduction in 2017. In 2020 approx. 50% of the nation's electricity is low carbon.
- **The next largest driver is reduced fuel consumption** by business and industry, responsible for about 31% of the emissions reduction in 2017.
- **Reduced electricity use** – mostly in the industrial and residential sectors – was responsible for 18% of the emissions reductions.
- Changes in **transport emissions** from fewer miles driven per capita and more efficient vehicles accounted for around 7%.

Although the link between carbon and energy is clear, it is important to ensure that discussions are clear. Therefore the rest of this chapter will be discussed in terms of energy rather than carbon.

Energy Overview

Whilst in the previous section we can see the carbon contribution from energy, it is important to understand how much energy this is, where it is used, and most importantly how this can be reduced. In total, Herefordshire uses 8,240GWh of energy every year. In the UK, energy comes from several sources. Currently, the vast majority of all energy is derived from "fossil fuels". To meet net zero we will need to move away from using coal, oil, and gas and rely more on electricity generated from renewable sources. Many consider gas a "transition fuel" and hopes are high that cleaner gas in way of biogas and green Hydrogen may join the stable of solutions. In the UK and particularly Herefordshire this is not currently a likely option in the 2030 time frame and more likely 10-15 years minimum.

Three-quarters of the energy consumed in Herefordshire is used to heat and power buildings (both residential and commercial) and the appliances they contain. Transport also uses a significant 20% of the energy used in the county. Overall, energy use has fallen by around 11% since 2005, but whilst emissions in the industry/commercial and domestic energy use sectors have fallen over that period, transport emissions have remained steady. At the same time, during 2019, the county generated just 116GWh of electricity per year equivalent to 8% (but only of current **electric** needs). In coming years with a switch to electric cars and heating, electric demand will rocket and the current generation will be a shrinking amount of the total.



Energy

Introduction

The vast majority of the UK's energy demand and therefore carbon emissions come from three main areas: industrial and commercial (I&C), residential, and transport. Specifically, this demand is split into:

- The heat and electricity used in industry and business,
- How our homes and buildings are heated, and the electricity used in homes,
- The fuel used in transport.

Over recent years, there has been a change in demand in all three areas because of a mixture of both efficiencies in the system (e.g. a decrease in the carbon intensity of electricity) and behavioural changes (e.g. an increase in the number of electric vehicles bought). However, a significant step-change in both areas is now required if we are to meet the net zero carbon challenge that has been set. Smart meters, flexible Tariffs supported by local/central government with energy retailer sponsorship must be a feature here to drive the transition.

Our energy system is already transforming as the trends towards decarbonisation, decentralisation, and digitisation revolutionise how we produce and use energy. In the first quarter of 2020, 47% of electricity was generated from renewable sources; this is up from 5.8% in 2010[1].

In the past 10 years, UK emissions fell by **29% while the UK economy grew by a fifth**[2]. This demonstrates a decoupling of energy consumption and carbon emissions and GDP growth. Indeed, in a post COVID-19 world and the UK looking to boost its economy – the green recovery is much advocated by current UK Government and internationally as it is increasingly accepted how **"green business is indeed good business"** and lowers energy bills for all which in turn boosts inward investment into society.

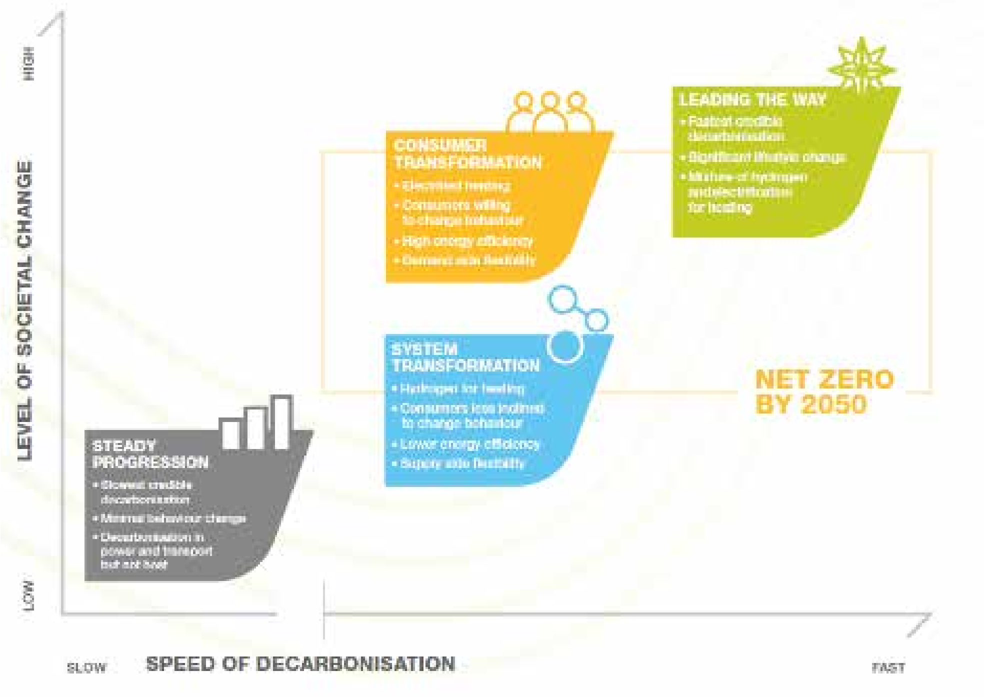
1. https://www.gov.uk/government/statistics/energy-trends-section-6-renewables
2. https://www.carbonbrief.org/analysis-uks-co2-emissions-have-fallen-29-per-cent-over-the-past-decade

Future Energy Scenarios

To help understand the scale of the challenge and the measure that would need to be taken, OFGEM and National Grid produce the Future Energy Scenarios (FES[3]) to create a range of potential futures. The Future Energy Scenarios are the result of in-depth analysis by National Grid's experts, combined with stakeholder insight and input from industry specialists. This collaborative approach helps ensure that the scenarios developed for the UK are realistic. The scenarios can help a range of organisations to build their own approaches to net zero. It should be noted that these scenarios are carried out at a national level, and further work will be required to make them relevant at a county level.

The headlines from FES show that:

- Reaching **net zero carbon emissions by 2050 is achievable** but requires immediate action across all key technologies and policy areas, and full engagement across society and end consumers.
- The Energy System will continue to change, with **increased flexibility** (SMART systems) in when and where energy is produced and consumed. There will also be an increasing scale, complexity and interdependency of energy conversions from one fuel to another.
- Consumers must also be willing to change. Scenarios with a greater acceptance of societal change have the lowest energy demand. It **relies on people being willing to change** the way they use energy. This requires huge effort to inspire action.



Three of the four FES scenarios meet net zero by 2050. If Herefordshire is to meet its more ambitious 2030 deadline, it will have to adopt the measures set out in the "Leading the Way" scenario.

This scenario assumes rapid decarbonisation with high levels of investment in world-leading technologies, with timelines being pushed to the earliest credible dates. Consumers will also need to be highly engaged in acting to reduce and manage their own energy consumption.

Work must be ongoing with WPD post this report, to develop their FES for Herefordshire. It is hoped that this will provide better data and understanding of improvements that can be made to the energy system, both in terms of generation and demand management.

Other National Models of Net Zero Carbon Britain

The Centre for Alternative Technology (CAT) has also looked at how to create a zero carbon Britain. The first Zero Carbon Britain[4] report was published in 2007 and has been followed by a series of follow up reports. The latest Zero Carbon Britain – Rising to the Climate Emergency[5] was published in 2019 and incorporates the latest developments in science and technology to show that nationally it is possible to create a net zero carbon Britain using only proven technology. In this report, we have come to realise there are existing solutions to meet net zero and certainly much of the hoped for aids on this journey such as clean gas / Hydrogen and carbon capture and storage are simply not practically available on the 2030 timeframe.

The report states that amongst other changes (land use, reduced food imports and healthier diets) all the technologies needed to reduce demand and increase available clean energy are ready and waiting. Key to the scenario is the **reduction in energy demand of up to 60%** by using energy more efficiently with particularly large savings in heating buildings (50%) and in transport (78%).

UK FIRES is a collaboration between the Universities of Cambridge, Oxford, Nottingham, Bath and Imperial College London. It is funded by the EPSRC (the Engineering and Physical Sciences Research Council), part of UK Research and Innovation (UKRI). Published in 2019, the 'Absolute Zero' report[6] takes as its basis the assumption that there are currently few proven technologies that they split into three categories:

- "Today's technologies", those that are current mass-market technologies
- "Incremental technologies", those that could be delivered today if customers asked for them, and
- "Breakthrough technologies", which are not yet mass-market, such as fuel cell vehicles.

The authors highlight that **with incremental changes to today's technologies, by 2050 we could enjoy an electrified life very similar to now. However, during a transition period, widespread changes will be required** to reduce flying, shipping, cement production as well as over-reliance on cattle for meat and dairy production. It argues that **technologies such as carbon capture**, utilisation and storage and hydrogen as energy sources **will take too long** to be deployed to aid the UK's goal of net zero greenhouse gas emissions by 2050. Reduction in energy in heating will be targeted by wide scale use of heat pumps and retrofit.

The importance of both of these reports will help inform this discussion paper, especially when formulating future scenarios for Herefordshire. Certainly, addressing a reduction in Herefordshire's current energy usage is paramount and will be used in this reports future scenarios.

3. https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2020-documents

4. https://www.cat.org.uk/app/uploads/dlm_uploads/2018/11/zerocarbonbritain-an-alternative-energy-strategy.pdf
5. https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-rising-to-the-climate-emergency/
6. https://ukfires.org/absolute-zero/

Current Energy Situation – Herefordshire

Electric Grid - Whilst OFGEM, National Grid and other major infrastructure suppliers will be key in setting the trajectory to net zero through changes to the system, local action will also be essential. It is therefore important to understand the local picture.

The rapid shift in how energy is used and generated at transmission and distribution levels has already caused significant challenges to energy networks. Herefordshire generated just over 116GWh of renewable electricity in 2019.

However, the electricity network is now reaching capacity, so significant further connections will require network upgrades and increased flexibility. As of Dec 2020 – there is scope for a further 150Mw of capacity across the county. This should clearly be installed as part of the plan. Ongoing investment will be essential as the county transitions to electric heat and power for vehicles. The network operator WPD estimate that reinforcing the grid to allow for all homes and cars to be converted to being powered by electricity would cost £150million.

Gas Mains - Discussion with Cadent locally have demonstrated that whilst 77% of the city's gas main is capable of taking blended clean gas/hydrogen, significant roll out of zero carbon gas is beyond the timescale of this 2030 timeline. It is likely to be 10-15 years before partial mixing at 20% a possibility/reality.

Current Energy Consumption

Energy consumption data is generally readily available at a county level. However, whilst data is available, some of the methods used vary, which can lead to confusion. In order to help ensure a consistent approach is followed across the UK, BEIS commissioned the development of a tool for local authorities to use in reporting energy usage and carbon emissions. SCATTER (Setting City Area Targets and Trajectories for Emissions Reduction) has been developed in collaboration with Nottingham City Council, GMCA, the Anthesis Group, and the Tyndall Centre. As this provides a comprehensive approach, we have used the methodology and data provided by SCATTER to set the baseline for understanding the sources and use of energy in Herefordshire.

It would be very helpful to have a better genuine understanding of power use and emissions at a local county level and this is perhaps something to develop in the coming period.

The data that SCATTER provides demonstrates that, in total, **Herefordshire uses 8,240GWh of all energy types every year.** Three quarters of this energy consumed in Herefordshire is used to heat and power buildings (both residential and commercial) and the appliances they contain. **Transport** also uses a significant 20% of energy used in the county.

Overall, energy use has fallen by around 11% since 2005, but whilst energy use in the industry/commercial and domestic sectors have fallen over that period, transport energy remains largely static. In coming years with switching demands the breakdown of type is predicted to see a huge change. It is imperative to reach our goal that we develop a local energy policy that drives the transition across all forms of energy use in the county.

The following table shows the energy used across Herefordshire in 2018. The energy is split into Scopes, which correspond to the Greenhouse Gas reporting protocol:

- **Scope 1 (Direct emissions)**
  GHG emissions from sources located within the county.
- **Scope 2 (Indirect emissions)**
  GHG emissions occurring because of the use of grid-supplied electricity, heat, steam and/or cooling within the county.
- **Scope 3 (Other)**
  All other GHG emissions that occur outside the county because of activities taking place within the county. These are significant in scale and much harder to control. Internationally recognized methodology can help measure from sources such as purchased goods and services; transportation and distribution (both up-and downstream); waste; business travel and employee commuting; use and disposal of sold products; and the impact of investments.

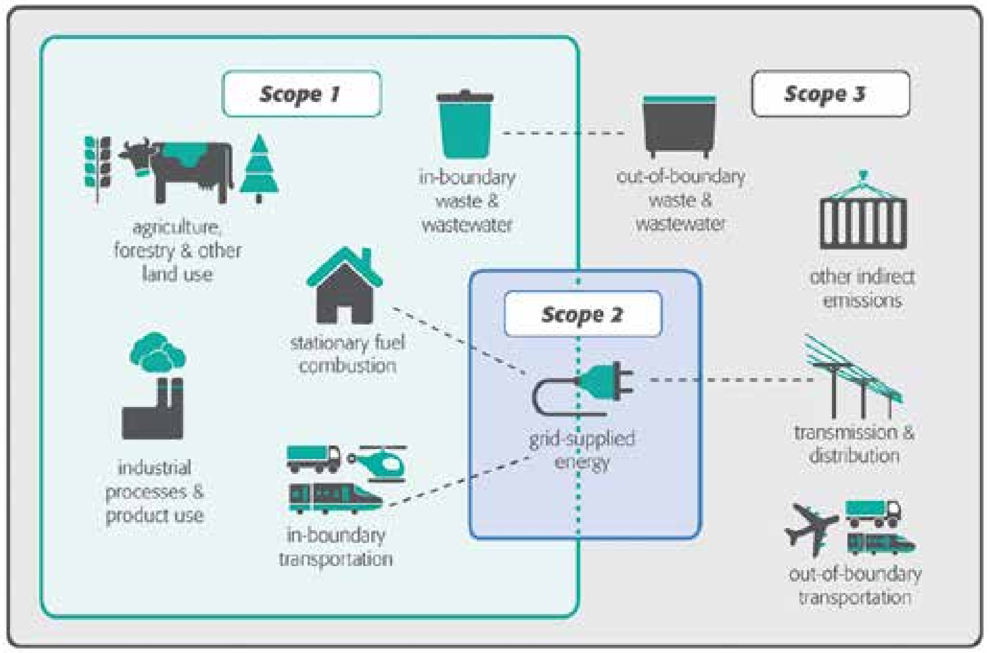
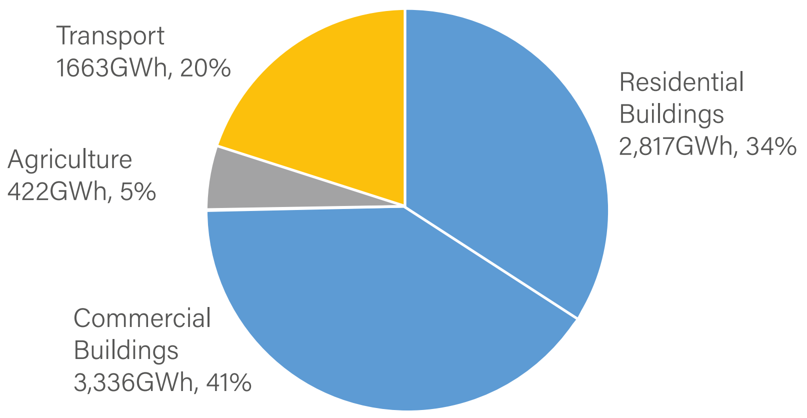


Figure 6 – Scope of emissions

Table 1 – Summary of energy use in Herefordshire - SCATTER

Summary Energy Use (GWh/annum)		Scope 1	Scope 2	Scope 3		
Sector	**Sub-sector**	**DIRECT**	**INDIRECT**	**OTHER**	**TOTAL**	**tCO2**
Stationary energy	Residential buildings	1,043	365	1,408	2,817	385,983
	Commercial buildings & facilities	247	66	313	626	88,352
	Institutional buildings & facilities	599	333	668	1,600	281,445
	Industrial buildings & facilities	362	193	555	1,110	180,397
	Agriculture	211	0	211	422	64,190
	Total Stationary Energy	**2,462**	**955**	**3,154**	**6,571**	**1,000,367**
Transportation	On-road transport	1,467	IE	69	1,536	375,813
	Off-road transport	15	IE		15	3,596
	Rail	56	IE	56	112	17,156
	Total Transport	**1,537**	**-**	**126**	**1,663**	**396,565**
	TOTAL	**4000**	**957**	**3,282**	**8,240**	**1,396,931**



Summary of sectors

SCATTER also uses a standard approach to convert energy use and other processes into carbon. It sets out a carbon inventory, which is made up of six key sectors:

Stationary

Greenhouse gas emissions are generated in this sector through the combustion of fuel in buildings, manufacturing industries, construction processes and power plants. This includes fugitive emissions.

