Hope Valley
Climate Action

Future Domestic Energy Demand Hope Valley

Dr Dawn Ward and Dr Stephen Platt

November 2021

Hope Valley Climate Action Energy Group

"Focusing on the promotion of energy efficiency, sustainable building and green energy generation, essential elements in the drive to achieve the UK's goal of net-zero carbon emissions by 2050."

About the authors

Dawn Ward

Dawn has a background in the design and implementation of renewable energy at an industrial, community and individual household level. She has also worked on reducing carbon through efficiency and the implementation of behavioural change. She has a BSc in Mechanical Engineering, an MSc in Renewable Energy Systems Technology and a Doctorate in Renewable Energy Marine Structures

Stephen Platt

Steve lives in Hathersage and is Treasurer of HVCA and a member of the Energy and Transport Groups. He is a social anthropologist with higher degrees in engineering and architecture. He is a Director of Cambridge Architectural Research Ltd and a Research Associate in the Centre for Risk Studies, University of Cambridge.

Acknowledgements

We would like to acknowledge the input and support of our Steering Group. This met monthly over the course of the project and guided our efforts.

Jeremy Wight, Chair HVCA

Andy Nash, Hope Valley Renewables and Bradwell PC

Prof Michael Corcoran, Advisor on Buildings and the Environment,

Julia Hartley, HVCA Energy Group

Laurie James, Sustainable Hayfield

Spencer Green, Hope Valley Cement Works

We would also like to acknowledge the support of the HVCA Energy Group coordinated by Zee-Zee Heine to which we reported monthly.

Contents

Executive summary

1. Introduction

This report was undertaken by the Hope Valley Climate Action Energy Group, to understand why and by how much our domestic electricity demand is likely to change in the years leading to 2050, and hence set a baseline for what domestic electricity demand the Hope Valley may require in the future. HVCA also aims to provide an understanding on home initiatives that could reduce CO_2 emissions to aid in the push towards net-zero emissions by 2050.

We want to invite stakeholders and the community into a discussion on how much of the extra demand could be offset locally through renewable generation, thereby helping to reduce the CO_2 emissions, a necessary step suggested by the Government within its recent paper 'Net Zero Strategy: Building Back Greener.

2. Study area today

To derive an estimate of the total domestic base energy demand, energy consumption was considered under three headings: electricity usage (lighting, cooling, laundry, cooking and current

electric heating), space heating (excluding electric storage heaters), and private vehicles.

Our study area is defined by S33 and S32 postcodes as well as the northern properties within the SK17 postcode. This extends from Edale in the north-west to Baslow in the south-east, including as far south as Tideswell.

The current annual domestic base electricity demand for this study area is around 23,000 MWh. The total current annual domestic total energy demand is around 154,000 MWh, which releases over 32,000 tonnes of CO_2 emissions, with heating responsible for 55% of the total.

3. Future energy scenarios

Three future energy scenarios have been used to predict domestic electricity demand: a best-case scenario based on the National Grid's 'Consumer Transformation' (CT); a little change scenario based on the National Grid's 'Steady Progress' (SP) and a mid-way (localised) scenario called 'Hope Valley' (HV).

4. Results

Annual values are predicted for 2030, 2040 and 2050. However, there is an unavoidable and unpredictable level of uncertainty within all the results presented.

Results given for 'total energy', is the domestic energy required to heat, electrify, and run private vehicles, with the different energy sources all converted to MWh.

Results for the 'total electricity', refers to just the domestic electricity needs of the study area

Total energy demand

We predict that by 2050 the total domestic energy demand per annum will be 134,000 MWh under the SP scenario, 87,000 MWh under the HV scenario, and 65,000 MWh under the CT scenario. This equates to a possible reduction from the current level of domestic energy CO_2 emissions of 40% under the HV scenario and 55% under the CT scenario.

Electricity demand

Under all three scenarios we predict an increase in the base electricity demand in Hope Valley of more than double the current

requirement, rising from 23,000 MWh to between 51,000 – 60,000 MWh by 2050.

5. Main findings

Our main finding is that the electricity requirements within Hope Valley will rise, at least doubling, by 2050. Under all future energy scenarios, we will see an increase in electricity demand within the Hope Valley as we electrify our vehicles and home heating sources. The emissions from electricity will however continue to fall as more electricity is generated by renewables, which will mean higher emission reductions than those predicted within this study.

The electricity capacity needed will, however, be much higher than the base electricity demand addressed within this study, as we need to have the capacity to also meet peak demand. In the future this could be met from stored energy, for example from large or domestic scale batteries and from electric cars.

6. Conclusions

Under all future energy scenarios, we will see an increase in the base electricity requirements within the Hope Valley, at least double the current requirement, as both vehicles and heating sources move

towards electricity, generated from lower carbon emission renewable sources.

If we continue, as we currently are, with small steps as outlined within the Steady Progress future energy scenario, then the emissions from our domestic energy requirements can be expected to be practically the same by 2050 as they are today. However, through electrification provided by renewable generation, domestic energy emissions could reduce by at least 55% by 2050.

Some of the necessary measures required to achieve this rely upon individual homeowner behavioural changes, which would also require adequate and easily accessible financial aid at governmental level. To ensure that the increased electrification comes from renewable sources, local authorities and stakeholders need to work with the community, and local climate groups, to look towards how they can support renewable generation in their areas as outlined within the Government's recent paper 'Net Zero Strategy: Building Back Greener.

We need to work together to explore the feasibility of producing some of the increased base electricity demand locally, firstly by investigating how current small scale renewable energy can be

extended to many more homes and secondly to investigate if there is a place for larger scale renewables within the Hope Valley, whilst recognising the importance of landscape sensitivity in the Peak Park.

1. Introduction

Climate change, mainly occurring due to increased emissions from human activity, has driven a rise in global warming of over 1 °C in the last 50 years (Figure 1) [1]. This temperature rise has in turn impacted our weather patterns leading to increases flooding, fires, desertification and food shortage.

Scientists have predicted that if the global average temperature rises above 1.5 degrees Celsius (compared to the pre-industrial level), then we will have reached a tipping point that will result in rising sea levels, floods, heatwaves, wildfires and droughts that will make many places uninhabitable and threaten the food supplies of all of us.

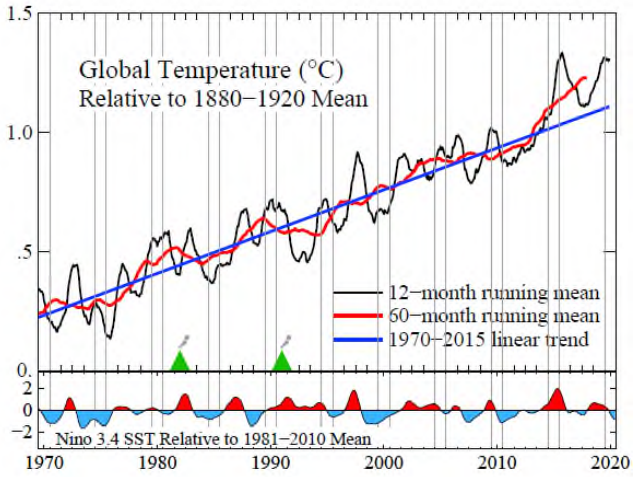

Figure 1. Global temperatures up to November 2020 [1]

Therefore, it is imperative that decisive measures, such as drastically reducing our use of fossil fuels, are taken immediately, to halt and then decrease the global average annual temperature.

Due to the imminent threat from the climate crisis, the UK has committed to a target of net-zero greenhouse gases by 2050 as well as to reduce economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels (Paris Agreement) - and then by 78% by 2035 (Sixth Carbon Budget). Some progress has been made and in 2019 UK greenhouse gas emissions were 40% less than those in 1990. However, even if the Government's recent 'Net Zero Strategy: Build Back Greener' [2], is realised, it is unlikely that we will meet these targets.

Net-zero emissions, also sometimes referred to as ‘carbon (or climate) neutrality’, is a target to reduce the emissions from greenhouse gases that cause global warming to net-zero. This could be achieved by balancing the amount released with the amount captured and stored. However, to achieve this, a large reduction in the amount released must be achieved.

The power of community involvement in helping to achieve all the emissions targets has been recognised in the Government's ‘Net Zero

Strategy', with a renewed drive to install more onshore wind and solar generation in the UK.

> *'Communities are especially well placed to help raise awareness and engage people in adopting net zero behaviours. For example, community ownership of renewables ….. can be an important driver of reducing local emissions.'*

It also recognised that local climate action groups (such as Hope Valley Climate Action) can help people to understand climate change and help them to adopt sustainable behaviour changes:

> *'most people want to play their part in achieving net zero, the strategy emphasises nudging/empowering people towards making low carbon choices by ensuring they are easier, affordable and well understood.'*

This report, undertaken by the Hope Valley Climate Action Energy Group, aims to inform the community living with the Hope Valley and the surrounding area and the relevant stakeholders about our domestic energy and base electricity needs up to 2050.

It is, however, recognized that it will not be possible for Hope Valley to become fully self-sufficient in electricity and this report, therefore focuses on domestic energy rather than total energy demand

including that from industry and the visitor economy. However, it is also important that the non-domestic demand within the Valley is addressed in the future, as it is estimated to be over ten times the annual domestic demand within the study area, with Hope Valley Cement using around 75% of that non-domestic electricity demand.

Our aim here, therefore, is to understand why and by how much our base domestic electricity demand will rise, and hence set a baseline for what electricity demand the Hope Valley may require. We also aim to suggest how different home initiatives such as increased insulation, switching to an electric vehicle and changing a household's heat source to an air source heat pump, could reduce the emissions regardless of the increased demand.

The question will then be, how much can we offset locally through renewable generation, thereby helping to reduce the CO_2 emissions from electricity nationally, and how much we will realistically continue to need to import.

1.1 Hope Valley Climate Action

Hope Valley Climate Action was set up two years ago to take action on climate change, by raising awareness, taking practical action, research and advocacy. We are a Charitable Incorporated Organisation with six hundred supporters. We have three main action groups: travel, energy and land. A key part of what we do is to carry out practical projects to demonstrate what realistic solutions to the climate crisis could look like. This allows us to advocate for change at a national level.

Alongside home energy efficiency, renewable energy is one of our main themes of HVCA's Energy Group, the authors of this report. Its areas of interest are energy efficiency, sustainable building, and green energy generation, all elements essential in the drive to achieve the UK's goal of net-zero carbon emissions by 2050.

"Together let's take action on climate change"

1.2 What we believe

We believe the science and what committees such as the IPCC and the UK's CCC say in their reports because they draw on wide-ranging, empirical research from a variety of sources world-wide.

We accept the reality of global warming and fear the threats it poses to our planet.

We believe that we need to reach net-zero CO_2 emissions much sooner than the UK government's goal of 2050 and hope that the events and activities we organise will contribute in some small way to achieving this.

We are focusing on the promotion of energy efficiency, sustainable building and green energy generation, all three of which we view as essential elements in the drive to achieve the UK's goal of net-zero carbon emissions by 2050.

> *Unquestionably, major transformation of the way the U.K. generates its heat and power is essential."*
>
> *Caroline Lucas - Green Party*

2. Study area

2.1 Hope Valley

Hope Valley, the area covered by this report is all within the Peak District National Park. The area is known for its stunning vistas and is much loved by residents and the many visitors.

Figure 2. Hope Valley in winter looking west from Surprise View

It is often associated with the open and exposed moorland, seen by many as ancient and untouched. However, much of the landscape and habitat is a product of human activity.

2.2 Household numbers

Our study area extends from Ladybower in the North to Tideswell in the South and from Edale in the West to Ringinglow in the East. This consists of the areas defined by the S33 and S32 postcodes as well as the northern properties within the SK17 postcode, including Tideswell. It consists of around 6300 domestic buildings and a permanent population of around 13000. Several of the domestic buildings identified are used solely for visitors throughout the year.

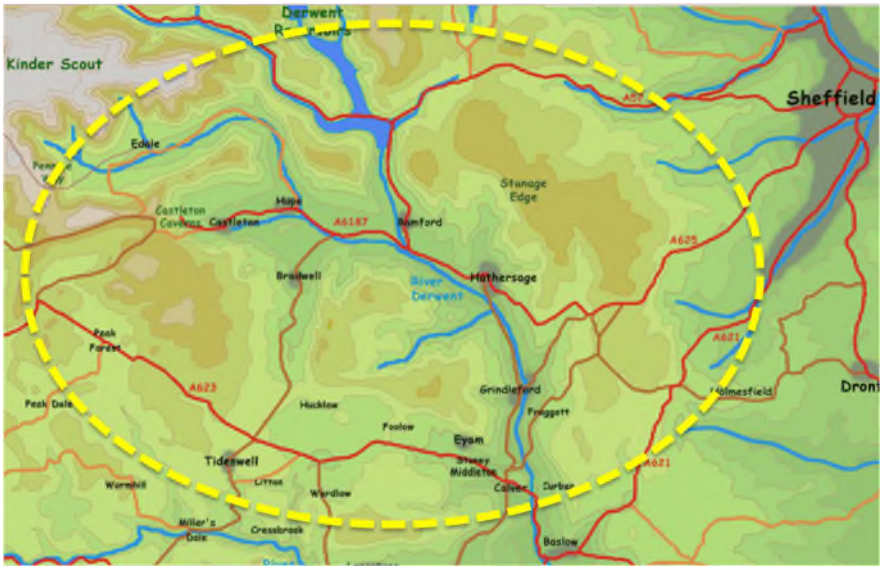

Figure 3. Hope Valley highlighting the approximate area covered within this study

2.3 Energy vs. Electricity

Within this report, ‘total (domestic) energy’, is the energy required to run domestic vehicles and to heat and electrify homes in the study area. The sources of this energy may be primary sources such as natural gas, oil and petroleum as well as electricity which is generated from both primary sources and renewables and nuclear.

The term ‘total (domestic) electricity’ refers to the electricity needs of a household and might include space heating and vehicles.