Transportation

This sector produces greenhouse gas emissions through the combustion of fuel or use of electricity during journeys travelled by road, rail, air or water for inter-city and international travel.

Waste

Disposal and treatment of solid waste and wastewater produce greenhouse gas emissions through incineration, aerobic and anaerobic decomposition.

Industrial Processes and Product Use (IPPU)

Industrial processes include those used to physically, or chemically transform materials produce greenhouse gas emissions. Also, industries use products that release greenhouse gas emissions throughout its use.

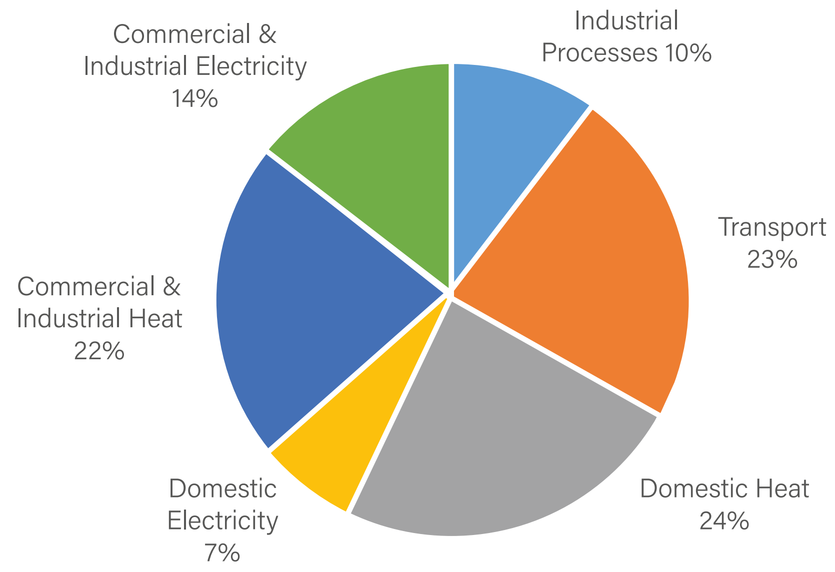
Agriculture, Forestry and Other Land Use (AFOLU)

The AFOLU sector produces greenhouse gas emissions through methane created by livestock, nutrient management for agricultural purposes, and land use change altering soil compositions. This also includes some degree of sequestration from land use. The authors think that this figure should be used with caution due to methane calculations.

The assumptions that were used to model the SCATTER analysis can be found in Appendix H.

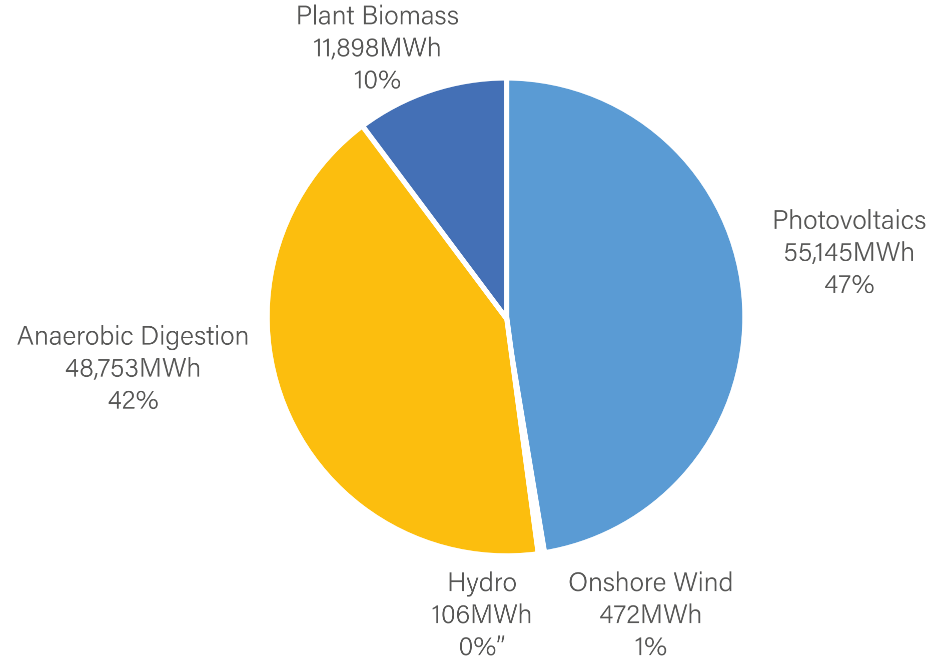
The SCATTER tool can also provide insight into whether the energy was used for electricity, heat or transport:

Energy Type = Heat/Electricity/Transport (%)



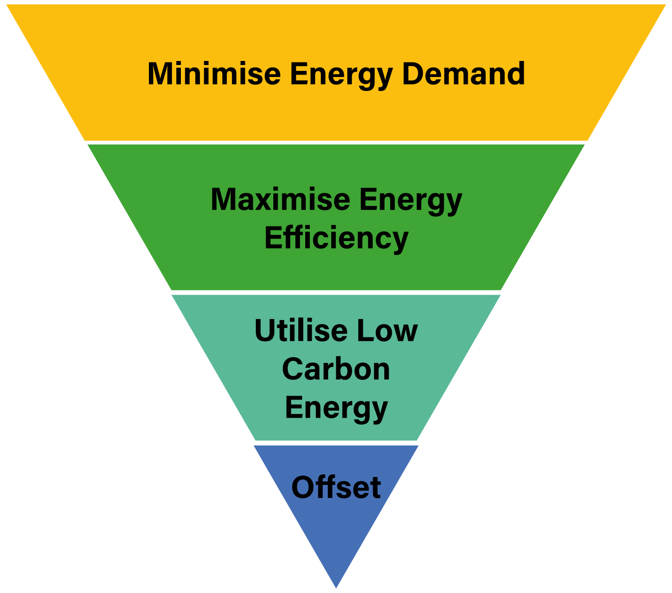
Finally, SCATTER can be used to provide Renewable Energy Generation data.

Renewable Energy Generation MWh (2019



Approach to net zero

Herefordshire has adopted a simple hierarchical approach to achieving net zero. This is outlined in the diagram below. All of the actions within the action plan should fit within this approach. In all sectors, the plan firsts look to reduce the current energy demand. This could be by using less energy using it differently or at different times of the day. Secondly, energy that is required should be used as efficiently as possible. This may require additional investment to install efficiency measures that will quickly reduce demand. It is then possible to meet more of this need by generating more energy locally through renewables and with the adoption of green tariffs. Finally, any residual emissions can then be offset through properly registered offset schemes. This approach will enable a number of potential pathways to net zero to be developed.



ARSO

Avoid consumption by not doing things,

Reduce the amount of energy used through efficiency measure and technique (Heat pumps, driver training),

Substitute with clean renewable generation for the power society needs,

Offset - invest in recognised and accredited projects that sequester or lower carbon elsewhere.

To help illustrate this, the following table contains an example approach to reaching net zero based on original energy demand of 8,240GWh and associated carbon footprint of nearly 1.5Mt CO2. It assumes significant work on Scope 3. Many of these measures come with a significant cost, however by enacting them they create investment/employment opportunity and offer longer term economic and social benefits for the county in addition to meeting the net zero target.

Table 2 – Pathway to net zero

Note: Assumptions have been made that such measures could be carried out and supported

Hierarchy Level	Action	Carbon Saving (tonnes)	Potential Pathway to net zero	Cost of implementing action
Current carbon footprint from energy is 1,497,563 tonnes. Following the current growth, this will be 1,898,387 tonnes in 2030.			1,898,387	
Minimise (Avoid)	Halt the 2.4% year-on-year growth in energy demand	400,824	1,497,563	£?
	Reducing the amount of travel by 50%	187,906	1,309,657	£?
	Reduce domestic heating demand by turning the thermostat down by 1degree	25,500	1,284,157	£0
	25% reduction in Scope 3 emissions. Harder to influence.	67,597	1,216,560	£?
Efficiency (Reduce)	Retrofit measures to domestic properties to remove virtually all gas and oil use from 50,000 of 80,000 homes	214,168	102,392	£152M grid reinforcement costs £300M
	Retrofit measures to commercial and community properties to remove virtually all gas and oil use (11,000 businesses)	219,582	782,810	£500M
	Increase the use of alternative transport fuels by converting fleet to EV (120,000 cars)	89,909	692,901	£2.4B
Generation (substitute)	Increase local renewable generation by 20% per year. 150Mw possible now. Appendix F/H	377,762	315,139	£105M
Green Tariffs	Look to purchase 50% of excess energy required from certified green energy suppliers	168,340	146,799	£0
Off-set	Offset the remainder through accredited schemes (Cost circa £5 per tonne) This is an annual cost. Appendix K	146,799	0	£1M
Final Carbon Footprint			**Net Zero**	**£3.5Bn**

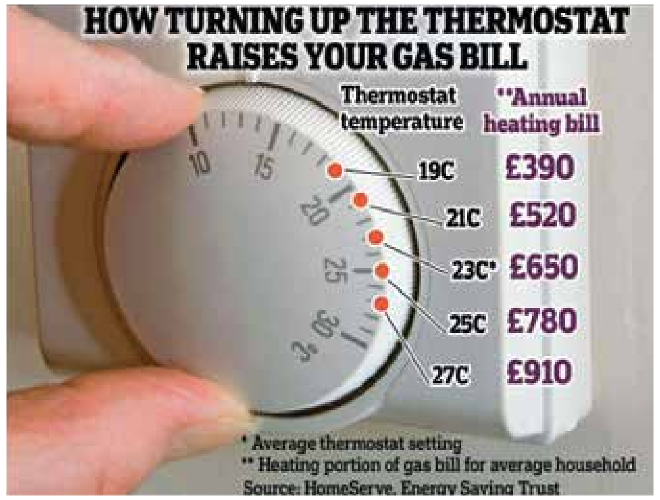
How to Progress to Net Zero

Several of these areas are explored more widely in the Appendix. Significant engagement and investment is required in virtually all areas. But the power of low cost behavioural changes should certainly not be underestimated or the fact that virtually all change to lower energy demand will bring long term commercial benefit.

1) Energy Demand

The demand for energy is changing. For the UK, energy demand is projected to decrease until 2025. After this, it is then projected to rise, as the effects of changes to policies and consumer choice push demand up. Minimising future demand is therefore a critical first step in the pathway to net zero. The more it is possible to reduce demand, the less reliant the pathway becomes on other measures. This is particularly important as the roll-out of low carbon alternatives such as heat pumps and electric vehicles will add to the demand for electricity. This will therefore require substantial changes to attitudes towards energy consumption. There is a lack of energy or carbon literacy in the UK; projects such as the smart meter roll-out are hoping to engage with wider audiences to make simple lifestyle changes.

Action – *Significant work to be done to inspire consumer attitude change in adopting lifestyles and business practice that uses less energy. General and planning Policy/Engagement.*



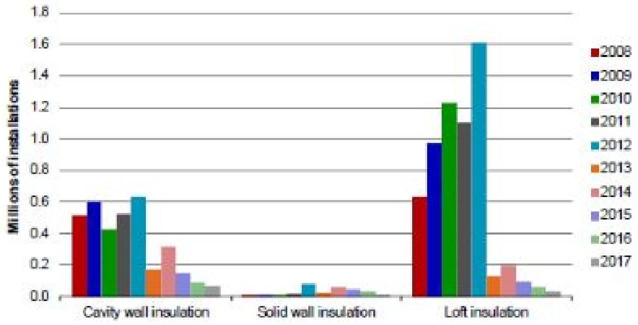
2) Energy Efficiency

Improving energy efficiency is the first step to ensuring net zero targets can be met. The energy efficiency of UK homes has increased markedly over the past decade, reducing consumption while enabling stable or increasing comfort levels.

Between 2005 and 2015, the average Standard Assessment Procedure (SAP) rating – which indicates household energy and environmental performance – improved from 49 to 62 in England. The SAP assesses how much energy a dwelling will consume when delivering a defined level of comfort and service provision. This improvement has been primarily driven by:

- More efficient electrical products. Regulation and technological improvements have made electrical goods more efficient, and overall efficiency has improved as consumers replace or upgrade their appliances and white goods.
- More efficient boilers. In 2015, 15.3 million UK homes had condensing or condensing-combination boilers, compared with only 1.1 million in 2005.
- Insulation improvements. In 2016, 69% of properties with cavity walls were known to have cavity insulation, compared to 44% in 2006.
- However, there has also been an enormous decrease in the number of energy efficiency interventions particularly in the fundamental areas of cavity and loft insulation since policy reductions in 2012 (BEIS).

Action – *More policy changes local and national to drive improved standards in new and retro fit homes. Vehicle standards as in electric vehicles now by 2030. Promotion and development of programmes such as the green homes grant and other commercial schemes and incentives (not all finance led). Car charger points/ skills capacity / Finance (e.g., revolving credit schemes). Uptake of Smart power systems.*



3) Energy Generation

In the near-term, Herefordshire is expected to remain a net importer of energy. We therefore need to consider where and how the energy we use is generated. Across the UK, total renewable generation increased by a record 30% (year-on-year) to 40.8TWh. As a result, renewables' share of total electricity generation increased to 47.0%, the bulk of this coming from an increase in off-shore and on-shore wind. This increase in generation leads to an ongoing reduction of the carbon intensity of grid electricity. The updated energy intensity scenarios developed by the CCC concludes that the current investment in low-carbon technologies through the 2020s could result in a carbon-intensity of around 50 gCO2e/kWh in 2030. This compares to the current level of 233gCO2e/kWh (historically, the carbon intensity of electricity was 718 gCO2e/kWh in 1990, and 500 gCO2e/kWh in 2008).

In Herefordshire, energy generation capacity has increased by 73% since 2014. This change is almost entirely through increases in photovoltaics and plant biomass. However, the total energy generated in 2019 was just 116GWh; far less than the county's energy demand.

Accepting that Herefordshire will not be able to generate all energy needed in the next 10 years, it should still be looking to generate the most it can, based on its resources. Around 116GWh of electricity per annum will be generated locally, mainly through small-scale solar photovoltaic (PV); the remaining will have to be imported from the GB power system via the National Grid.

Action – *Work with WPD for increased capacity in the network. Drive local and national policy for uptake of generation and including the removal of barriers e.g. Rates and VAT n renewable initiatives. Ensure that current 150Mw of potential generation is developed. Uptake of Smart power systems.*

Community Energy - An important link to our future energy landscape

Community Energy is the creation of locally based large scale renewable energy generation systems that encourage the local population to become shareholders in part of their own energy generation. In 2018 across the UK it generates energy to power 64,000 homes and much more is in the pipeline. Western Power and other DNO's see it as 'An integral part of their portfolio to help customers benefit from low carbon technologies.' It keeps money in the local economy and provides a vital step towards acceptance of more larger scale local energy generation that we will need. Many councils across the country have already linked up with community energy organisations to work together. Much more information on this in Appendix H

4) Green Energy Supply

An alternative to being able to supply all energy from Herefordshire-based renewables, a lesser option would be to offer an accredited green energy supply. This would support the general decarbonisation of the electricity network and lower the county's carbon footprint, but would not benefit the low carbon goods and services sector in the County.

With electricity from low carbon sources making up an ever larger percentage of our national grid, we are all likely to be using some sustainably generated electricity, whatever tariff we're on.

A green tariff means that some or all of the electricity is 'matched' by purchases of renewable energy that the energy supplier makes. These could come from a variety of renewable energy sources such as wind farms and hydroelectric power stations. Some green supply tariffs are also nuclear-free.

Some tariffs will be '100% renewable', others will offer a percentage of the total.

When an energy supplier buys renewable (green) electricity and its accompanying certificates (RIGO) directly from generators, such as UK wind or solar farms, this provides a clear benefit to the UK renewable industry.

It is planned in this report that work is done to switch consumers to 100% green power to achieve net zero energy.

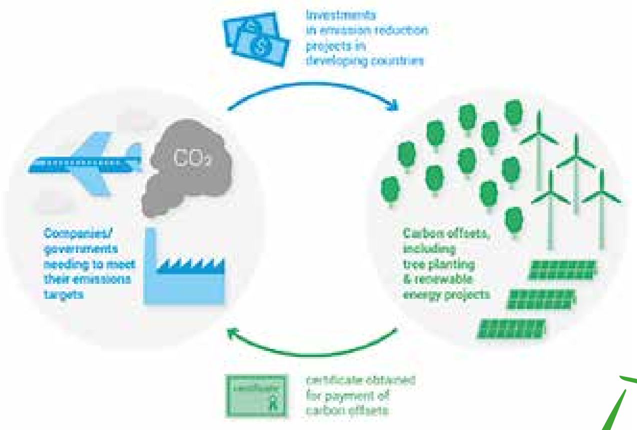
Action – *To research the most effective offers and instigate a programme and offer to inspire mass switching of users.*

5) Off-setting & Sequestration

Any remaining emissions in 2030 attributable to energy use in Herefordshire that is not fully decarbonised will therefore need to be offset. It is important that off-setting is not seen as an easy or always acceptable solution to fixing the energy problem.