As we approach 2050, the difference between ‘total domestic energy’ and ‘total domestic electricity’ will reduce as homes become more electrified and the sources of electricity move further away from fossil fuels as more renewable energy is connected to the grid.

Energy consumption is given in megawatt hours (MWh). A megawatt hour is used to measure electric output and is equivalent to 1,000 kilowatts (kW) of electricity generated per hour. Currently, the average UK household uses around 10 kWh of electricity per day. Therefore 1 MWh would run 100 houses for one day, and one house uses around 3.6 MWh per year.

2.4 Current energy and emissions

To estimate the total domestic base energy demand, energy consumption was considered under three headings: electricity demand (used for lighting, laundry, refrigeration, cooking and current electric heating [1]), space heating, and private vehicles.

Our current annual base electricity demand is around 23,000 MWh. This was derived from data provided by the Northern Powergrid's energy scenarios [3]. It includes the electricity used by households heating their homes with electric storage heaters (which account for approximately 6% of homes [4]).

Mains gas as a heating source is used by 80% of homes within Hope Valley, a lower percentage than the national average (85%) accounted for by its rural location. Oil and LPG off grid heating is used in approximately 12% of homes, with 2% using other sources such as biomass or ground/air source heat pumps [4] [5].

It is estimated that there are around 7100 private vehicles [6] within Hope Valley with an average annual milage of 8000 miles, 17% above the UK average, again due to the rural setting [7][8]. Of these, the majority are fossil fuel with electric vehicles accounting for just 3%.

[1] Within this study, the demand for cooking and hot water are not separated out.

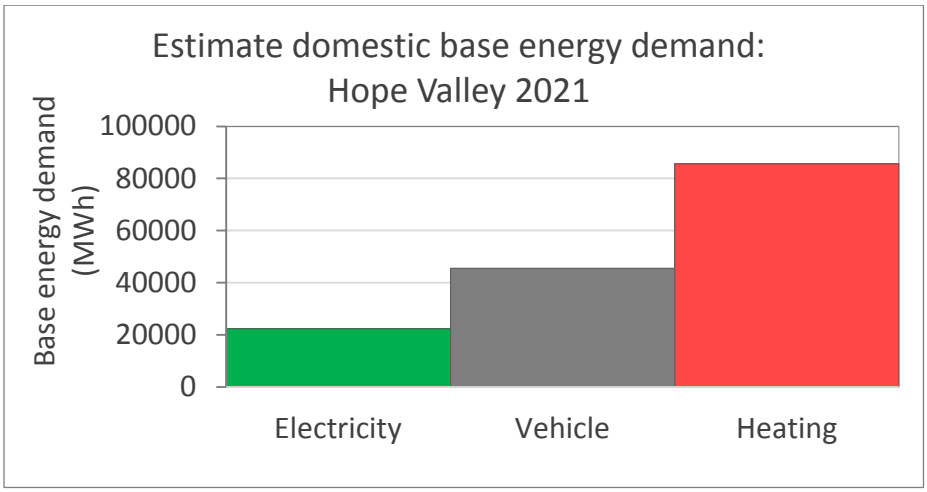

Figure 4. Estimate domestic energy demand of the study area in 2021

The total current annual energy demand within the study area is 154,000 MWh which releases over 32,000 tonnes of CO_2 each year, with heating (excluding storage heaters) responsible for 55% of the total.

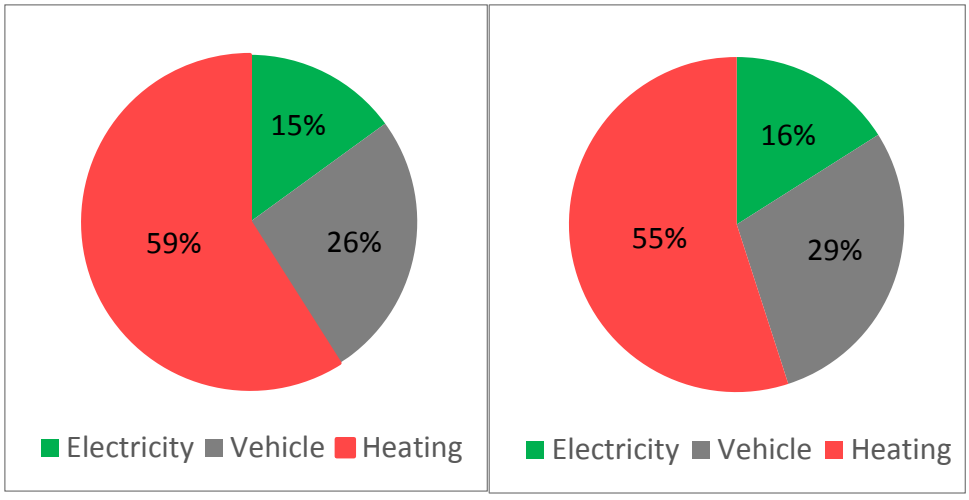

Figure 5. Current domestic energy demand (left) and current CO_2 emissions (right) by source in 2021

3 Future energy scenarios

Three future energy scenarios have been used within this study to predict domestic electricity demand: a best-case scenario based on the National Grid's 'Consumer Transformation' (CT) [12]; a little change scenario based on the National Grid's 'Steady Progress' (SP) [12] and a likely mid-way scenario we have named 'Hope Valley' (HV). For most of the results only the SP and HV scenarios have been presented, with the CT scenario only being applied to the final total energy, electricity and emission predictions.

The HV scenario is based upon the CT scenario (Appendix A) but with the following local adjustments, taking account of the rural setting and style of some houses:

- Current gas boiler usage applicable to 80% of homes, rather than 85% in 2021
- LPG and Oil as heating sources increased to 12% from 8% in 2021
- Other heat sources increased to 2% from 1% in 2021
- Gas boilers still account for 30% of heating by 2050

The SP scenario is based upon the National Grid's SP scenario (Appendix A) but with the following local adjustments:

- 25% of cars are still run-on fossil fuel by 2050

The adjustment to the SP scenario is based on an assumption that electric car adoption could be slower than predicted, if the ban of non-zero emission cars is delayed to 2040 [5].

Under each scenario we have predicted the energy use and emissions for: private vehicles (dependent upon the quantity within the study area, annual millage and fuel source); household heating (dependent upon the fuel source and standard of home insulation), and electricity demand (for lighting, refrigeration, laundry and cooking). Under all scenarios, vehicle milage has been increased from the national average by 17%, because of the rural nature of the study area [8].

4. Results

Results given for the 'total (domestic) energy', are for the energy required to heat, electrify, and run domestic vehicles, with the different energy sources all converted to MWh.

Results for the 'total (domestic) electricity', refers only to the electricity needs of a household and can include heating and vehicles.

Annual values are predicted for 2030, 2040 and 2050. However, there is an unavoidable and unpredictable level of uncertainty within all the results presented.

4.1 Household numbers to 2050

The Office for National Statistics projections for household growth in the High Peak and 2011 census data were used to estimate the change in households through to 2050 as shown in Table 1 [9] [10] [11]. Although a slight population decrease is expected by 2050, there is a rise of approximately 650 houses may be seen by 2050.