It should be regarded as the last option if realistic alternatives really do not exist. Off-setting has multiple options for use. The local agriculture and Land Use subgroup are developing an action plan based around options to sequester carbon. As well as tree planting, this may also include better management of soil, rivers, and wetlands. An alternative may be to develop robust carbon, capture and storage projects. These are being developed across the UK and may be included in the Action Plan when the technology is mature enough however actual availability and scale need to be considered. The current large scale options are to consider using the services of certified off-setting companies.

Action – *Calculate the evolving gap in achieving net zero. Research and then adopt schemes (local/national/international) that complete the net zero ambition. This option will be reviewed and adjusted as more action is taken under the preceding measures. Schemes could also encourage Herefordshire to work at a social and educational level with the countries and communities where the projects occur to bring wider benefit.*



The Low Carbon Goods and Services Sector

In the strictest sense, the Low Carbon Goods and Services sector is not a "sector" but a flexible construct or "umbrella" term for capturing any Low Carbon, Environmental and Renewable Energy activities spread across many existing areas such as transport, construction, and energy. It is a constantly evolving sector as new activities are identified, or reach the market and can be assigned to it.

Whilst measuring the value of the green economy is not new, in the Marches, this is an emerging piece of work. An interim report recently suggested that in the Marches there are approximately 12,000 people employed by 700 companies working in the LCGS sector. The value of this sector in 2019 was valued at nearly £1.8Bn. It is also noted that the sector has seen year-on-year increase in value. Although this has been impacted by the Covid-19 pandemic, it is likely to be one of the areas that will recover strongly, given the emphasis placed by the Government on growing back greener.

Estimating the "cost" of the net zero goal has been a hot topic ever since the UK government made its net zero commitment in 2019.

The current Climate change committee (CCC) advice not only estimates lower costs overall (first estimated at 1-2% GDP), but it also looks at the longer-term impact on GDP of transitioning to a cleaner society. It concludes that it could see a GDP boost of around 2% within a decade.

The CCC's analysis suggests that the yearly cost of achieving net zero would be 0.6% of GDP by the early 2030s, before falling to around 0.5% by 2050.

Nationally this would involve increasing low-carbon investment from around £10bn in 2020 to around £50bn by 2030, "primarily" from private companies and individuals, the committee says. It notes that the total economy-wide investment in the UK last year was £390bn.

"This investment generates substantial fuel savings, as cleaner, more-efficient technologies replace their fossil-fuelled predecessors," **writes Lord Deben in his introduction to the report.**

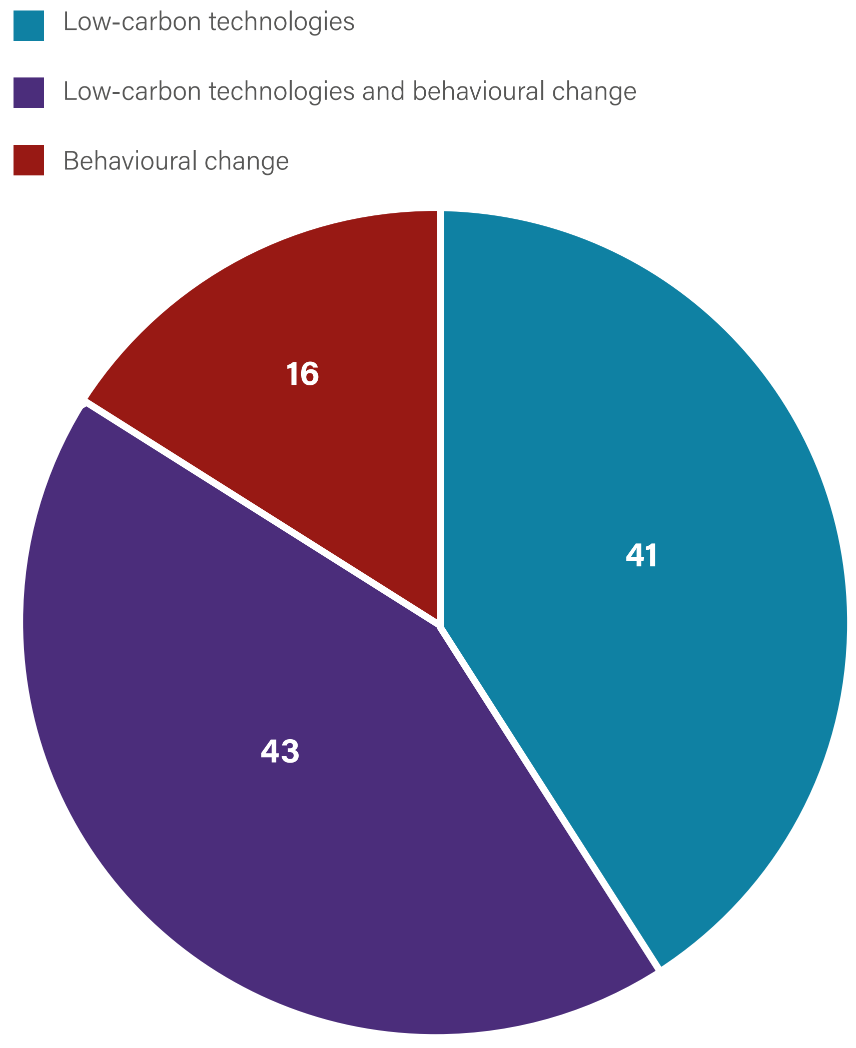
Action Plan

This report looks to develop a framework and basic pipeline of actions to meet the net zero aspirations of the Climate Emergency Declaration. To do this we have looked at potential scenarios and come up with some appropriate actions needed to achieve this. The Action Plan is an evolving document, but the latest edition can be found at this link. The plan aims to capture some of the proposed and emerging actions that are required, and who needs to be involved to address these.

It MUST be emphasized that the task is huge and has not been described as the "challenge of our century" lightly. It will require all of the county's population to make significant changes and adoptions and this will need to be inspired and driven with resource and commitment.

Delivering net zero carbon emissions

How important is behavioural change in meeting the target (%)



Source: Committee on Climate Change, BBC

Overlaps with other subgroups

Energy affects all areas of the County's carbon footprint. There are particularly significant links with the following sectors:

Housing – Housing represents a significant proportion of the carbon emissions in Herefordshire and will require significant retro fit and new build policy and action. Particularly around improving efficiency and power source for heating.

Commercial energy users – It is important that energy constraints are not a barrier to business investment. Business can make significant improvements to their returns through increased efficiency measures that come with lower carbon activity. There is also a huge opportunity in the supply chain in achieving net zero.

Transport – significant use of energy – FES mapping of EV until 2050. Huge investment required in EV cars and infrastructure. Some 120k cars requiring home premises and some public chargers.

Communications – What is the communication plan to achieve the "18% tipping point" and ongoing delivery of the net zero plan. This is substantial and must be led.

The overall carbon plan is made up of reports and ongoing work in these areas.

Stakeholder and Activity Mapping

Part of this process has been to ensure engagement with the various stakeholders that will influence the desire for energy carbon neutrality. As with other parts of this study – some of the recommendations will design post to further required work outside of the capacity and scope here. In the meantime – significant resource is channelled to discussion and understanding from the key energy providers to the county. These are namely Western Power (electricity) and Cadent (gas). Also as it is identified that significant green energy will need to be imported discussions will be held with Green energy suppliers to understand the reality of this level of demand.

Table 3 – Herefordshire stakeholders

Group	Details	Current activity
Electricity DNO/DSO	WPD	RIIO-ED2
Gas Infrastructure	Cadent	Consulting on future role
Large-scale Energy Users	Industrial Parks	
Local Authorities	Herefordshire Council – Energy Team – Planning – Development Control – Transport Parish Councils / HALC	Carbon Management Plan LTP Local Plan
Energy Companies / Renewable Energy Companies	MCS	
Community Energy	Pomona Solar Marches Energy Agency Severn Wye Energy Agency	
Community groups	Zero Carbon Herefordshire group Herefordshire Green Network	
Other Statutory bodies etc.	Environment Agency Natural England	River Severn Partnership
Other	Midlands Energy Hub Marches LEP	Marches Energy Strategy

Herefordshire Scenarios (an introduction to next steps)

Here is an introduction to the next steps scenario assumptions and approaches by sector. The evolving Climate Board and team created/evolved to carry this work forwards will need to evolve this plan in line with the other areas of work identified (Buildings/transport/waste/land use etc) and put in place actions to take these next steps highlighted below and evolving when working with stakeholders.

Sector	Sub-sector	Potential Approach	Next Steps
Engagement	Governance	Develop a governance structure to deliver Action Plan.	Agree on the structure in Jan 2021.
	Policy	Work with relevant bodies to influence national and local policy.	Work with subgroups to understand the level of ambition.
	Communications	Energy messages to ensure everyone can be brought along on the net zero journey.	Work with subgroups to develop a communications strategy.
	Energy Literacy	Significant engagement capacity required to develop a plan and work with population direct and via the already existing stakeholder networks.	Develop capacity and plan.
Infrastructure	Constraints	Overcome capacity constraints by adding resilience to the distribution network.	Continue to work with WPD and Cadent on the delivery of their net zero ambitions. (Push for more ambitious targets to meet Herefordshire's 2030 target).
	Energy Storage	Storage capacity on the distribution network is increased in order to enable flexible connections.	Work with WPD to understand new Flexible Power arrangements for Herefordshire.
	Flexibility	Support projects that enable additional flexibility to be built into the system.	SMARTY system development and deploy
Buildings	Heat	Reduce the energy required to power buildings by following energy hierarchy. (Solutions are likely to vary depending on existing infrastructure, energy demand and sources of fuel).	Work with buildings and planning subgroup to understand the level of ambition for non-fossil fuel in domestic and commercial buildings. (links with fuel poverty)
	Power	The push to increase in heat pumps and electric vehicles is likely to increase potential power demand.	

Sector	Sub-sector	Potential Approach	Next Steps
Transport	Behaviour	Support opportunities to reduce emissions from transport by reduction in overall mileage. Driver training.	Work with Transport subgroup on the development of potential projects.
	Infrastructure	Significant alteration to existing infrastructure is required to enable complete decarbonisation of transport. Electric vehicles. Active transport measures.	Work with transport sub-group to understand level of ambition for non-fossil fuel transport in Herefordshire and consequently required infrastructure.
	Future Fuels	Range of fuel options are likely to be required to fulfil varied transport requirements.	Adopt fuelling strategy to understand potential for alternative transport fuels
Generation	Power	Distribution resource potential is maximised as per Marches Energy Strategy and broadly aligned to the FES 2020 "Leading the Way" Scenario.	Work with WPD and Cadent to maximise potential for renewable generation in Herefordshire.
	Technology	Range of technologies is incorporated at different levels appropriate to location.	Identify opportunities to utilise renewable technologies that might be appropriate to Herefordshire.
Offsetting	Sequestration	Calculate the amount of tons to offset. Understand extent of opportunities for sequestration locally.	Links with Land-use subgroup. Research appropriate programmes, cost and execute.
Green Power	Green Tariffs	Identify the potential of offering green energy to Herefordshire residents	Contract agreement and promotion to the county
	Offsetting credits	Link with organisation to offset any remaining emissions from energy.	...

Appendix A - Government Policy

BEIS is set to release an Energy White Paper, detailing the country's strategy to achieving net zero emissions by 2050. The White Paper is expected to yield further policy indications on a range of energy and environmental issues that are currently unclear. The white paper was originally due to be published in the summer of 2019 but has been repeatedly delayed and now not is expected until 2021.

This document will be key for Herefordshire as it is set to outline the roadmap for net zero, helping the industry to move forwards towards this now legally binding target. This will include decisions on renewables, nuclear levels and the role of carbon capture, usage and storage.

The Committee on Climate Change (CCC)[7] is also scheduled to publish its recommendations on the level of the Sixth Carbon Budget in December 2020. It will set the path to the UK's new net zero emissions target in 2050, as the first carbon budget to be set into law following that commitment.

The Sixth Carbon Budget, required under the Climate Change Act, will provide ministers with advice on the volume of greenhouse gases the UK can emit during the period 2033-2037. The Budget will set the path to the UK's net zero emissions target in 2050, as the first carbon budget to be set into law following that commitment.

Both of these papers will feed into the rescheduled 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change is scheduled to take place a year later in 2021 in Glasgow. The UK will host the main COP summit, which will enable world leaders to discuss actions to tackle climate change and serve as a spotlight on how far the government's climate policy decisions have come.

There is anticipation in the role hydrogen could play in the decarbonisation of heat and industry. A series of reports and feasibility studies have been published, and new government R&D programmes announced. The Committee for Climate Change report in 2018 'Hydrogen in a Low Carbon Economy'[8] found that the Government must support the early demonstration of the everyday uses of hydrogen in order to establish the practicality of switching from natural gas to hydrogen and to increase awareness amongst the general public of reasons to move away from natural gas heating to low-carbon alternatives. There have been several pilot projects using hydrogen solutions and hopefully, these will be further rolled out if successful. A priority should be to deploy more established technologies whilst demonstrating hydrogen systems at scale to find out whether they will be technically, economically and socially viable. To complement this, further action is needed to create a market for carbon capture and storage.

The Government's Clean Growth Strategy[9] published by BEIS in 2017 brings together government policies and proposals related to the energy sector and action on climate change. The strategies are supported by the Industrial Strategy[10] and the Local Industrial Strategies[11].

7. https://www.theccc.org.uk/comingup/advice-on-the-sixth-carbon-budget/#:~:text=The%20Committee%20on%20Climate%20Change,during%20the%20period%202033%2D2037
8. https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf
9. https://www.gov.uk/government/publications/clean-growth-strategy
10. https://www.gov.uk/government/topical-events/the-uks-industrial-strategy
11. https://www.marcheslep.org.uk/download/marches_local_industrial_strategy/Marches-Local-Industrial-Strategy-Final-draft-20.12.19.pdf

Whilst there is a lot of optimistic rhetoric about electric vehicles, transport emissions are rising and the sales of low carbon vehicles remain low. The Department of Transport's Road to Zero strategy[12] is welcome setting out an ambition for a consumer- and industry-led transition to between 50% and 70% of new car sales being ultra-low-emission vehicles (ULEV) by 2030.

The Renewable Energy Roadmap[13], published in 2011 sets out how the UK will reach the goal of generating 15% of UK energy use from renewables by 2020. It presented a framework and set of actions for the delivery of renewable energy deployment. We are awaiting an update of this policy, which itself will be steered by the Energy White Paper possibly due 2021. Renewable energy helps the UK achieve the challenging decarbonisation targets it has set in an effort to combat increasing climate change. A key benefit of deploying renewable energy technologies is the potential reduction in carbon emissions when compared to fossil fuels.

Department for Business, Energy & Industrial Strategy

The Marches Local Enterprise Partnership
Herefordshire - Shropshire - Telford & Wrekin

Herefordshire Council

PARISH COUNCIL

12. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/724391/road-to-zero.pdf
13. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48128/2167-uk-renewable-energy-roadmap.pdf

Appendix B - Marches Energy Strategy

The Marches Energy Strategy[14] was commissioned by the Marches Local Enterprise Partnership (LEP) in 2017 with support from the Department of Business and Industrial Strategy (BEIS). Its objectives were to:

- Identify barriers to growth from current energy infrastructure.
- Highlight opportunities for the Marches to deliver its growth potential through innovative and low carbon related business opportunities.
- Develop an achievable action plan required to mitigate risks and capture the opportunities for the Marches that come with change in the national energy system.

The Marches is an area with ambitious growth plans; it is set to create 40,000 new jobs and 70,000 new homes over the next twenty years. Energy is a vital component in the realisation of these plans in terms of the availability and reliability of supply to be able to support this growth trajectory. Within the energy sector, there are also opportunities to expand high-value supply chains supporting technological innovation.

Key findings included:

- There is significant potential for renewable generation including biomass, solar, wind and anaerobic digestion.
- A significantly constrained electrical grid both in terms of generation and supply leading to difficulties in connecting both new development and energy generation assets.
- The Marches is already a national leader in the deployment of anaerobic digestion plants.
- The rural nature of the area results in;
    - Comparatively high transport emissions as vehicles have to travel further to their destinations.
    - Significant areas off the gas grid leading to the relatively widespread use of high carbon and high-cost fuels.
    - Above national and West Midlands average levels of fuel poverty.

The strategy identifies the following key priorities to deliver low carbon growth in the Marches:

- Key priority 1: Smart control and mitigation of grid constraints
- Key priority 2: Innovation in agricultural technologies
- Key priority 3: Sufficient reliable energy supply
- Key priority 4: Development of the supply chain in key areas of the low carbon economy
- Key priority 5: Local renewable energy supply
- Key priority 6: Addressing high levels of fuel poverty

14. https://www.marcheslep.org.uk/download/energy/Marches-Energy-Strategy.pdf

Appendix C - Herefordshire Council

A climate emergency was declared in Herefordshire on the 8 March 2019 and following this, in September 2019, committed to take a major step to minimise our impact on the environment, agreeing to:

- Accelerate a reduction of emissions and aspire to become carbon neutral by 2030/31.
- Deliver an updated carbon management plan and associated action plan for council emissions by April 2020.
- Work with strategic partners, residents and local organisations to develop a revised countywide carbon dioxide reduction strategy aspiring for carbon neutrality by 2030.
- Use 100% renewably sourced energy where this provides the best carbon reduction return on investment.