Given the nature of the area and its placement within the Peak District, this level of rise may not come to fruition. However, it is important that we plan for the worst case in terms of increased electricity demand within our study area, hence this possible 650 household increase has been used for all scenarios.

Table 1. Household projections in the study area up to 2050

Year	2021	2030	2040	2050
Household numbers	6295	6645	6960	6960

4.2 Domestic private vehicles to 2050

An increase in electric vehicle take-up has a direct impact on the base electricity demand. Under the HV scenario most privately owned vehicles will be electric, whilst, under the SP scenario, electric vehicles account for 75% of privately owned vehicles by 2050.

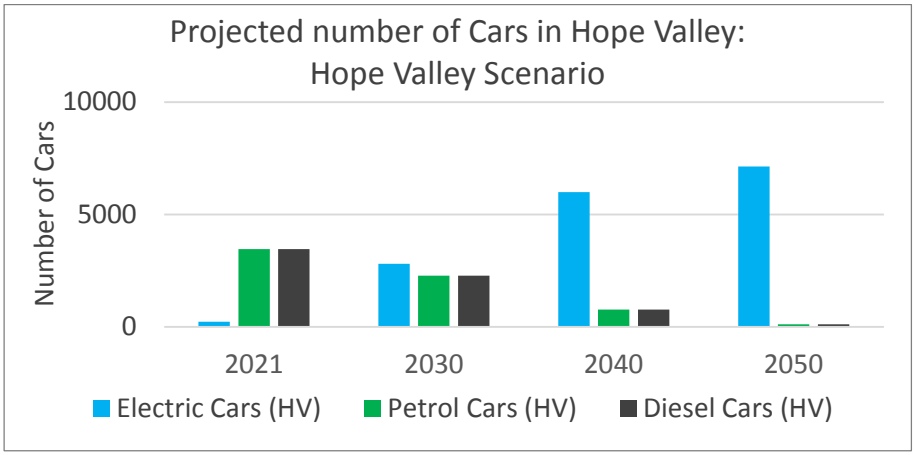

Figure 6. Projected annual number of vehicles under HV scenario

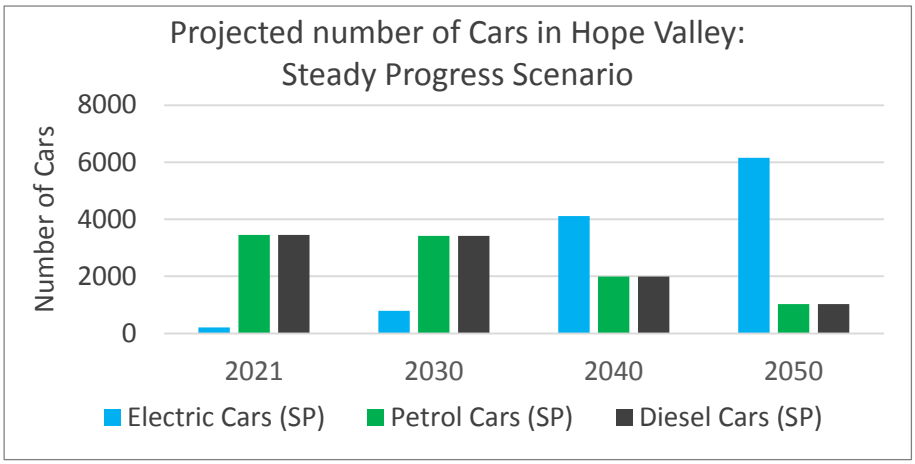

Figure 7. Projected annual number of vehicles under SP scenario

For all scenarios an in annual mileage of 17% more than the national average has been applied due to rural setting [7] [8]. Costs and emission comparisons between vehicle types, shown in Figure 8 highlight the advantages of moving towards electric vehicles in the push towards net-zero greenhouse gases by 2050 [13] [14] [15]. All vehicle types are based on a similar mid-size family car [16] [17][18].

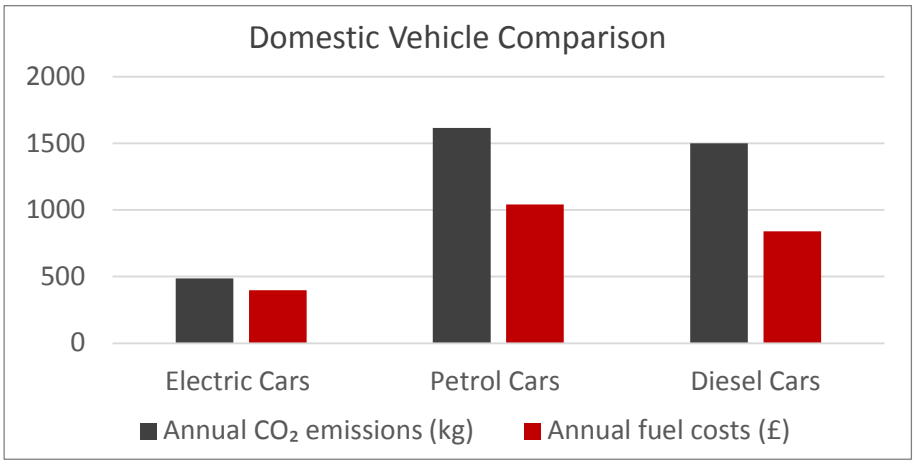

Figure 8. Annual individual vehicle emissions and costs based on 2021 data

Fuel costs and emissions are based on 2021 values. The cost of fossil fuels is expected to rise at a faster rate than electricity, just as the emissions from electricity will drop further as more renewable sources come on to the grid, thus widening the gaps between fossil fuel powered cars and electric vehicles still further, making electric vehicles even more attractive over time.

4.3 Domestic heating to 2050

Under the HV scenario, by 2050, around 60% of homes could be heated by heat pumps (twice as many as by mains gas), whilst under the SP scenario just 20% can be expected to be heated by heat pumps.

The coefficient of performance (CoP), used for the heat pumps installed in each of the two scenarios differs to reflect the assumptions made on home insulation and hence heat source efficiency. The HV scenario (and CT scenario) have a CoP of 4 (better efficiency and lower energy required) reflecting the assumption that homes will be well insulated. For the SP scenario a CoP of 2 has been applied, as homes are unlikely to have achieved the higher insulation efficiency.