The above actions are reflected in the Herefordshire Council Environmental Policy (January 2019). The Council has commitments to use renewable energy where possible whilst reducing overall energy usage. This has been realised in 100% RECO Electricity being purchased and used across the corporate estate including schools.

The recent 3rd Carbon Management Plan (June 2020) draws and builds upon the previous plans with one significant difference – the ultimate target for the Council to become carbon neutral by 2030/31.

It outlines how Herefordshire Council has seen a reduction in its carbon. Between 2008/9 and 2019, Herefordshire Council has reduced its carbon footprint by 43%.

This was largely achieved through a number of different carbon reduction schemes including:

- LED street lighting,
- Installation of solar panels on council buildings,
- Purchase of electric and hybrid vehicles.

Herefordshire Council's actions with regards to energy purchasing, use of ERDF project monies to help deploy renewable energies through BEEP, MarRe, SEPuBu and a renewed schools programme will be key in helping to deliver this target.

Fuel Poverty in Herefordshire

A household is considered to be fuel poor if they have required fuel costs that are above average (the national median level) and where, if they were to spend that amount, they would be left with a residual income below the official poverty line.

Key Drivers of fuel poverty include:

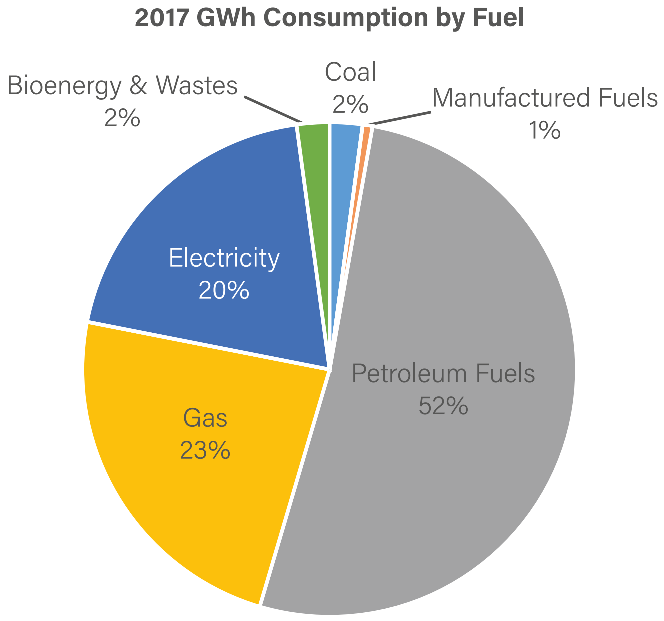
- Energy efficiency – improvement in energy efficiency slowed between 2015 and 2017.
- Fuel prices – prepayment price cap has contributed to the reduction of energy prices for mainly low-income households.
- Incomes – incomes increased at a faster rate for low-income households, partly due to the introduction of the National Living Wage.

In December 2014, the Government introduced a new statutory fuel poverty target for England. The target is to ensure that as many fuel poor homes as reasonably practicable achieve a minimum energy efficiency rating of Band C by 2030 (with interim milestones to lift as many fuel poor homes in England, as is reasonably practicable, to Band E by 2020; and Band D by 2025).

Currently, there are 84,796 properties in Herefordshire, 12.9% (latest BEIS 2018 figures) of which are in fuel poverty equating to over 10,000 households; a higher proportion than in England as a whole (10.25%). The majority of households affected by fuel poverty live in rural areas. 37.5% of properties in Herefordshire are off-gas grid. (www.nongasmap.org.uk) The majority of these properties are heated by oil, solid fuel or old electrical storage heaters.

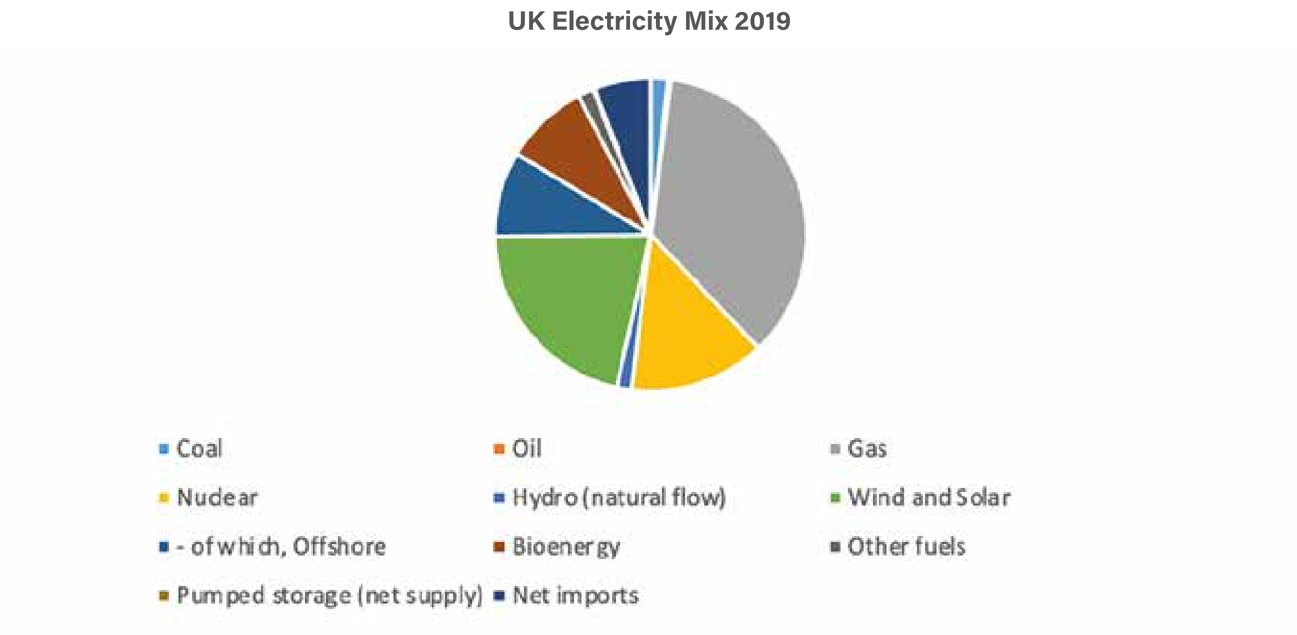
15. https://www.herefordshire.gov.uk/info/200249/climate/882/climate_change
16. https://www.herefordshire.gov.uk/download/downloads/id/20530/carbon_management_plan_202021_to_202526.pdf
17. https://www.herefordshire.gov.uk/download/downloads/id/8985/environmental_policy_2019.pdf
18. https://www.herefordshire.gov.uk/download/downloads/id/20530/carbon_management_plan_202021_to_202526.pdf

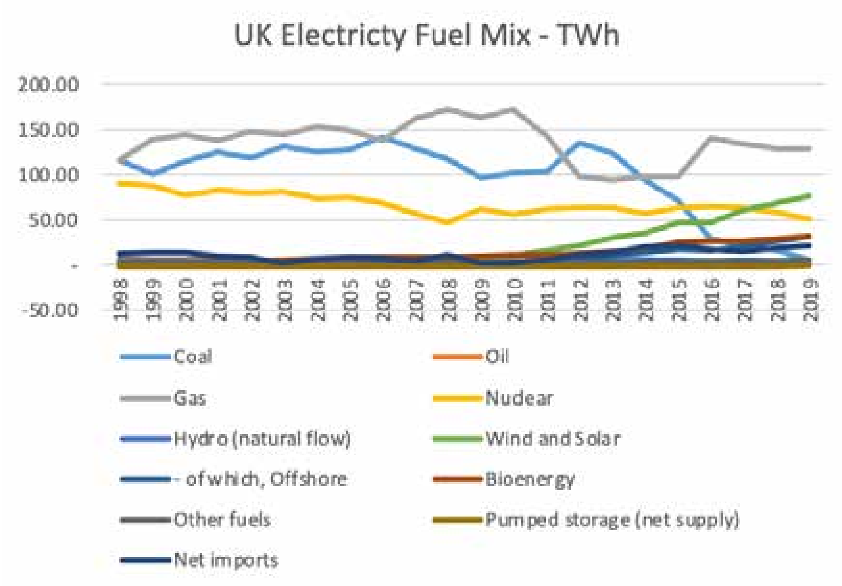
Appendix D – National and Local Energy trends



Generation of electricity in the UK

The mix of fuels in the generation of electricity has changed significantly over the last ten years, with coal at an all-time low, and more renewables being used. Electricity consumption continues to fall by just under 1% pa, whilst gas consumption has been static over the last few years.

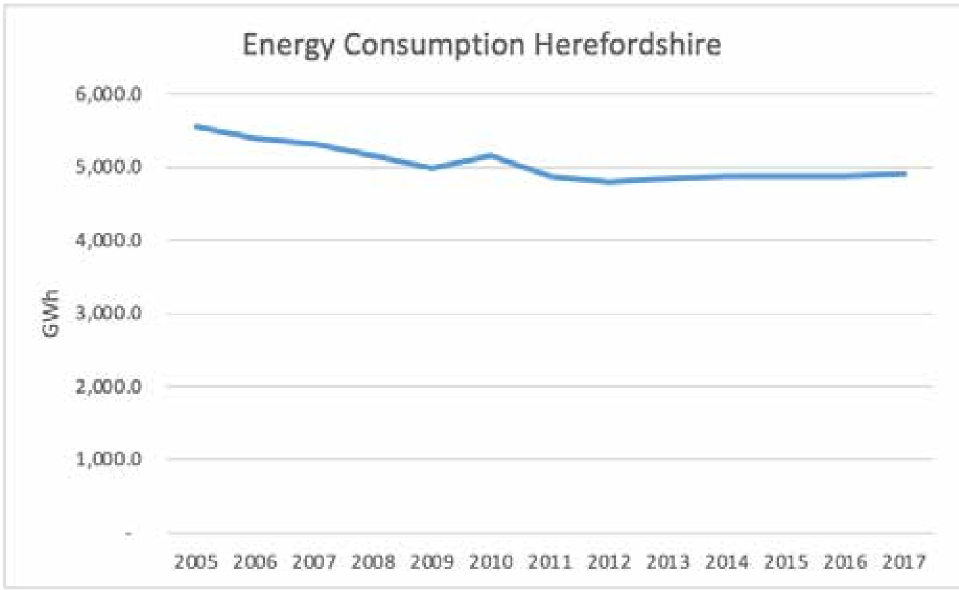


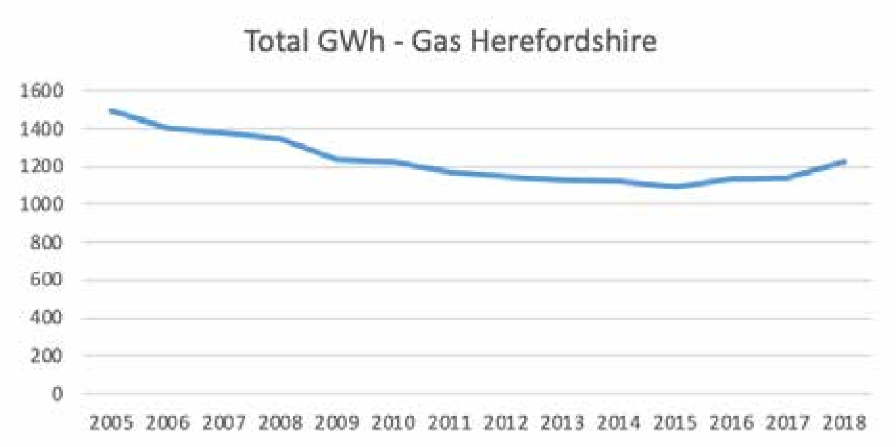


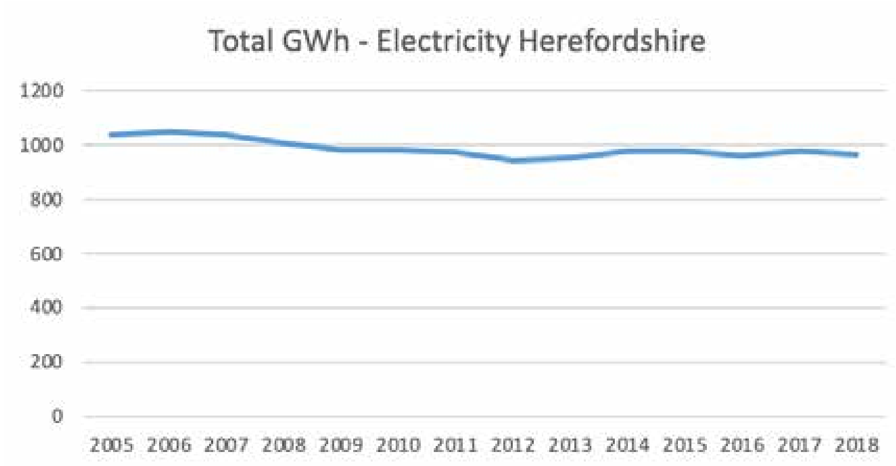
https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

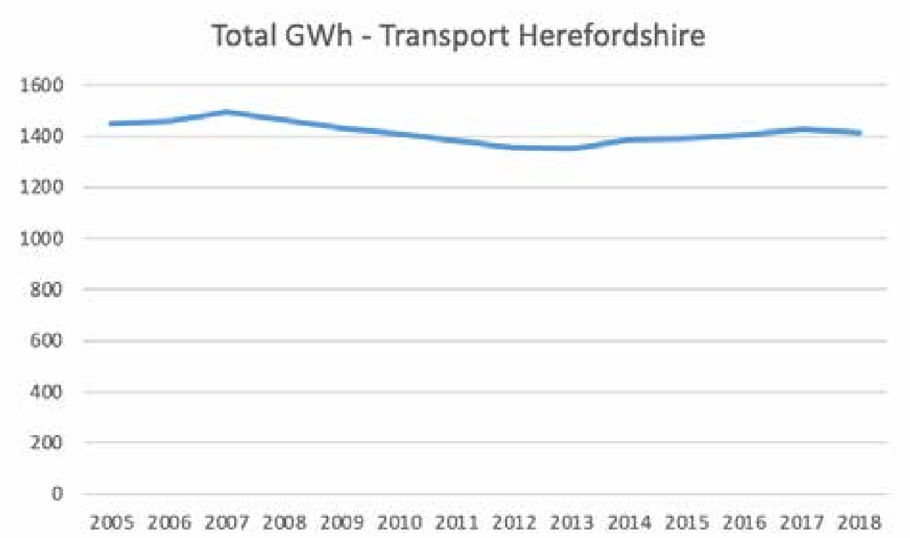
Trends in Consumption in Herefordshire

Energy consumption has generally decreased since 2005, although significantly, this has levelled off or risen slightly since 2012. There are however, noticeable differences between the amounts of energy from gas, electricity and transport.







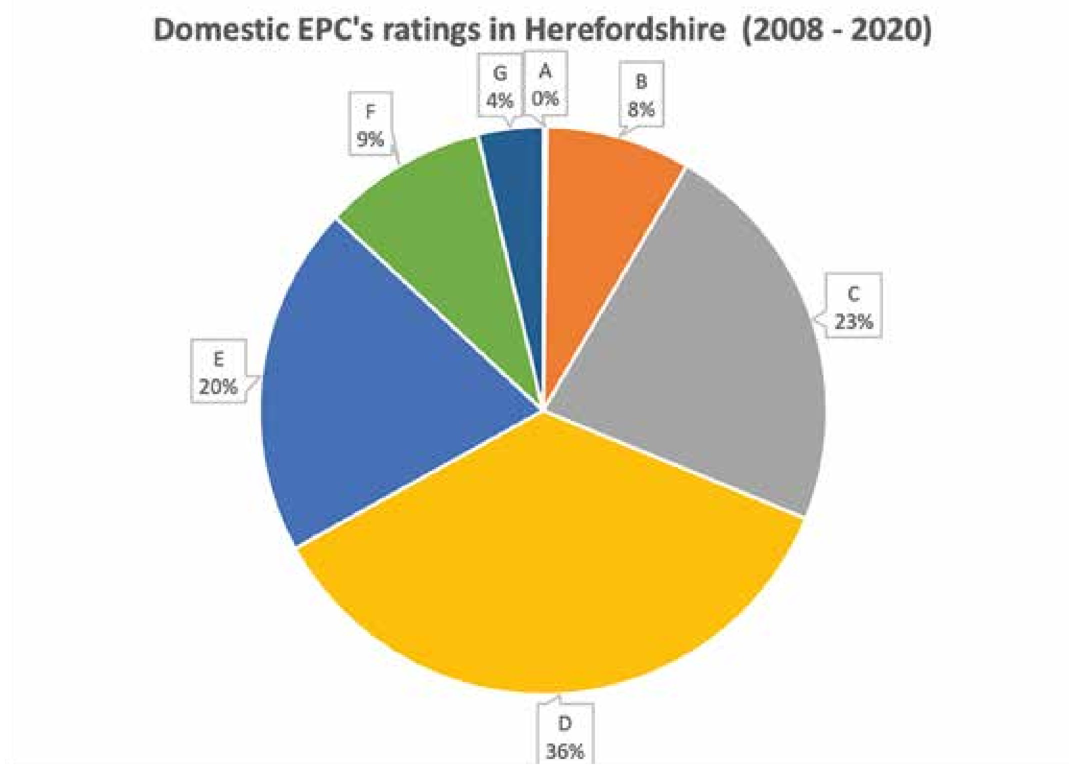


https://www.gov.uk/government/statistical-data-sets/total-final-energy-consumption-at-regional-and-local-authority-level

Appendix E – Current Energy Efficient Status of Commercial and Domestic properties in Herefordshire

The data collected through the Healthy Housing Survey (2011)[19] indicates that 20.5% of homes in Herefordshire were built before 1919. Mains gas was available to only 69.4% of properties, compared to 87% nationally. Of vulnerable households in Herefordshire, 25.5% inhabit dwellings classified as 'non-decent' under the Decent Homes Standard, 33.0% of whom live in pre1919 homes and 23.2% of whom live in properties with a SAP rating of below 55 (Band E).

Open EPC Data 2008- Jan 2020 (only updated once per six months). TOTAL 59,664 (70% of total households) broken down as follows:



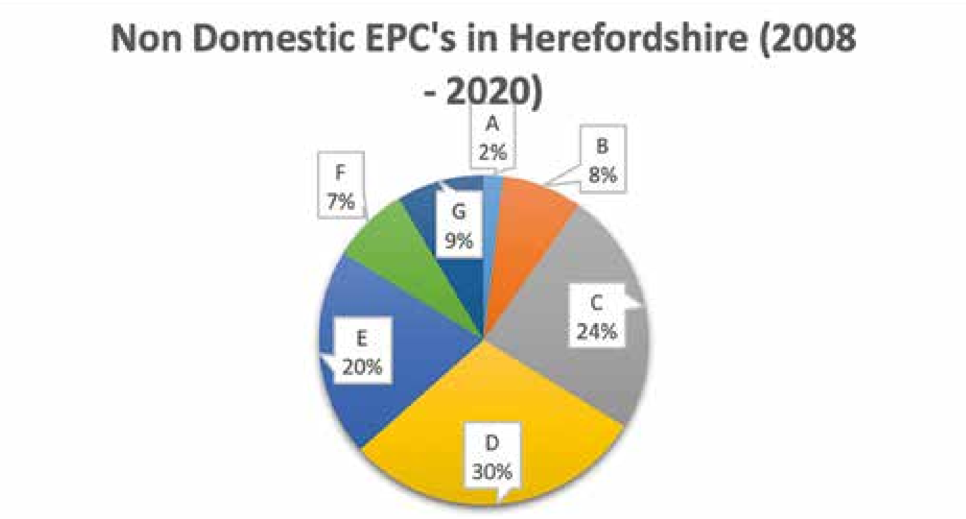
https://epc.opendatacommunities.org/

19. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/6735/2084179.pdf

Of these, there was a mixture of fuel (heating) types when broken down to the primary heating type gives the following:

Table - % of heating fuel types in Domestic property

	Biogas	Electricity	Solid Fuel	LPG	Mains Gas	Oil	Biomass
A	0.00	0.10	0.00	0.00	0.11	0.01	0.00
B	0.00	0.77	0.00	0.01	8.05	0.07	0.02
C	0.00	2.19	0.03	0.07	20.08	1.29	0.07
D	0.00	4.53	0.19	0.48	26.95	5.13	0.22
E	0.00	4.08	0.31	0.85	8.03	5.59	0.22
F	0.00	1.62	0.39	0.83	1.49	3.15	0.25
G	0.00	0.67	0.66	0.44	0.12	0.74	0.18



Of these, there was a mixture of fuel (heating) types when broken down to the primary heating type gives the following:

Table - % of heating fuel types in Non Domestic property

	Biogas	Biomass	Dual Fuel Appliances (Mineral + Wood)	Grid Supplied Electricity	LPG	Natural Gas	Oil	Other	Waste Heat
A	0.00	0.51	0.00	0.62	0.15	0.59	0.00	0.04	0.00
B	0.07	0.40	0.00	3.26	0.26	3.48	0.29	0.07	0.04
C	0.00	0.15	0.00	9.57	1.17	11.18	1.36	0.51	0.04
D	0.00	0.04	0.18	13.71	0.99	11.48	2.60	0.66	0.00
E	0.00	0.22	0.15	11.48	0.73	5.17	2.57	0.07	0.00
F	0.00	0.00	0.04	4.77	0.22	1.43	1.03	0.07	0.00
G	0.00	0.00	0.04	6.20	0.11	0.95	1.25	0.07	0.00

Appendix F - Renewable Energy Generation and technologies in Herefordshire

Based on national data from 2019 from BEIS[20], this is the current level of deployment of renewable energy in Herefordshire:

Renewable Technology	Photovoltaic	Onshore Wind	Hydro	AD	Plant Biomass	Total
Number of Installations	5,090	21	6	20	16	5,153
Installed Capacity (MWp)	56.3	0.2	0.0	8.9	2.1	67.5
Total Generation (MWh)	55,145	472	106	48,753	11,898	116,373.6

Renewable Sites in the Renewable Energy Planning Database in Herefordshire

Looking at the number of sites in the planning system, cross working with the planning group will be important especially as two large solar projects went to appeal and were refused totalling 21MW. A further 11MW of biomass were cancelled in Kingston and Pontrilas. The potential of the latest known renewable electric installs could have led to a 96.8MW addition shown below (this is the original applied for size which may be reduced upon installation) of electricity being generated.

	Development Status							
Technology	Abandoned	Application Refused	Application Submitted	Application Withdrawn	Awaiting Construction	Operational	Planning Permission Expired	Grand Total
Battery					1	1		2
Biomass (dedicated)	2							2
Solar Photovoltaics		3	1	2	2	3		11
Wind Onshore							1	1
Grand Total	2	3	1	2	3	4	1	16

Development status of Renewable Electricity projects[21] in the County of Herefordshire (correct March 2020 Q1)

20. https://www.gov.uk/government/collections/renewables-statistics
21. https://www.gov.uk/government/collections/renewables-statistics

Cost of Renewable Installations

Data for the cost of installs is lacking for most technologies. BEIS updates a monthly deployment of solar PV and the latest digest found that the average cost of solar installations fell in 2019/20. For the smallest (0-4kW) installations, the mean cost decreased to £1,562 per kW installed, (4-10kW) £1,704 and (10-50kW) £1,077[22].

Wind

The West Midlands has very few large-scale projects – just 17 totalling 45MW, 30.6 of which are in Powys. There are also a limited number of small turbines, 106 turbines totalling less than 1MW. No significant deployment of wind is currently planned. Planning and market uncertainty are both contributing factors that have stalled development of wind power in the West Midlands. There is also some uncertainty surrounding the availability of suitable sites.

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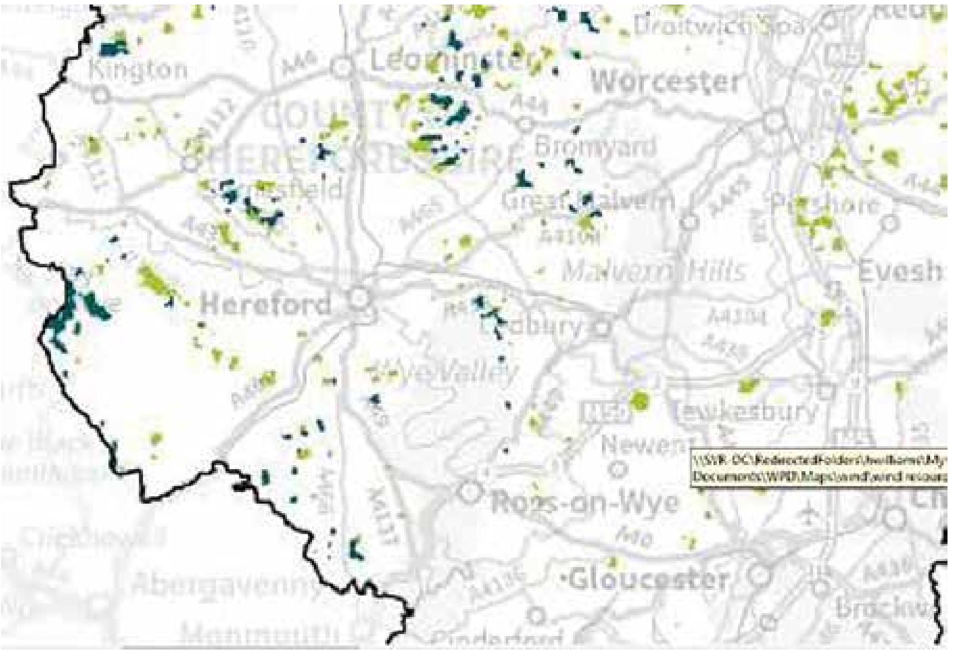


Distributed generation and demand study – WPD 2018

Solar PV

Changes to the subsidy regime for Solar PV has had a significant impact on the delivery of schemes across the UK. However, thanks largely to falling module prices due to increases in global supply and innovation, the installed cost of solar PV has dropped significantly. The market is now at a point where financial models support the subsidy free installation of PV at all levels.

22. https://www.gov.uk/government/statistics/solar-pv-cost-data

AD

Herefordshire along with Shropshire is a leading area for AD, although the number of new plants has reduced significantly in recent years. AD offers significant potential for growth. Given the right conditions, there is good potential for the development of AD in the area. However, unlike solar PV, there are unlikely to be significant cost reductions for AD that would make it widely viable without subsidy/with a low subsidy.

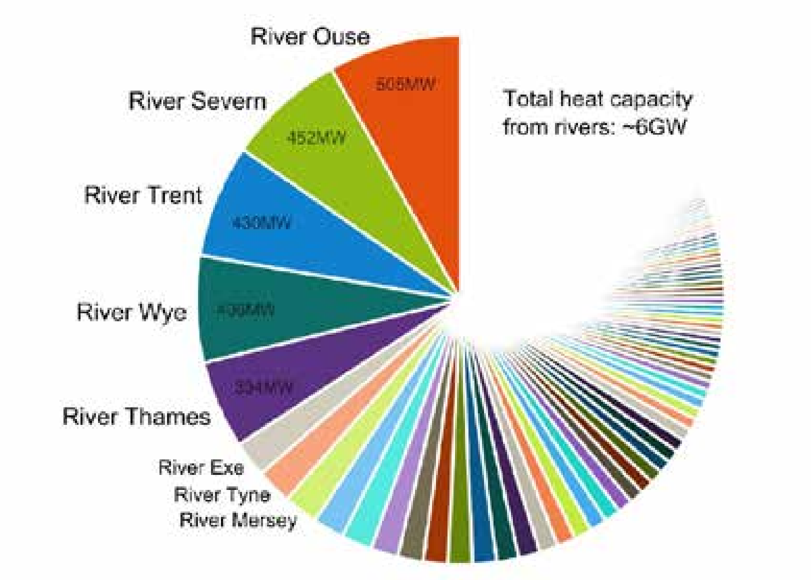
The Renewable Heat Incentive (RHI) has been extended until 2021, which may be useful in encouraging sites. Consultation, which is currently planned for July 2020, suggests that RHI is replaced with a grant.

Hydropower

There is currently very little scope in Herefordshire for hydropower at anything other than very small scale.

Water-source Heat

DECC and the Environment Agency have undertaken a piece of work to determine the amount of heat that could be extracted from rivers across the UK. The research demonstrates that the River Wye has the potential to be the 4th largest source of heat with 406MW of energy available. 305MW would be available at Hereford.



EfW (energy from Waste)

There are no EfW plants in Herefordshire, although waste from Herefordshire is sent to the jointly owned EfW plant in Worcestershire. Research estimates that, based on currently operational plants and those in the pipeline (under construction or at financial close), the UK's residual waste treatment capacity will exceed supply around 2021, taking into account export commitments.

CHP (combined heat and power)

There has been a growth in CHP plants. Whilst these help to balance the strain on the local grid and DNO, the authors are not sure how diesel and gas CHP will help to meet net zero goals.

Green Gas

Due to significant existing infrastructure, a lot of work is ongoing to unlock the potential to utilise renewable gas. A lot of work is currently being carried out by Cadent Gas to investigate options in this area.

Biofuel

Bioenergy is energy derived from biofuels. Biofuels are fuels produced directly or indirectly from organic material – biomass – including plant materials and animal waste. The authors believe that whilst this could play a part in the energy mixture, a full lifetime carbon cycle analysis should be carried out.

Hydrogen

Currently, the global hydrogen industry is well established and produces 50 million tonnes[23] of hydrogen per year.

There are various ways to produce low carbon hydrogen – ranging from steam methane reforming combined with carbon capture and storage to water electrolysis and use of waste streams. Other routes to hydrogen are expected to be commercially developed; one example is via the utilisation of nuclear heat. No one solution is expected to dominate world markets – allowing flexibility in its production. However, hydrogen fuel itself can be produced with ever-increasing cost-effectiveness through electrolysis, by splitting water into its constituent hydrogen and oxygen atoms. This generates two useful gases and, when powered by green energy, makes hydrogen production a carbon-neutral act.

At present, however, just 2% of hydrogen manufactured each year around the world is produced by water electrolysis, while 98% is produced from natural gas, with carbon dioxide as a by-product. However to meet ambitious targets - The use of 'green' hydrogen production would be required.

The European Commission aims to promote so-called 'green' hydrogen produced from renewable electricity over the 'grey' sort obtained from natural gas steam reforming. Renewable hydrogen produced from wind and solar power is "the most compatible option with the EU's climate neutrality goal in the long term and is the priority focus" of the EU executive, states the latest draft of the strategy, documented by EURACTIV[24].

Keele University is experimenting with injecting hydrogen into pipes. HyDeploy[25] is a ground-breaking green energy trial and is injecting up to 20% (by volume) of hydrogen into Keele University's existing natural gas network, feeding 100 homes and 30 faculty buildings. The 20% hydrogen blend is the highest in Europe, together with a similar project being run by Engie in Northern France.

23. http://www.ukhfca.co.uk/the-industry/hydrogen/
24. https://www.euractiv.com/
25. https://www.keele.ac.uk/

Battery storage

Primarily driven by the advance of EV, battery technology is a rapidly growing market. The latest information from the UK Battery Storage Project database report reveals that nearly 300MW of utility scale battery storage was deployed in 2019, bringing cumulative installations to over 900MW.

The total pipeline of battery storage projects in the UK has now reached over 13.5GW and is made up of a diverse range of projects, including co-location with renewables, stand-alone and "behind-the-meter". This is generally small-scale in Herefordshire. Until recently, there was no MCS accreditation for batteries or their installation.

Ensuring installation standards - MCS Accreditations

In any and all infrastructure development, it is vital that high and appropriate standards are maintained. In the UK for renewable generation (smaller systems), this is monitored at this time by MCS.

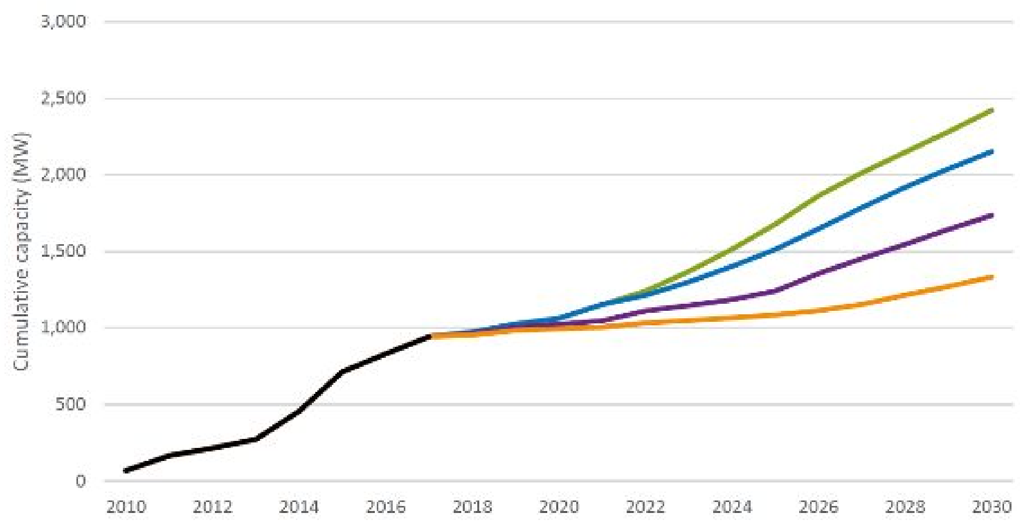
MCS is a standards organisation who create and maintain standards that allow for the certification of products, installers and their installations. MCS certifies low-carbon products and installations used to produce electricity and heat from renewable sources. MCS is a mark of quality, and membership of MCS demonstrates adherence to these recognised industry standards, highlighting quality, competency and compliance. Installation by an accredited contractor is often mandatory if any grant or subsidy is sought. There are currently 13 contractors in Herefordshire listed on the MCS database.