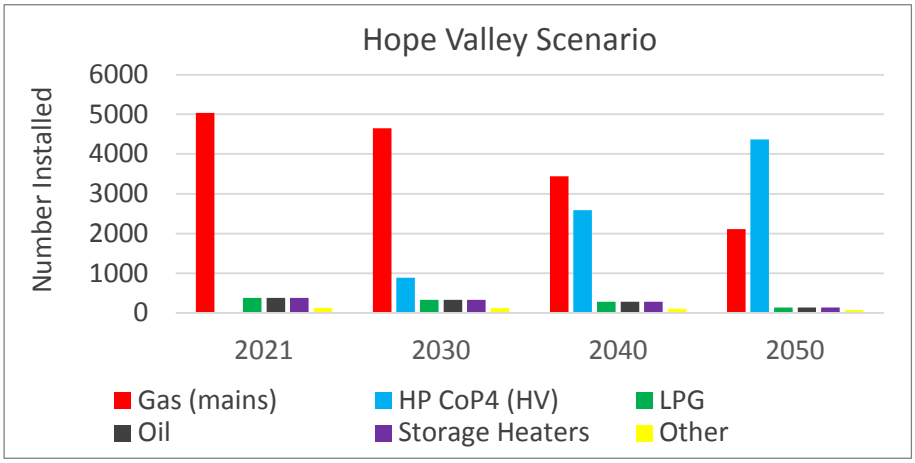

Figure 9. Projected source of heating under HV scenario within the study

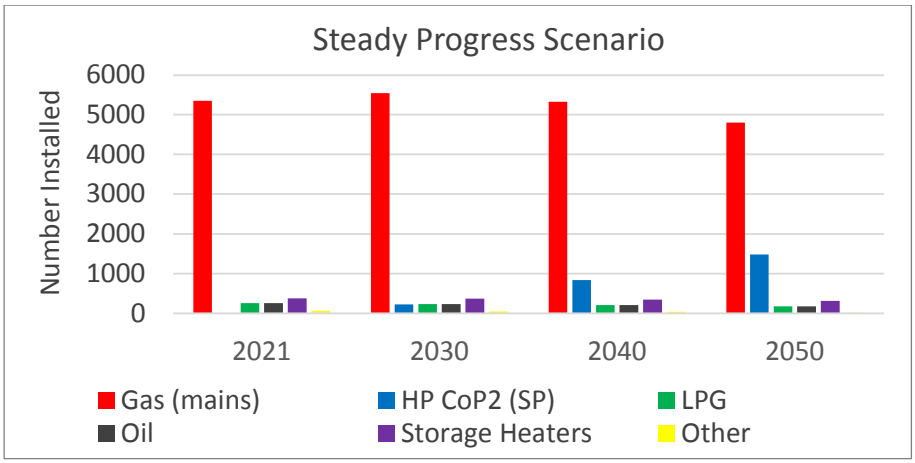

Figure 10. Projected source of heating under SP scenario within the study area

Costs and emissions comparisons between heating types highlight the advantages of moving towards heat pumps in terms of CO_2 emissions. All heating types are based on a mid-size 3-bed home. However, it is only in a very well insulated home that heat pump costs are comparable to the cost of mains gas central heating. Fuel costs and emissions [13] are based on current values and the cost of fossil fuels and gas might realistically rise at a faster rate than electricity.

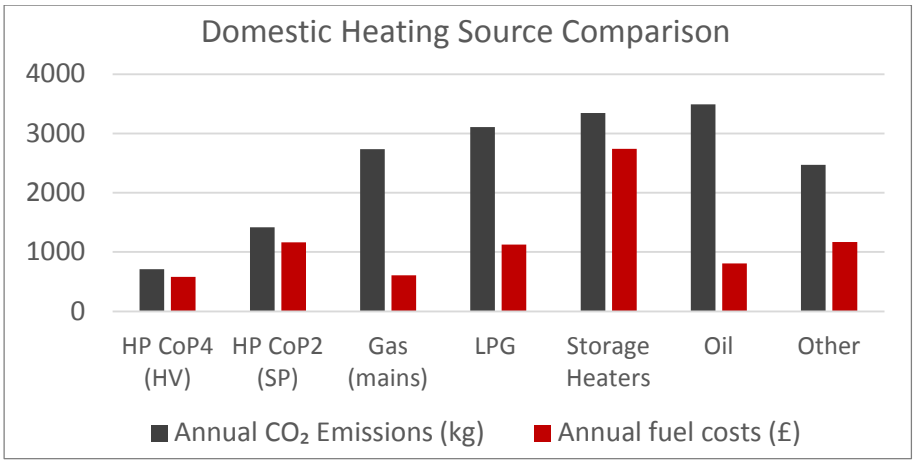

Figure 11. Annual heating emissions and costs based on 2021

4.4 Total domestic demand to 2050

Under the HV scenario the projected annual energy demand for all private vehicles is around 17,000 MWh by 2050 and under the SP scenario it can be expected to rise to around 26,000 MWh.

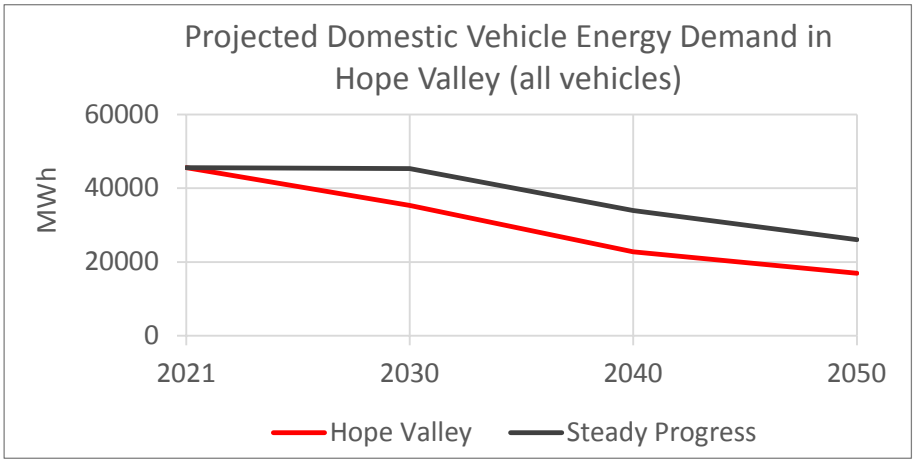

Figure 12. Annual domestic vehicle energy demand within the study area

Under the HV scenario, the total annual projected domestic heating energy demand is around 50,000 MWh by 2050, and 85,000 MWh per annum under the SP scenario.

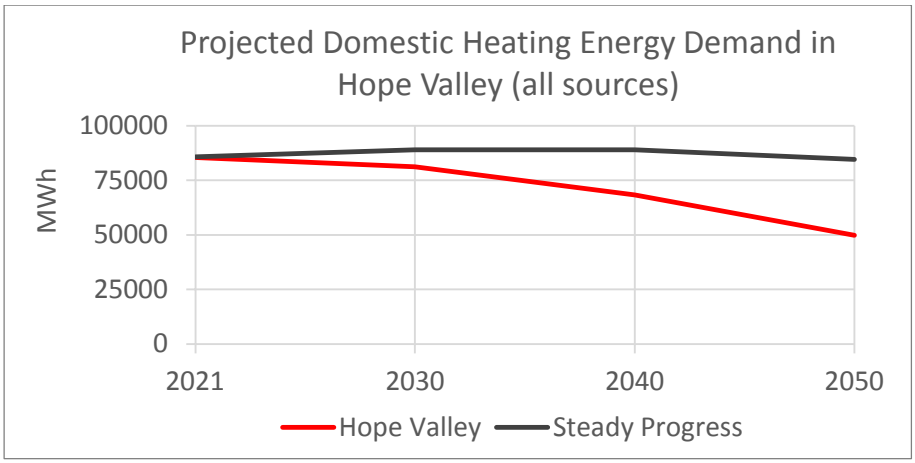

Figure 13. Annual domestic heating energy demand within the study area

This means that the annual 'total domestic energy' demand follows a similar pattern, with 134,000 MWh required by 2050 under the SP scenario, 87,000 MWh under the HV scenario, and 65,000 MWh under the CT scenario. Thus, in the worst-case prediction, under the SP scenario, the 'total domestic energy' demand could be 54% higher than the demand predicted by the HV scenario and 106% higher than under the CT scenario.