MCS CERTIFIED

Appendix G- Future Scenarios for Herefordshire and Network Constraints

The National Grid's Future Energy Scenarios also looks at the likely capacity of renewable energy under a range of options. WPD are currently working on projections for each Local Authority area to provide an estimate of the likely deployment of renewable technology up until 2030. The graph below shows the combined results for the West Midlands region under each of the four Future Energy Scenarios proposed by OFGEM in 2017. (NB. Up-to-date data for the scenarios for Herefordshire has been requested from WPD).

Technology	Units	Baseline Total	Local Authority Projections in 2030				
			Consumer Power	Gone Green	No Progression	Slow Progression	WPD Best View
Battery storage	Installed capacity (MW)	-	69.9	75.9	13.2	38.1	38.1
Electric vehicles	Number of units	669.0	35,148.0	56,773.0	26,894.0	41,494.0	35,148.0
Heat pumps	Number of units	662.0	2,346.0	5,336.0	1,102.0	3,217.0	5,336.0
Large scale PV	Installed capacity (MW)	15.9	20.7	21.7	17.3	19.1	19.1
New I&C developments	Floorspace (m2)	-	339,315.0	339,315.0	221,160.0	221,160.0	221,160.0
New domestic developments	Number of houses	266.0	12,040.0	12,040.0	8,911.0	8,911.0	8,911.0
Other generation	Installed capacity (MW)	29.1	50.6	40.8	32.1	35.2	35.2
Small scale PV	Installed capacity (MW)	37.7	84.7	96.9	52.9	69.6	69.6
Wind	Installed capacity (MW)	0.4	4.3	3.1	0.8	1.4	1.4



WPD discussions about state of network:

- The 66kV to 11kV transformation level seems to be in good health. This is mostly down to the recent investment in Hereford Central.
- The 132/66kV is more problematic – it's fairly constrained at the moment. WPD are currently adding a new Grid Transformer in the Hereford area. This has a lead time of around 2 years, but should provide lots more capacity across a wide area.
- WPD will undertake a 11kV study. This is more involved and will take some time to complete. This will enable a comparison between the vision of the distribution of new gen/demand, it's impact on peak flows and reasonable cost estimate between us – acknowledging the tight timescales.
- WPD will hold a 'surgery' with Herefordshire Council and subgroup, and will develop a demonstrator project to help overcome the constraint issues.

A report commissioned by Telford & Wrekin Council in 2011 estimated the total capacity of renewable energy in the West Midlands and calculated the following potential capacity in Herefordshire. The data and assumptions made in this report will require updating to reflect changes in technology and the market since 2011.

Renewable Technology	Onshore Wind		Hydro	Microgeneration				Total
	(Large Scale)	(Small Scale)		Solar PV	Solar water Heating	GSHP	ASHP	
Installed Capacity (MWp)	7,786	237	15	67	53	97	388	

Role of Electricity Storage

This is an emerging piece of work. Currently, there is very little data available at a Herefordshire level.

The UK energy system is undergoing significant change including the closure of a legacy generating plant, the growth of distributed generation and the shift towards more variable sources of low carbon energy.

	Capacity 2010/11	Closed* since 2010	New Cap added	Current 2015/16	Closed by 2030 ???
Coal	26 GW	13.3 GW		12.8GW	12.8 GW
Gas	30.2 GW	4.5 GW	8.5GW	33.7 GW	16.5 GW
Renewables	8.6 GW		24.8 GW	33.3 GW	3.5 GW
Nuclear	10.7 GW	1.4 GW		8.9 GW	7.7.GW
	77.8 GW	22.9 GW	33.2 GW	90 GW	41.4 GW

* Closed, partially closed, converted to biomass or mothballed

Source: Distributed generation and demand study Technology growth scenarios to 2030 Regen/WPD 2018.

An overall impact of this change has been to increase the need for greater flexibility within the energy system in order to; improve the balancing of generation and consumption, maximise the use of low carbon energy generation and optimise the investment in infrastructure. Installing large scale storage on the grid network better enables the balancing of supply and demand and assists in providing technical services such as frequency response and voltage optimisation.

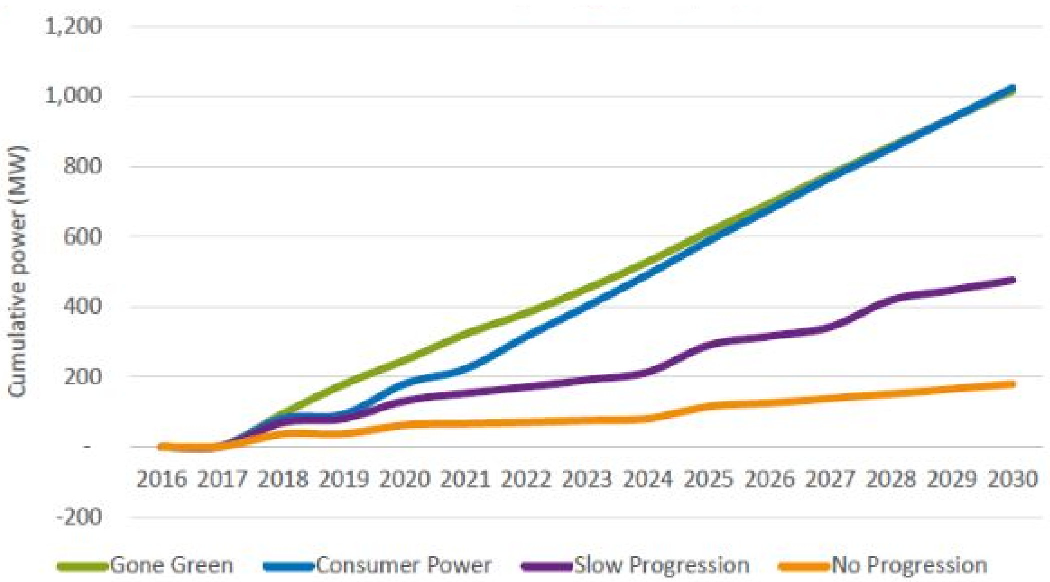
A summary of the electricity storage business models used in the future growth scenario has been modelled and assumed up to 2030 for the future three energy scenarios.

Great Britain market scenario growth assumptions to 2030*
Used to underpin West Midlands licence area scenarios

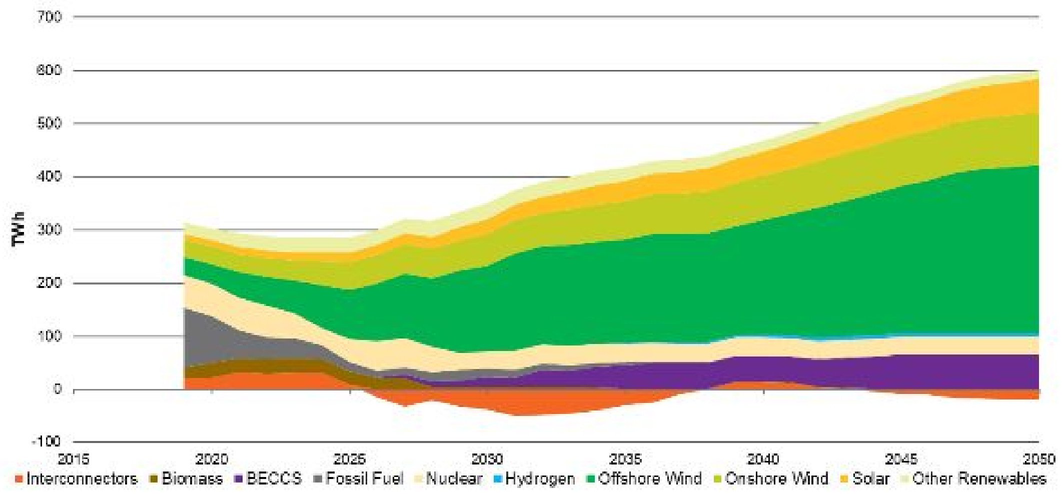
Business model	Gone Green and Consumer Power	No and Slow Progression	Possible upside very high growth scenario
Response service	2 GW	0.5 - 1 GW	2 - 3 GW
	2 GWh	0.5 - 1 GWh	4 - 5 GWh
Reserve Services*	3-4 GW	2-3 GW	4 GW
C&I high energy user & behind the meter	2.5 - 4 GW	0.6 - 1.2 GW	5 GW
	10 - 16 GWh	2.5 - 5 GWh	20 GWh
Domestic and community own use with PV***	1.5 - 2 GW	0.37 - 0.75 GW	3 GW
	6 - 8 GWh	1.2 - 3 GWh	12 GWh
Generation co-location	2 GW	0.5 - 1GW	4 GW
	6 - 8 GWh	2-4 GWh	16 GWh
Total Great Britain market	10 - 12 GW	4 - 5 GW	15 GW**
	24 - 44 GWh	6 - 13 GWh	50 GWh

* includes existing 2.7 GW of storage – mainly pumped hydro reserve services

The scenario analysis has considered a high growth scenario of 10-12 GW and 24-44 GWh of energy storage capacity installed across Great Britain by 2030 and a lower growth scenario of 4-5 GW and 6- 15 GWh across GB by 2030. The graph below shows the West Midlands Growth scenarios electricity storage power (MW) potential.

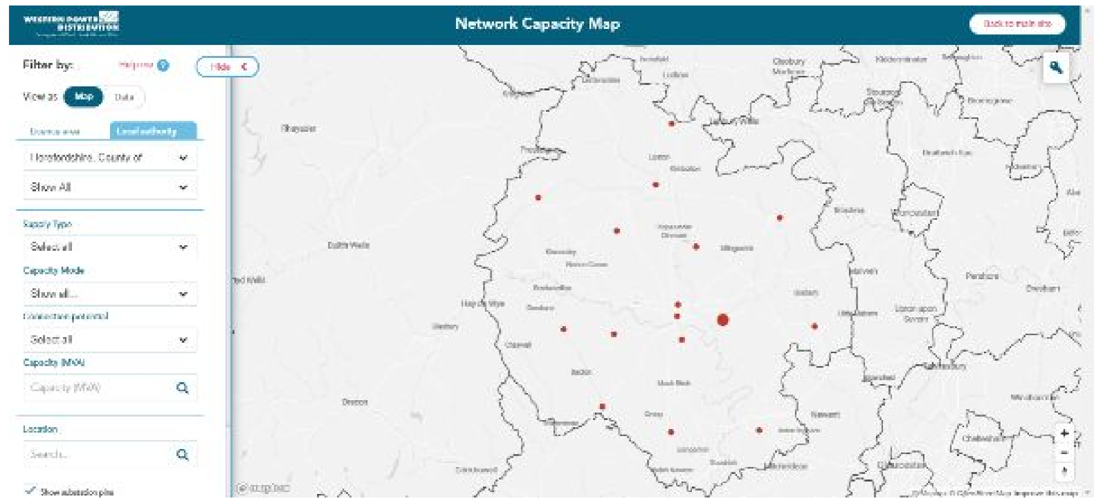


The amount of electricity required in the UK has been forecast out to 2050 as part of the Future Energy Scenario work. The following graph shows that demand for electricity will continue to grow. It is therefore important that this new generation is lower in carbon. The carbon intensity of electricity continues to decline as more renewable generation comes on line.



Network Capacity Constraints

There are 17 Bulk Supply Points (BSP)/ Primary Substations in Herefordshire, all of which have significant associated constraints, particularly for new generation. (Red dots on WPD mapping data indicate constrained substation). This limits the potential for large-scale renewables without also significant upgrade to the 11 and 66kVA systems.



https://www.westernpower.co.uk/our-network/network-capacity-map-application

The companies that operate the electricity networks in Great Britain have an essential function. Their infrastructure ensures that consumers have access to a secure supply of electricity. We are in a period when the demands being placed on these networks, and the energy system more widely, are changing. The Networks Operators (or DNOs) operate in regions where they largely have a monopoly on network services. The government therefore caps the revenues they can recover from customers.

The role of OFGEM, the government's regulator is to ensure that both existing and future consumers pay a fair price for the cost of running these networks and get the services they require. This is done through a price control process called RIIO (Revenues using Incentives to deliver Innovation and Outputs).

A review of this price control system is currently underway. As well as setting investment priorities for the DNOs, RIIO-ed2 will also seek to:

- Support decarbonisation,
- Drive innovation and competition,
- Develop a smart, flexible energy system.

It is a critical time to ensure that the needs for improved infrastructure and capacity in Herefordshire are taken.

The rapid shift in how energy is used and generated at transmission and distribution levels has already caused significant challenges to energy networks. The West Midlands already has 1.4GW of renewable generation connected and with its distributed electricity network now reaching capacity, further connections are likely to require further network upgrades and increased flexibility.

Demand Side Response (DSR)

Demand side response (DSR) is all about intelligent energy use. In the WPD supply area, DSR is managed through a scheme called Flexible Power. Through Flexible Power, businesses and consumers in a Constraint Management Zone (CMZ) can turn up, turn down, or shift demand in real-time in order to reduce the pressure on the system. To date, no CMZs have been defined in Herefordshire.

Future with Electric vehicles

As of 1st April 2020, there were 56 publicly available electric vehicle (EV) charging devices available in Herefordshire, of which seven were rapid charging devices.

EVs will require a significant amount of electricity to charge. There are currently around 120,000 registered cars in Herefordshire. If the aspiration is to convert 100% of these existing vehicles to EV, this would require around 223GWh of energy to be used per year and around 15,000 new charging points to be installed (mostly 3kW or 7kW chargers in private-off street locations).

All things being equal and no significant changes to driver behaviour would have the following impact for Herefordshire:

Target percentage EV uptake	100	%
Number of EV's	117,185	
Average annual mileage	8000	
Battery capacity in kWh	40	Leaf
Mileage per 100% charge	168	
Annual number of charges	48	
Annual energy required in kWh/car	1905	
Total annual energy required in kWh	223,210,038	kWh

This would therefore require significant additional infrastructure. (No distinction is made for on-road charging).

Charger Type in kW	Annual energy delivered	Use	Hours Available
3	13140	Overnight home charging	12
7	17920	Daytime workplace charging	8
50	146000	Destination charging	8
150	985500	Charge Hub stations	18

Future with Heat Pumps

The Government is currently developing its new policy framework for the long-term future of heat. A new Heat Policy Roadmap will set out the key steps required to make key decisions on heat decarbonisation. Currently, it is planned that all new developments should be low carbon – essentially electric. The amount of electricity required for this change is also significant. By way of example, the table below demonstrates the energy use in an average property year before and after installation of an ASHP.

BEFORE		AFTER	
Electricity	2,680 kWh per year	Electricity	8,481 kWh per year
Gas	24,950 kWh per year	Gas	950 KWh per year
Total energy use	27, 630 KWh per year	Total energy use	9,431 kWh per year

This demonstrates the significant overall energy saving from providing energy to the property but also highlights the significant increase in the electricity use of the property. This will further stretch the ability of the electricity grid to cope with demand. A house would potentially require an additional 5,801 kWh of electricity per year, assuming all of the necessary measures are installed to enable the house to be retrofitted to a state where an ASHP is a viable option for heating. Assuming 65% of the existing housing stock is to be upgraded (52,000 homes), an additional 300GWh of energy would be required.

WPD Costing Development

WPD have begun an exercise to cost the impact of installing new heat pumps and EV chargers in Herefordshire. This is still a work in progress, but initial findings indicate that the cost to reinforce the grid to cope with additional EV and heat pumps that would be required would cost £152M.

High Level Preliminary Estimate on LCT upgrade costs in Herefordshire

Question

Impact of 117,000 EV chargers (7.4kW) and 52,000 Heat Pumps (3kw-6kW)

Current Herefordshire network configuration

HV/LV transformation and LV network

There are 662 distribution substations in Herefordshire. The average transformer capacity is just under 500kVA (460kVA) and on average there are 143 customers connected to each of them. The current peak utilisation is around 40%.

EHV/HV transformation and HV network

There are 19 BSPs feeding Herefordshire, mostly 66/11kV. There is approximately 326MVA of EHV firm capacity in the area utilised at around 60%.

132kV network

There is further network feeding into the area on the 132kV voltages.

Additional Demand Estimates

The 117,000 EV chargers will not all be used coincidentally, an after diversity maximum demand of 1.6kW/EV has been used to calculate the maximum demand figure in the LV, with this being reduced by 25% once it is transformed to the HV.

The 52,000 heat pumps will be coincident so create a maximum demand of (52,000 x 3.6kW) at LV and above.

Likely costs to accommodate

Costs used to inform this study come from the CDCM ARP table for MIDE region.

Voltage	Costs
LV	£40,036,439.24
HV/LV	£31,296,527.05
HV	£31,733,978.42
EHV/HV	£26,471,919.59
EHV	£12,692,996.08
132kV	£9,995,968.73

Total Costs

The cost to reinforce the distribution network in Herefordshire would be in the region of £152m.