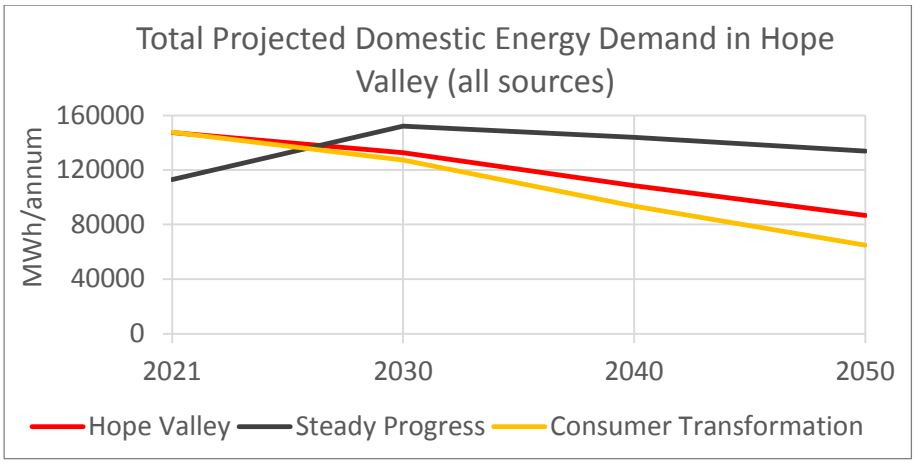

Figure 14. Total predicted annual domestic energy demand with the study area

Under all scenarios we predict an increase in electricity demand as we electrify of our homes to reduce emissions. Our current annual base electricity demand requirement is around 23,000 MWh, which we predict to rise to between 51,000–60,000 MWh. Thus, a doubling or more in our domestic electricity demand by 2050.

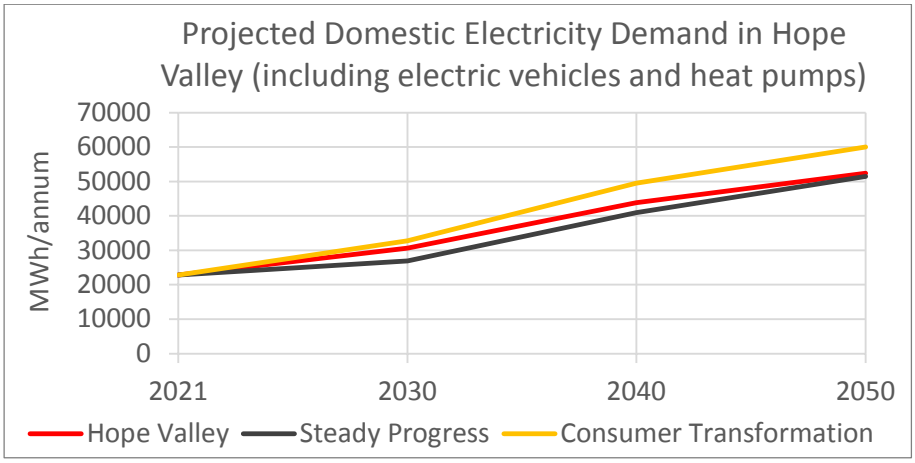

Figure 15. Projected domestic electricity demand up to 2050

4.5 Total domestic emissions to 2050

Currently, in 2021, CO_2 emissions from private cars within our study area are around 11,000 tonnes. Under the HV scenario the projected CO_2 emissions, by 2050, from private vehicles is predicted to be in the region of 3,600 tonnes and under SP is 5,800 tonnes, hence a reduction to a third of the current emissions due to private vehicles could be achieved by us all changing to an electric car.

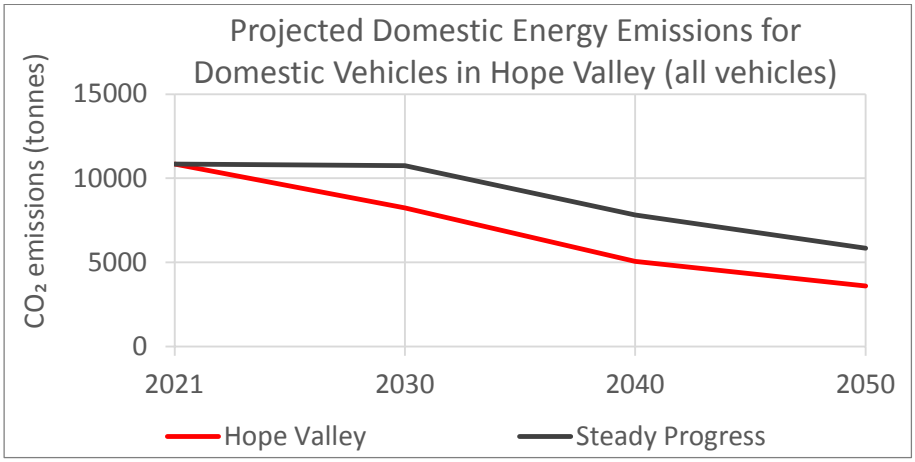

Figure 16. Projected CO_2 emissions from the annual domestic vehicle energy consumption within the study area

Current heating emissions within our study area are around 18,000 tonnes. Under the HV scenario total projected domestic heating emissions could drop to about 10,500 tonnes per year by 2050. However, under the SP scenario there is little change in emissions by

2050, because, although more air source heat pumps have been installed, without the required level of home installation, demand is double that of an air source heat pump installed in a home with good installation.

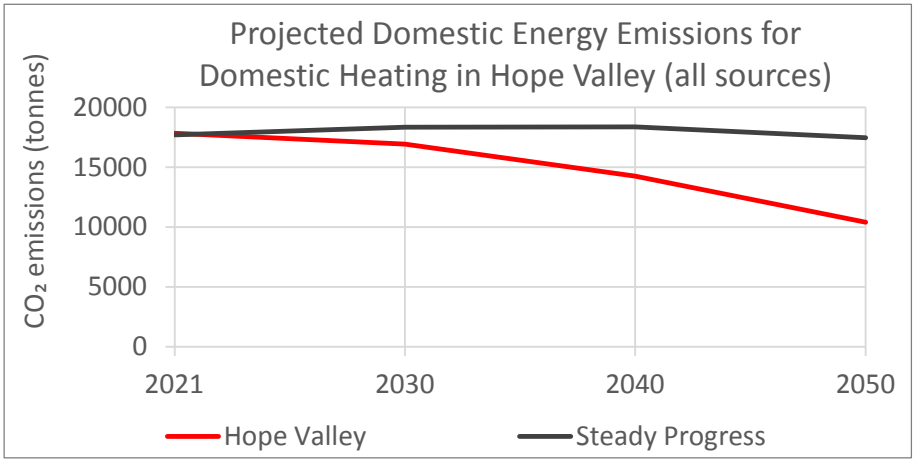

Figure 17. Projected CO2 emissions from the annual domestic heating energy consumption within the study area

Total CO_2 emissions

The current total annual CO_2 emissions from the 'total domestic energy' needs, within the study area, is around 32,000 tonnes. CO_2 emissions under the SP scenario are projected to fall slightly to 28,000 tonnes, whilst under the HV scenario a reduction of 40% down to 18,000 tonnes could be achieved and under the CT scenario a reduction of 55% to 14,000 tonnes is predicted.