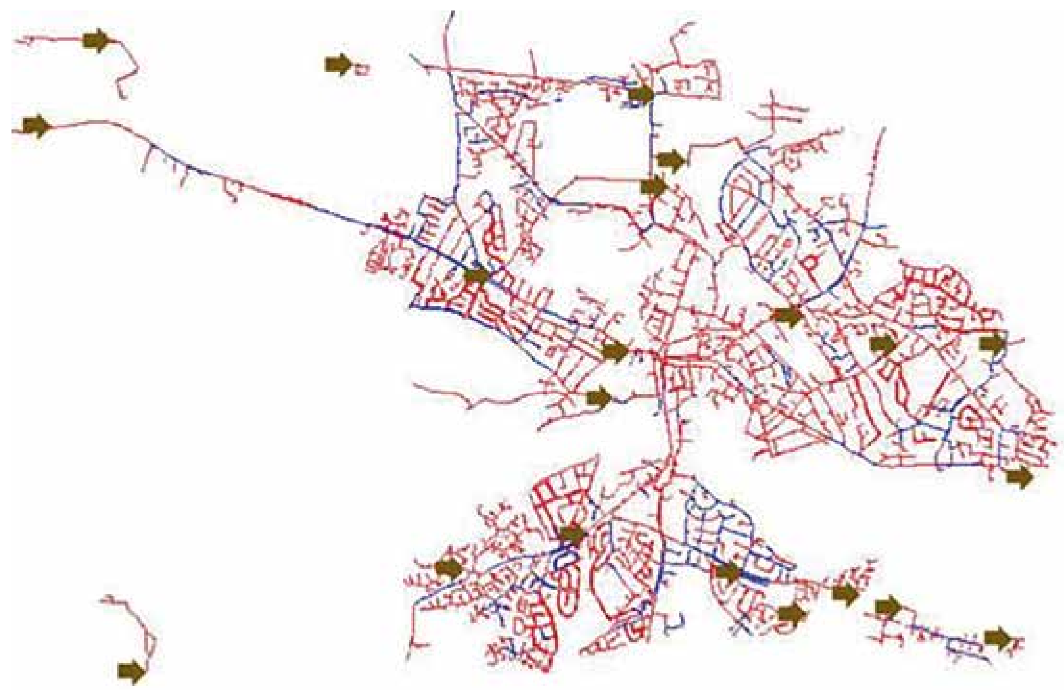
The Future Role of Gas

In its role as DNO for the gas network, Cadent are looking at how best to utilise the existing gas network to help to decarbonise heat in the county. This will concentrate on areas where the network already exists and potentially identify sites for future development. Cadent also recognise that hydrogen may play a role in powering non-electrified transport. They are working with partners across the Midlands on a range of demonstrator projects.

Cadent are already working to decarbonise the gas in our network through bio-gas connections to the grid. They are also currently trialling a 20% hydrogen blend (which requires no changes to appliances etc.) at their Hydeploy project at Keele University. Longer term Cadent are looking at developing 100% hydrogen in the gas grid. The transition through these different stages will look different in each area – the HyNet project gives a good overview of how this could potentially develop (https://cadentgas.com/future-of-gas).

A team dedicated to helping manage this transition in Herefordshire is currently being set-up. This will expand on the work carried out to date which has looked at what this transition to hydrogen will look like for Hereford city. The initial work indicates that Herefordshire could be converted over fairly easily as a large proportion of the network has already been converted over to plastic.

The map below shows the current gas network in Hereford. Red lines represent current plastic pipes and blue lines are predicted plastic once replaced by 2030.



In terms of converting the gas grid for a hydrogen solution for Hereford as a whole, things look promising (80% of the system could be repurposed without requiring reinforcement). It is likely that further in-depth analysis over the next 12 months will provide more certainty regarding this.

Currently, 77% of the Hereford network is plastic, and this is set to rise to over 90% as we approach 2030. Cadent work on the assumption that the majority of pipes will be plastic in any future scenario, and therefore potentially compatible with conversion to hydrogen.

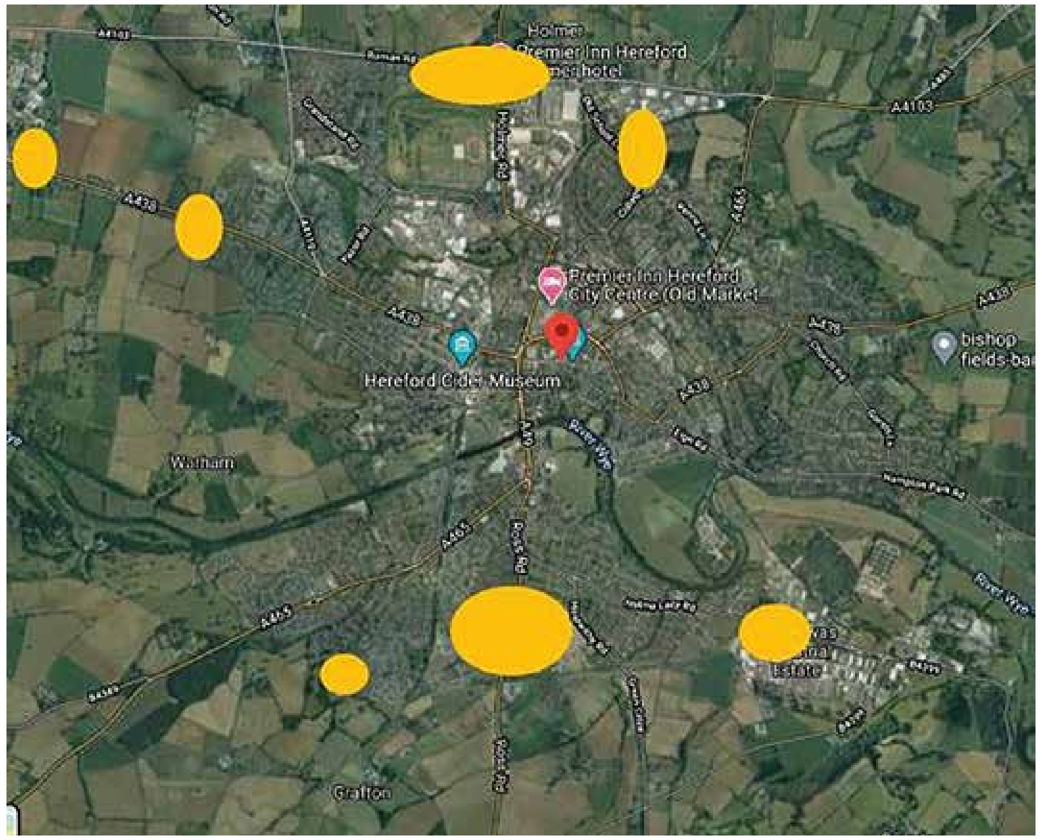
Network Capacity Check

A quick check shows that hydrogen conversion in the Hereford area could be achievable with some investment required in the network to maintain supply to all customers.

	Customer Count	Peak Demand (mwh)
Commercial	604	65.02
Domestic	22686	148.34
Industrial	77	21.51
Total	23367	234.87

Investments

Cadent have identified the areas where investment/upgrades may be required and shown below. These will either be pressure increases or pipelay to bolster the network capacity to meet peak demand in a Hydrogen future.



Conversion Process

Conversion will need some network alterations such as the installation of valves, this will enable Cadent to section customers and convert the network from methane to hydrogen in a gradual process so that everyone has a heat source. Cadent are currently working on how many valves will be required in the network.

Customer Journey

Cadent are also exploring the customer journey and believe that as a best case scenario, conversion could be done in 1 day if the house is hydrogen ready (with appliances fitted before conversion). However, this could take significantly longer if all the appliances are not ready for conversion.

Future Goals

Cadent aim to deliver a more detailed analysis response in the future; analysis is scheduled to start in 2021 and over the next 15 months, they will have detailed plans of how to convert a network. They will be able to provide more reports on costs, valve installation requirements and which areas will need focus for investment.

Appendix H - Who is producing the energy?

This section looks at the large and small scale producers with a spotlight on Community Energy, an emerging and growing field.

Large Scale Producers

The energy market is complex. As well as the National Grid and the six Distribution Network Operators, there are hundreds of electricity generators and suppliers involved in the distribution of electricity to domestic and non-domestic properties across the UK.

Ofgem regulates Great Britain's gas and electricity markets, to protect the interests of current and future consumers. Through regulation, they aim to deliver five outcomes for consumers:

- Lower bills than would otherwise have been the case,
- Reduced environmental damage both now and in the future,
- Improved reliability and safety,
- Better quality of service, appropriate for an essential service,
- Benefits for society as a whole, including support for those struggling to pay their bills.

There are a number of strains on this sector, including managing the transition to significantly increase the amount of distributed energy generated (solar panels on houses) and competition between suppliers causing others to go out of business.

Small Scale Producers

Over the last 10-15 years, there has been a significant rise in the solar capacity in the UK with an increase from 5,488.6 MW in 2014 to 13,259 MW in June 2019. Significantly, over 90% of the one million solar installations have been small, domestic scale. Despite the removal of the Feed-in-tariffs, it is likely that due to falling costs, solar PV will continue to increase in scale.

Community Energy

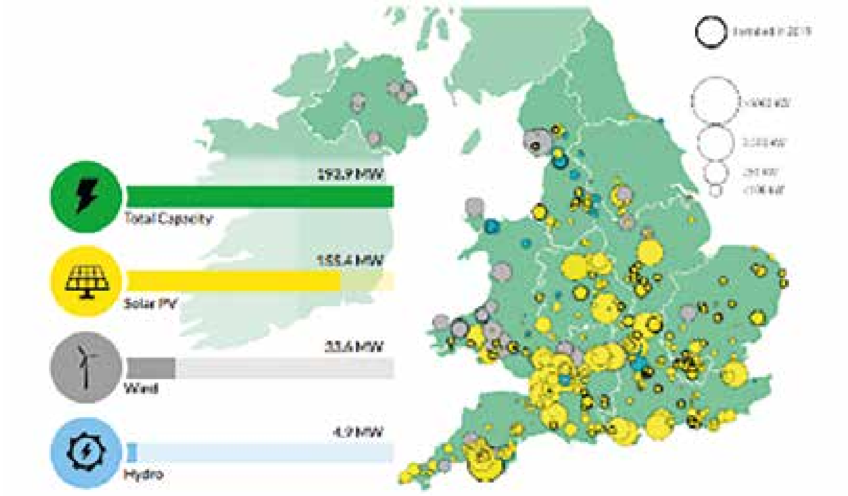
Community energy is the delivery of community led renewable energy, energy demand reduction and energy supply projects. These projects can be wholly owned and/or controlled by communities or through a partnership with commercial or public sector partners.

As of December 2019, the total community-owned electricity generation capacity was 193.9 MW across England, Wales and Northern Ireland (this consists of 155.4 MW solar PV, 33.6 MW wind, and 4.9 MW hydroelectric). Combined, these community energy projects generated 222.3 GWh of low carbon electricity. This is equivalent to the annual electricity demand of 74,100 UK homes. Cumulatively, since 2016, community energy projects have also prevented over 238,000 tonnes of carbon emissions through electricity generation.

In this paper 'A local Authority Perspective'[26] various L.A's from across the country have given feedback as to the importance of working with Community Energy groups in:

- Investment into energy generation projects,
- Regulatory Support,
- Financial Support,
- Engagement with communities,
- Resource sharing.

The Local Government Association has produced a guidance document[27] for councils indicating ways of joint partnerships and shared funding with community energy groups. A summary from Scotland[28] discusses the social factors for success on what can support community energy projects to be successful. WPD have indicated their clear focus in supporting Community Energy projects[29].



There are currently three solar co-operatives operating in Herefordshire.

There is a much smaller level of community owned renewable heat projects. In total, community organisations were found to own 2.1 MW of heat generation capacity, with a total annual output of 3.0 GWh. Capacity is dominated by biomass, with contributions from community ground and air source heat pumps and solar thermal.

26. https://communityenergyengland.org/files/document/70/1501767092_CommunityEnergyALocalAuthorityPerspective.pdf
27. https://www.local.gov.uk/sites/default/files/documents/download-potential-energy-9f8.pdf
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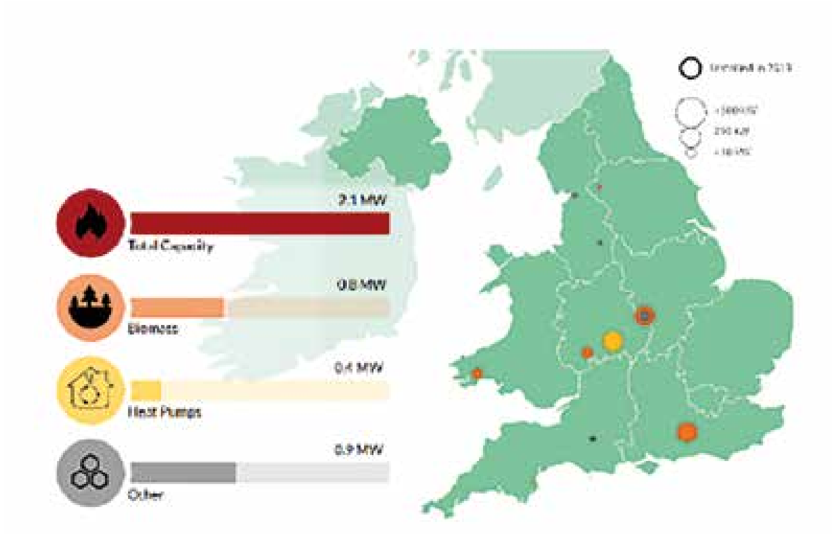


Community Energy Projects also have a role to play in energy storage, energy efficiency and low carbon transport.

Importantly, community energy has also engaged with over 90,000 local homes and businesses with the low carbon transition and supported 22,000 community members and 415 businesses to improve energy efficiency and reduce energy use. Community Energy projects generated £4.6m in local economic benefit in 2019, including nearly £2m in grants and loans to support local people, community organisations, charities and SMEs. Projects are now continuing to innovate to overcome barriers, developing projects with new technologies, business models and through greater partnership working.

Advantages and Disadvantages of Community Energy

Community led renewable energy and energy efficiency projects have had good success across the country especially where the work is in conjunction with local authorities. Local authorities have been an essential stakeholder and catalyst in setting up partnerships and development networks, helping to facilitate the creation of community energy organisations, through to capacity building, leasing of roofs, funding, supporting, financing and installing.

Outcomes from this support have included not just the development of community energy organisations and the delivery of renewable energy schemes, but wider energy efficiency advice, fuel poverty alleviation, energy education, awareness raising, community partnerships and community benefit funds.

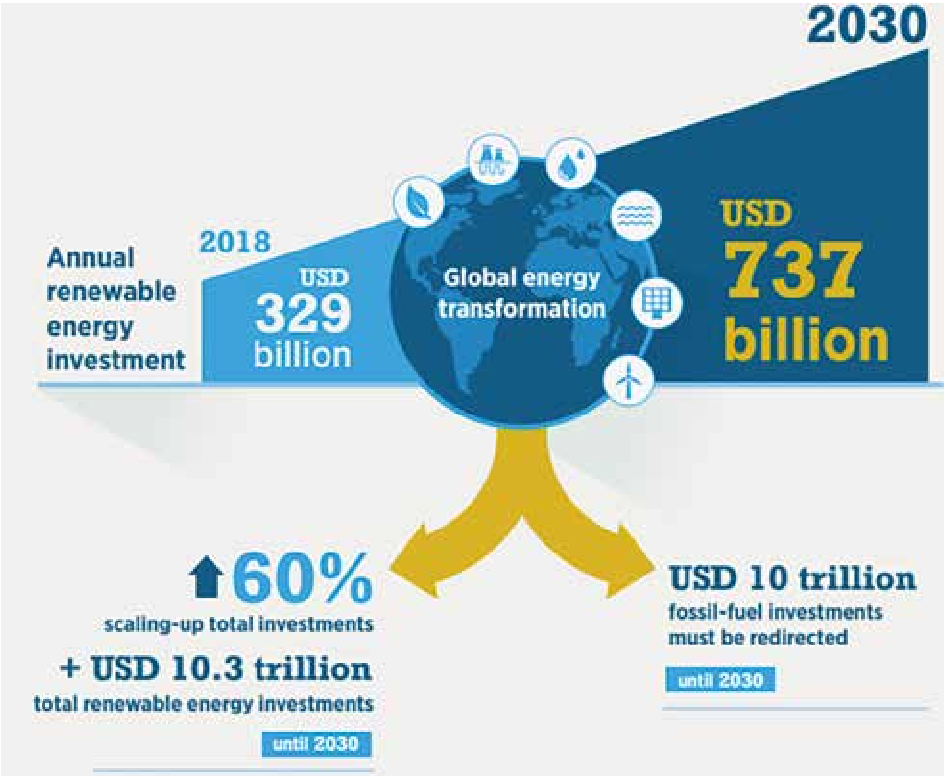
Community Energy England's 2018 State of the Sector[30] report found that 58% of community organisations surveyed cited educational initiatives as a core outcome of their projects. Benefits listed include using installed solar panels as a resource for interdisciplinary learning, for example embedding them in the geography, maths and physics curricula. The report further provides evidence of the wider social and economic benefits of community energy. It also highlights that the majority of money spent on community energy projects was retained in the invested area: of the £50 million investment in existing projects, £23 million was spent with local businesses.

30. https://communityenergyengland.org/pages/state-of-the-sector

Devon Council[31] have developed many support processes for community energy projects and Islington Council[32] has set up a community energy fund to support the creation of community energy projects.

Technologies installed by community groups largely focus on Solar PV, Wind and Hydro. The greatest heat capacity was in the Midlands area with a 200kW project in Herefordshire at Woolhope Woodheat[33].

The authors therefore consider that community energy is an important contributory factor not only to the 'green' and 'low carbon' agenda of local authorities (and LEPs), but also to; sustainable local and regional inclusive growth, economic resilience, community development, and inequality alleviation through projects aimed at tackling fuel poverty, for example.



31. https://www.devon.gov.uk/energyandclimatechange/community-energy-legal-toolkit
32. http://www.energyadvice.islington.gov.uk/wp-content/uploads/2017/12/Community-Energy-Fund-prospectus-2017-12-18.pdf
33. https://woolhopewoodheat.org.uk/

Appendix I - Financial Support for Energy Efficiency and Renewable Generation

The number of installations or renewable technology declined massively since the FiT was removed. However, there are a number of schemes within Herefordshire to support the installation of renewables.

The government and the energy regulator OFGEM, have put a number of schemes in place to encourage energy generators, businesses and individuals to play their part. The Green Deal was a government-backed scheme, designed to help homeowners pay for energy efficiency improvements, such as double-glazing, solid wall insulation, and boiler upgrades, from projected savings on energy bills. Unfortunately, the government announced that funding of the scheme would end in 2015. No new schemes have come online since then, although the post-covid recovery planning does suggest that new schemes to tackle energy efficiency in properties could be on their way.

There are a few other schemes that can have an influence on energy efficiency, which include:

- Energy Company Obligation, which obligates larger suppliers to deliver energy efficiency measures to domestic premises in Britain.
- The Renewables Obligation is the main support mechanism for renewable electricity projects in the UK.
- The Warm Home Discount is a one-off discount to reduce the cost of energy bills.

RHI

Supporting deployment of technologies is the Renewable Heat Incentive[34] (RHI). It was introduced in the non-domestic sector in November 2011 and the domestic sector in April 2014. It is intended to help overcome the cost differential between renewable and conventional heating systems to encourage more deployment of renewable systems.

Non Domestic Scheme

The non –domestic scheme[35] supports the installation of renewable and low-carbon heating by businesses, charities and the public sector, as well as systems supplying heat to more than one domestic property. Eligible technologies include heat pumps, biomass boilers, solar thermal panels, deep geothermal, biogas and biomethane for injection.

RHI payments are made to the owner of the installation for a 20 year period for heat that is generated and used for an eligible purpose such as space, water or process heating. Producers of biomethane for injection into the gas grid may also apply to the scheme. All installations must be fitted with heat meters to determine the amount of renewable heat production being used for an eligible purpose. Payments are calculated by multiplying this heat output (kWh) by the relevant tariff rate for the technology being used (pence per kWh).

Data for Domestic Accredited Sites covers the period (Apr 2014-May 2020) The West Midlands area represents only 6% of the national accredited sites with a technology breakdown of:

GSHP 5%; ASHP 10% ; Biomass 6%; Solar Thermal 7%

There are a total of 792 accredited domestic sites in Herefordshire.

34. https://www.ofgem.gov.uk/environmental-programmes
35. https://www.ofgem.gov.uk/environmental-programmes/non-domestic-rhi

Domestic Scheme

The Domestic RHI[36] supports the installation of renewable and low-carbon-heating by individual households. The scheme opened in April 2014. RHI Payments are made over a 7 year period and, in most cases, will be estimated using values from the dwelling's Energy Performance Certificate (EPC).

New applications can be made at any point, provided it is within 12 months of the commissioning of the system. Eligible technologies on the Domestic RHI scheme include air source heat pumps, ground source heat pumps, biomass boilers, biomass stoves with integrated boilers and solar thermal panels. All systems must be certified and installed under the Microgeneration Certification Scheme (MCS) or an equivalent scheme in order to qualify for payments. The government announced in April 2020 that the domestic scheme has been extended to March 2022.

The non-domestic RHI the West Midlands[37] as an area accounts for 11% of National accredited sites representing 614MW capacity in region.

Beyond RHI?

The government has a consultation that closes 7th July and it focuses on a Clean Heat Grant and a Green Gas Support Scheme.

Clean Heat Grant

The Government is proposing a Clean Heat Grant[38] that would commence in 2022, offering funding support of up to £4,000 for each household or business that integrates heating technologies such as heat pumps. An eligible list of technologies applicable for funding support will also be outlined. The Clean Heat Grant is only proposed to last for two years. This lack of clarity will provide no certainty for businesses proposing to serve the market.

£4,000 will only amount to a small contribution towards a £16,000 investment in a ground source heat pump system. The Government should be encouraging investment in ground source systems because they are inherently more efficient and because a key part of the investment is in a ground array that will last for over 100 years.

Green Gas Support Scheme

The Government is also proposing a new Green Gas Support Scheme[39] to increase the percentage of biomethane available on the gas grid.

MarRE

MarRE[40] is a grant scheme allowing eligible applicants based in the Marches to apply for a 50% grant towards new installations of renewable technologies on their premises. Installations ranging from 4kWp to 200kWp (system kilowatt peak) can be supported. Eligible applicants must be located in the Marches local authority areas of Herefordshire, Shropshire, and Telford & Wrekin.

36. https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi
37. https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-may-2020
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39. https://www.gov.uk/government/consultations/future-support-for-low-carbon-heat
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RCEF

The Rural Community Energy Fund[41] (RCEF) is a £10 million programme, which supports rural communities in England to develop renewable energy projects, which provide economic and social benefits to the community.

RCEF provides support to rural communities in 2 stages:

- Stage 1: Grants of up to £40,000 for a feasibility study for a renewable energy project.
- Stage 2: Grants of up to £100,000 for business development and planning of feasible schemes.

BEEP

The Business Energy Efficiency Programme[42] (BEEP) can provide grants of up to 40% of the total cost of a project (to the maximum contribution of £20,000 for businesses to improve their energy efficiency and reduce carbon emissions.

FiT

The Feed-in Tariff (FiT)[43] was a government subsidy scheme launched following the Energy Act 2008, to allow growth in electricity generation from green microgeneration technologies. To be eligible for feed-in tariff payments in the UK, installations needed to have a declared net capacity of 5MW or less. The Feed-in Tariff closed to new applications on the 1st April 2019 but this deadline was extended to allow those in the system affected by the COVID-19 to progress.

Developer Funding

Planning obligations under Section 106 of the Town and Country Planning Act 1990, commonly known as s106 agreements, are a mechanism that make a development proposal acceptable in planning terms. They are focused on site-specific mitigation of the impact of development. S106 agreements are often referred to as 'developer contributions' along with highway contributions and the Community Infrastructure Levy.

The Community Infrastructure Levy (CIL), introduced by the Planning Act 2008 is a tool to help councils deliver infrastructure in tandem with new development. It works differently to Section 106 payments and effectively operates as a development tax based on a fee per m2 of development.

A number of local authorities have now successfully used planning obligations to enable energy projects to be funded. These projects have included infrastructure, energy efficiency retrofit schemes, renewable energy projects, sustainable transport, and even offsetting projects.

Other sources

Bank loans, private investment, PPA investment

41. https://www.gov.uk/guidance/rural-community-energy-fund
42. https://www.business-central.co.uk/beep/
43. https://www.ofgem.gov.uk/environmental-programmes/fit

Appendix J - SCATTER Assumptions

The following assumptions were used to calculate SCATTER assumptions in the report.

	Description
Impacts all other areas	Solid biomass generation quadruples in 2025, dropping off after that. ; Coal phase-out follows trajectories from the National Grid's Two Degrees scenario.
	Hydroelectric power generation grows to 34 MWh per hectare inland water in 2030; 41 in 2050.
	No change to large-scale offshore wind generation.
	Large-scale onshore wind generation grows to 1.56 MWh per hectare in 2030; 1.75 MWh in 2050.
	Small-scale wind grows to 2.3 MWh per hectare in 2030; 2.6 in 2050 (from a baseline of 1.2 MWh per hectare.)
	Large-scale solar generation grows to 200 kWh per hectare in 2030; 400 in 2050 (from a baseline of 50 kWh per hectare.)
	Local solar capacity grows, generating equivalent to 2500 kWh per household in 2030; 5200 in 2050 (from a baseline of 400 kWh per household.)
	For areas with wave / tidal power, no change to current levels.
Agriculture	24% increase in forest cover by 2030.
	7% decrease in grassland. Cropland decreases 1%; increase in the coverage of settled land.
	0.5% annual reduction in livestock numbers
	Tree-planting to increase current coverage by 30% by 2030; from 2030-2050 further increase of 20%.
Domestic	By 2050, domestic lighting and appliance total energy demand has dropped to 27% of current levels.
	Small reductions in efficiency of domestic cooking. Proportion of cooking which is electric increases to 100% in 2050.
	Hot water demand per household reduces by 8% every 5 years
	From 2021, 100% new-build properties are built to passivhaus standard.
	By 2050, 10% of current stock is retrofitted to a medium level; 80% deep retrofit.
	By 2050, most heating comes from ground source heat pumps and community -scale CHP, some district heating
Industry and Commercial	In 2050, commercial heating, cooling and hot water demand is 60% of today's levels
	By 2050, 90% heating with fuel-cell µCHP
	Commercial lighting & appliance energy demand decreases 25% by 2050.
	By 2050, 100% of commercial cooking is electrified.
	Industrial electricity consumption is 50% of total energy consumption by 2035; 65% by 2050. Output falls by 2% every year for non-heavy industry.
	Reductions in process emissions from all industry: general industry reduces process emissions at a rate of 4.5% per year. Chemicals emissions reduce 1% per year; metals 0.7% per year, and minerals 0.8% per year.

Transport	By 2050, 22% decrease in distance travelled by road freight; 75% increase in efficiency. In waterborne transportation, 28% increase in use of waterborne transport.
	25% reduction in total distance travelled per individual per year by 2030.
	Average modal share of cars, vans and motorbikes decreases from current national average 74% total miles to 38% in 2050.
	Cars and buses are 100% electric by 2035, rail is 100% electric by 2030. Average occupancies increase to 18 people per bus km (from 12), 1.65 people per car-km (up from 1.56), and 0.42 people per rail-km (from 0.32).
	Department for Transport "Low" forecast for aviation. The "Low" forecast encapsulates 'lower economic growth worldwide with restricted trade, coupled with higher oil prices and failure to agree a global carbon emissions trading scheme. For reference, see Pathways Methodology.
	By 2050, 28% decrease in fuel use at UK ports.
Waste	65% recycling, 10% landfill, 25% incineration achieved by 2035, recycling rates increasing to 85% by 2050
	Total volume of waste is 61% of 2017 levels by 2040.

Appendix K – Offsetting

To understand how offsetting could fit into the net zero picture for Herefordshire, CO2Balance and Gaia Together were approached to provide an outline proposal, as laid out below.

Introduction

Gaia Together works directly with clients to create innovative carbon management strategies that help reduce carbon footprints through a range of services that address all the key areas of carbon management, from carbon foot printing and environmental audits through to delivering bespoke offset packages.

Working alongside COBbalance, Gaia are part of the retail arm supporting clients directly with services and support to offer premium offset credits from community-based projects that improve the quality of life for local people and help to protect the ecosystem services which they depend upon.

Background

Following discussions, Gaia with the support of CO2Balance, have been asked to prepare a proposal for offsetting activities with Herefordshire to deliver a net zero carbon footprint initiative that can be implemented across all sectors within the region.

The proposal below is based on a blended portfolio of carbon credits to include fuel efficient stoves, safe water and forestry projects. These projects have been chosen to align with the sectors in scope such as residential, education, agriculture and also services relating to clean water and sanitation.

Volume (Tonnes)	*Cost per Tonne (€ / £)	Portfolio % Blend Stove / Water / Forestry
<10,000	6.00 / 5.38	25 / 25 / 50
10,000 – 100,000	5.50 / 4.93	25 / 25 / 50
100,000+	4.75 / 4.26	25 / 25 / 50

Fuel Efficient Stoves

Gaia Together Cookstove Projects support the construction and dissemination of improved cooking solutions for rural communities that primarily rely on highly inefficient, traditional cooking methods; most commonly the 'three-stone fire.'

Particularly in rural areas, wood is the most accessible and affordable energy source for remote communities.

The reliance on these unimproved cooking methods and firewood as the only accessible energy source exposes households to hazardous household air pollution, drives deforestation and releases significant carbon emissions.

Our projects offer households subsidised or free clean cooking solutions, which are adapted to meet local customs and contexts. The cookstoves have increased thermal efficiency that greatly reduce wood fuel consumption and carbon emissions.

Safe Water

Our Safe Water Projects support rural communities in developing nations with no access to clean water sources. Communities either consume unsafe water, which results in a high prevalence of waterborne diseases; or purify water, usually by boiling it over open fires. Such communities rely on wood fuel as their affordable energy source for boiling for purification. This process produces hazardous household air pollution as well as releasing potent carbon dioxide emissions.

We work with experienced technicians to rehabilitate and/or install water points in disrepair or distribute water treatment units.

To ensure the sustainability of the vital water supply, our projects support the formation of Water Resource Committees at the community level to receive training in minor water point maintenance and management and W.A.S.H (Water, Sanitation and Hygiene) to raise awareness of sustainable water point use and household level hygiene.

Forestry

These high-impact projects protect the rainforest through avoiding deforestation with community training and raising awareness.

Training in forestry management, sustainable cattle raising, and seedling production are delivered to ensure the communities involved can build sustainable livelihoods which do not rely on clearing the rainforest.

The protection of the rainforest avoids the release of carbon emissions, with trees sequestrating carbon dioxide straight from the atmosphere and storing it through their lifetime.

External Project Verification

Our Energy Efficient Stove Projects and Safe Water Projects are externally accredited through The Gold Standard, an internationally respected standard that assesses the social and community benefits to the region in addition to carbon saving.

The Gold Standard was initiated by the World Wildlife Fund and is endorsed by 80+ NGOs with more than 1,100+ projects in 70 countries undergoing certification. The Gold Standard has become the global benchmark for the highest integrity and greatest impact on climate and development initiatives.

UN Sustainable Development Goals

Investing in our emission reduction projects goes beyond climate change mitigation by making a measurable contribution towards the UN's Sustainable Development Goals and enhancing your organisation's corporate social responsibility.

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/724391/road-to-zero.pdf

Clean Growth Strategies and LIS

The Government's Clean Growth Strategy published by BEIS in 2017 brings together government policies and proposals related to the energy sector and action on climate change.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf

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Future Energy Scenarios

The National Grid produce the Future Energy Scenarios to help guide the development of necessary energy infrastructure https://www.nationalgrideso.com/future-energy/future-energy-scenarios

The latest FES for 2020 Scenarios have recently been updated at https://www.nationalgrideso.com/document/174541/download https://www.westernpower.co.uk/downloads/4025

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Glossary

Decarbonised electricity sector

The reduction of the carbon intensity of the electricity sector by increased use of technologies that result in a lower concentration of fossil fuels released into the atmosphere during electricity generation.

Demand Response / Demand side management (DSM)

Refers to the use of mechanisms that encourage consumers to adjust their electricity demand. DSM can be static or more dynamic.

Energy

The capacity to do work. Energy is power integrated over time. It can be either stored or consumed/ produced over a period of time. The unit of energy is Joule or, more commonly in the power sector watt hours (Wh).

Generation

Generation is the amount of electricity a generator has produced over a specific period of time. For example, a generator with 1 megawatt (MW) generation capacity that operates at that capacity consistently for one hour will produce 1 megawatt hour (MWh) of electricity. If the generator operates at only half that capacity for one hour, it will produce 0.5 MWh of electricity.

Gigawatt (GW)

A unit of power equal to 1 billion watts; 1 million kilowatts, or 1,000 megawatts.

Gigawatt-hour (GWh)

A unit of energy equal to million kilowatt-hours. 1 GWh is equivalent to the total electricity typically used by 250 homes in one year.

Kilowatt (kW)

A standard unit of electrical power equal to 1,000 watts, or to energy consumption at a rate of 1,000 joules per second.

Kilowatt-hour (kWh)

A unit of energy consumption. A typical home uses around 3,300 kWh of electricity per annum.

Megawatt (MW)

The equivalent to one thousand kilowatts (kW).

Power

Power is the rate at which work is done, or the amount of energy generated, transferred or consumed per unit time. The unit of power is watt (W). Often, energy and power are confused.

Terawatt-hour (TWh)

The equivalent to one thousand gigawatt hours (GWh).

Watt

Watt is the standard unit to measure electrical power. This can apply to power produced by a generator, consumed by a load or transferred via the grid. Multiples of the watt include kilo (KW), mega (MW), giga (GW), tera (TW), peta (PW).

Watt hour

Watt hour is the standard unit of energy, which can be produced, used or stored.