This means that although our electricity demand will increase by at least double, our overall emissions could halve.

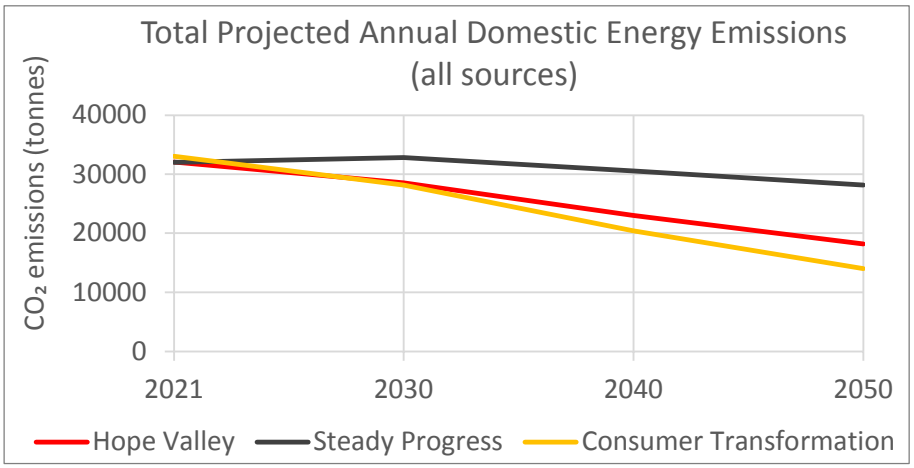

Figure 18. Projected CO_2 emissions from the total annual domestic energy consumption within the study area

The emissions are also based on the average emissions relative to 2021 for the different energy sources. The emissions from electricity have been falling in recent years and will continue to fall further as more renewable energy sources become available, allowing more fossil fuel and gas power stations to close.

5. Main findings

Our main finding is that electricity requirements within Hope Valley will rise and are likely to at least double by 2050. However, switching to more electrification in our homes and vehicles could reduce CO_2 emissions by 55%.

Under all future energy scenarios, we will see an increase in the electricity requirements within the Hope Valley as both vehicles and heating sources move towards electricity as their energy source, this can be generated from lower carbon emission renewable sources.

By moving towards electric cars, a drop in the 'total energy' required for vehicles of over 70% is predicted under the HV and CT scenario.

The National Grid CT scenario predicts that the proportion of homes heated by gas will reduce from 85% in 2021 to 1.5% by 2050. Homes will need to have been insulated to a high level for a heat pump to operate with the higher Coefficient of Performance (CoP) of 4 seen in both the HV and CT scenarios. The current lack of current government support for home insulation has led us to be more conservative in the HV scenario in terms of the anticipated take up of electric heating and the rate of gas boiler replacements where 30% of homes are predicted to still be heated by gas in 2050.

By moving towards electric cars a drop in the ‘total energy’ required for vehicles of over 70% is predicted under the HV and CT scenario.

Consumers will play a large part in moving towards a net-zero carbon emission future as reducing emissions requires behavioural change, including increasing home energy efficiency. This is highly dependent on financial incentives, advice, availability of materials and a trained workforce [19]. A push towards air source heat pumps for domestic heating, without the financial help to ensure homes are insulated to a high standard, could lead to increased fuel poverty.

The generated energy needed is much higher than the base electricity demand addressed within this study as we need to have the capacity to also provide peak demand. In the future this could be met from stored energy such as large or domestic scale battery banks and electric cars. This would require smart technological advances to control it.

Currently, most of the domestic electrical energy is generated outside of the valley and supplied by the high voltage National Grid infrastructure. This infrastructure will need to be increased and strengthened to cope with the elevated electricity demands. We also need to consider whether any of the electricity demand might be met by local generation within the Valley.

5.1 Observations

Generating double our electricity requirement outside of the valley, will impact on other places in Britain. Should we be taking responsibility for providing some of our own energy within Hope Valley? If so, what would be the best local energy generation and storage solutions?

Some homes within the Hope Valley already provide some of their electricity requirement from solar panels on their roofs. There are also a few examples of small-scale wind turbines, supplying individual homes and businesses, as well as ground source and air source heat pumps. As a community should we increase the take up of these small-scale renewable generating sources and is there a place for larger scale renewable local generation? If so, what type of renewable installations are most appropriate and where should they be sited, recognising the importance of landscape sensitivity in the national park?

> *"The climate emergency is the biggest threat facing our countryside and planet… there's good news: the countryside can provide many of the solutions."*
> *CPRE The Countryside Charity*

6. Conclusion

There is strong evidence that we are experiencing a climate emergency and the UK Government has pledged to halve our carbon emissions by 2030 and to reach net zero by 2050. Part of the strategy of achieving this reduction is to electrify our homes and vehicles and provide that additional demand from renewable sources. This means that the demand for electricity is likely to at least double, as seen in Table 2.

Table 2. Projected electricity demand in Hope Valley in MWh

Year	2021	2030	2040	2050
Steady Progress	22847	26931	40977	51500
Hope Valley	22834	30680	43865	52449
Consumer Transformation	22834	32819	49551	60084

If we continue, as we currently are, with small steps as outlined within the Steady Progress future energy scenario, then the emissions from our domestic energy requirements can be expected to be the same by 2050 as they are today.

However, under the Hope Valley scenario, a reduction of 40% of domestic energy emissions could be achieved by 2050 and reduction of up to 55% under the Consumer Transformation scenario. These predicted emissions would, in reality, reduce by considerably more, as the amount of electricity from renewable energy increases and fossil fuel and gas power stations close.

This will require a push towards electric vehicles, highly efficient, well insulated homes and electricity-based renewable heating sources. Although many of these measures require individual homeowner behavioural changes, there will also be a requirement for adequate and easily accessible financial aid at governmental level.

To ensure that the increased electrification comes from renewable sources, local authorities and stakeholders need to work with the community, and local climate groups, to explore how they can support renewable generation in their areas as outlined within the Government's recent paper 'Net Zero Strategy: Building Back Greener.

Given the predicted increase in energy demand we need to explore the feasibility of producing some of the increased demand within the Hope Valley.

Firstly, we need to investigate how current small scale renewable energy can be extended to many more homes in Hope valley.

Secondly, we need to investigate if there is a place for larger scale renewables, and if so, what sources would be the most beneficial and acceptable to the whole community, recognising the importance of landscape sensitivity in the Peak Park.

We need to work together to explore the feasibility of producing some of the increased base electricity demand whilst striving to be innovative and adaptive to establish what works in the context of this local, national and global challenge.

6.1 Further work

To understand the role that locally generated renewable electricity could play in the Hope Valley and the surrounding areas, a study of different options and their requirements and costs would be a necessary addition to enable the community and stakeholders to assess future possible generation in the area.

Due to the intermittent nature of renewable energy, throughout the day, season and year, methods of storing the electricity generated will become increasingly necessary as the grid becomes more reliant on renewables. Hence a study into how and where this could be applicable within the Hope Valley would provide useful additional information.

As the non-domestic demand within the Valley is estimated to be over ten times the annual domestic demand, knowledge of how this is likely to change by 2050 and what could be done to mitigate increases, would be a necessary step in any plan hoping to achieve net-zero emissions by 2050.

Appendix A. Future energy scenarios

The assumptions provided for both the 'Consumer Transformation' (CT) future energy scenario and the 'Steady Progress' (SP) scenario are taken from the National Grids 'FES 2020 Scenario Framework' except for the assumption under SP that 25% of cars are still run-on fossil fuel by 2050.

The assumptions provided for the 'Hope Valley' scenario are based on the CT scenario except for the following:

- Current gas boiler usage applicable to 80% of homes, rather than 85% in 2021
- LPG and Oil as heating sources increased to 12% from 8% in 2021
- Other heat sources increased to 2% from 1% in 2021
- Gas boilers still account for 30% of heating by 2050

A1. Assumptions under the 'Consumer Transformation' scenario

- Decarbonisation becomes the top policy goal, supported, and sustained by a concerned and engaged public
- High development of renewable and low carbon (or negative carbon) technologies but geared slightly towards smaller, more decentralised projects.
- Home heating and domestic vehicles largely electrified
- High consumer engagement in smart systems, tariffs, and energy storage
- Vehicle to Grid adoption levels high
- Consumers are highly engaged in smart charging and vehicle-to-grid (V2G).
- Charging predominately happens at home.
- There is more consumer demand for both autonomous vehicles and public transport.
- Substantial increase in energy efficiency measures within every home
- Lower end-user energy demand
- Increased renewable energy generation required
- 40% of homes with heat pumps will have thermal storage
- Good progress in electrical efficiency of appliances which meet the EU 30% target.
- Consumers rapidly move towards smaller or more portable appliances.
- A GB-wide insulation programme implemented that requires minimum efficiency standards which regions are incentivised to exceed.

A2. Assumptions under the ‘Steady Progress’ scenario

- 25% of cars are still run-on fossil fuel by 2050
- Slower transition towards decarbonisation means traditional sources of supply continue to be used for a longer period.
- No strong mandate from public for strong decarbonisation drive and thus no step change in policy
- Historic progress in residential electrical efficiency - EU targets missed.
- Low consumer engagement in smart systems, tariffs, and energy storage
- Consumer resistance and other barriers means the uptake of electric cars is slower.
- There is low growth in public transport due to a lack of consumer willingness to mode shift.
- Vehicle-to-Grid adoption levels are low
- Consumers buy similar appliances to today.
- Incentive schemes are not extended, and supply chain doesn't get the chance to mature and develop
- Strong bias towards status quo technologies not overcome and gas boilers remain dominant
- Heat networks not decarbonised and remain largely unregulated.
- Gas remains very cheap at the point of use
- Energy efficiency programmes remain focused on addressing fuel poverty

A3. Assumptions under the ‘Hope Valley’ scenario

- Current gas boiler usage applicable to 80% of homes, rather
- than 85% in 2021
- LPG and Oil as heating sources increased to 12% from 8% in 2021
- Other heat sources increased to 2% from 1% in 2021
- Gas boilers still account for 30% of heating by 2050
- Decarbonisation becomes the top policy goal, supported, and sustained by a concerned and engaged public
- High development of renewable and low carbon (or negative carbon) technologies but geared slightly towards smaller, more decentralised projects.
- Home heating and domestic vehicles largely electrified
- High consumer engagement in smart systems, tariffs, and energy storage
- Vehicle to Grid adoption levels high
- Consumers are highly engaged in smart charging and vehicle-to-grid (V2G).
- Charging predominately happens at home.
- There is more consumer demand for both autonomous vehicles and public transport.
- Substantial increase in energy efficiency measures within every home
- Lower end-user energy demand
- Increased renewable energy generation required
- 40% of homes with heat pumps will have thermal storage
- Good progress in electrical efficiency of appliances which meet the EU 30% target.
- Consumers rapidly move towards smaller or more portable appliances.
- A GB-wide insulation programme implemented that requires
- minimum efficiency standards which regions are incentivised
- to exceed.

Appendix B. Glossary

CCC	Climate Change Committee
CoP	Coefficient of performance
CT	Consumer Transformation
FES	Future energy scenario(s)
HV	Hope Valley
HVCA	Hope Valley Climate Action
IPCC	Intergovernmental Panel on Climate Change
kW	kilowatts
MWh	Megawatt hour
SP	Steady Progress
CO_2	Carbon dioxide

References

[1] https://www.co2.earth/global-warming-update
[2] UK Government Paper (2021) Net Zero Strategy: Building Back Greener
[3] https://odileeds.github.io/northern-powergrid/2020-DFES/index.html
[4] Ofgem 2015 report 'Insight's paper on households with electric and other non-gas heating'
[5] National Grid (2020), FES 2020 Scenario Framework
[6] Department of Transport (July 2021) Vehicle Licensing Statistics
[7] Department of Transport MOT data
[8] https://www.energy.gov/eere/vehicles/fact-759-december-24-2012-rural-vs-urban-driving-differences
[9] http://www.ukcensusdata.com/high-peak-e07000037#sthash.0YgTiLif.dpbs
[10] https://www.citypopulation.de/en/uk/eastmidlands/wards/highpeak/E05010636hopevalley/
[11] Office for National Statistics (2018) 2018-based household projections for local authorities and higher administrative areas within England (principal projection)
[12] National Grid (2020), FES 2020 Scenario Framework
[13] UK Government (2021) GHG Conversion Factors for Company Reporting 2021
[14] https://www.gocompare.com/gas-and-electricity/guide/energy-per-kwh/
[15] RAC Weekly Fuel Facts 2nd August 2021
[16] https://www.volkswagen.co.uk/order-a-brochure/golf-8
[17] https://www.whatcar.com/volkswagen/id3/hatchback/150kw-life-pro-performance-58kwh-5dr-auto/95708#review
[18] golf-8-brochure-pricelist-p11d
[19] Cambridge Econometrics (2021) The economic impacts of decarbonising household heating in the UK https://www.greenpeace.org.uk/wp-content/uploads/2021/09/Economic-Impacts-of-Decarbonising-Heating-in-Residential-Buildings_Final-Report.pdf