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STOKE-ON-TRENT CITY COUNCIL

CLIMATE CHANGE EVIDENCE BASE

BASELINE REPORT & POLICY RECOMMENDATIONS

JANUARY 2022

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STOKE-ON-TRENT CITY COUNCIL

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BASELINE REPORT & POLICY RECOMMENDATIONS

JANUARY 20222

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APPENDICES

APPENDIX A – Renewable Energy Generation Constraints Map for Stoke-on-Trent

APPENDIX B - Historic Adverse Weather Events in UK and Stoke-on-Trent

ABBREVIATIONS

ASHP	Air Source Heat Pump
AQMA	Air Quality Monitoring Area
ASR	Stoke-on-Trent City Council 2020 Air Quality Annual Status Report
BEIS	Government Department for Business, Energy & Industrial Strategy
BEV	Battery Electric Vehicles
CAZ	Clean Air Zone
CC	Climate Change
CCC	Climate Change Committee
CfSH	Code for Sustainable Homes
CH_4	Methane Gas
CHP	Combined Heat and Power
CO_2	Carbon Dioxide Gas
CO_2e	Carbon Dioxide Equivalent
CO_2/energy	Carbon Intensity
COP	The United Nations Climate Change Conference of Parties
DECC	Former Government Department of Energy & Climate Change
DER	Dwelling Emission Rate
DEFRA	Government Department for Environment, Food & Rural Affairs
DFEE	Dwelling Fabric Energy Efficiency
DLUHC	Government Department for Levelling Up, Housing and Communities
DHN	District Heat Network
DNO	Distribution Network Operator
EIB	European Investment Bank
EfW	Energy from Waste
EPC	Energy Performance Certificate
ESCo	Energy Supply Company
EV	Electric Vehicles
EVCP	Electric Vehicle Charge Points
FBS	Future Building Standard
FEES	Fabric Energy Efficiency Standards
FHS	Future Homes Standard
FiT	Feed-in Tariffs Scheme

GSHP	Ground Source Heat Pump
GWP	Global Warming Potential
GHG	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
JAQU	Joint Air Quality Unit
kW	Kilowatt (unit of power)
kWh	Kilowatt hour (unit of energy)
kWh_{th}/y	Kilowatt hour (of unit of thermal energy) per year
kWp	Kilowatt peak (unit of power output)
Kt CO_2e	Kilo-tonnes Carbon Dioxide Equivalent
LDF	Local Development Framework
LED	Light-Emitting Diode (energy efficient light bulbs)
LEP	Local Enterprise Partnership
LIHC	Low Income High Costs (LIHC) indicator (old measure for fuel poverty)
LILEE	Low Income Low Energy Efficiency (LILEE) indicator (new measure for fuel poverty)
LPA	Local Planning Authority
LTP	Local Transport Plan
LWS	Local Wildlife Sites
mCHP	Micro Combined Heat and Power
MHCLG	Former Government Ministry for Housing, Communities and Local Government
MVHR	Mechanical Ventilation with Heat Recovery
MW	Megawatt (unit of power)
MWh	Megawatt hour (unit of energy)
MWp	Megawatt peak (unit of power output)
NAEI	National Atmospheric Emissions Inventory
NEVO	Natural Environment Valuation Online
NHBCF	National Housing Building Council Foundation
NO_2	Nitrous Dioxide Gas
N_2O	Nitrous Oxide Gas
NSIP	Nationally Significant Infrastructure Project
OFGEM	Office of Gas and Electricity Markets
O_3	Ozone Gas

PAN	Planning Advice Note
PHEV	Plugin Hybrid Electric Vehicles
PBCC	Place Based Carbon Calculator
$PM_{2.5}$	Particulate Matter of 2.5 micro diameters in size
PM_{10}	Particulate Matter of 10 micro diameters in size
PV	Solar Photovoltaic
RCP	Representative Concentration Pathways
SPD	Supplementary Planning Document
SoTCC	Stoke-on-Trent City Council
SO_2	Sulphur Dioxide Gas
tCO_2e	Tonnes Carbon Dioxide Equivalent
tCO_2/y	Tonnes of Carbon Dioxide per year
TER	Target Emission Rate
TCFD	Task Force on Climate-related Financial Disclosures
TFEE	Target Fabric Energy Efficiency
TWh	Terawatt-hour (unit of energy)
UK	United Kingdom
UKCP18	United Kingdom Climate Projections 2018
ULEV	Ultra-Low Emissions Vehicles
VCA	Vehicle Certification Agency
WA	Wardell Armstrong LLP
WWHR	Waste Water Heat Recovery
WPD	Western Power Distribution
WMO	World Meteorological Organisation

EXECUTIVE SUMMARY

Wardell Armstrong (WA) was commissioned by Stoke-on-Trent City Council to develop a climate change evidence base for new energy, sustainability and climate adaption policies being considered for Stoke-on-Trent City Council as part of the emerging Local Plan, to cover the period up to 2040. The Baseline Report estimates some of the anticipated changes in Greenhouse Gas (GHG) emissions that may arise as a result of new development in the region, along with broader national trends. Emissions for Stoke-on-Trent have been compared against those of surrounding authorities and the United Kingdom.

In summary, the total GHG emissions in Stoke-on-Trent across all sectors is estimated to be 1,265.4 kt CO_2e in 2019. This equates to approximately 13.5 kt CO_2e per km^2 and 4.9 tCO_2e per person. Sustained economic growth in Stoke-on-Trent is likely to impact the level of carbon emissions per capita in the region in coming years.

New development in the Stoke-on-Trent region will need to demonstrate innovation to overcome space restrictions in the heavily urbanised city and increase resilience to future climate change. Engagement with landowners and developers via the planning process is key to achieving suitable climate change mitigation, biodiversity enhancement measures, and opportunities for natural carbon sequestration on all future development sites in the city. Transitioning to low carbon emissions will provide opportunities that have economic and health benefits as well as environmental benefits.

High-level constraints mapping for renewable energy technologies in the local area indicates that hydropower and large-scale wind developments are unlikely to be feasible in the city. However, there may be opportunities to further utilise solar photovoltaics in both commercial and domestic settings. Small-scale commercial wind developments may also be feasible subject to the planning process. District Heating Networks can be expanded across the city, and there are opportunities for renewable heat from mine water. This resource could potentially be used to provide heat elsewhere in the city as an alternative low carbon heating source.

The evidence from the Baseline Report has been used as the basis for establishing a range of policy recommendations focusing on policy to meet current government targets. This includes (but is not limited to) the areas of Sustainable Building Design

and Construction, Carbon Capture, Utilisation and Storage (CCUS) and Natural Capital, Sustainable Transport, and Renewable and Low Carbon Energy and Storage.

1 INTRODUCTION

1.1 Background

1.1.1 Wardell Armstrong (WA) has been commissioned by Stoke-on-Trent City Council to develop a climate change evidence base for new energy, sustainability and climate adaption policies being considered for Stoke-on-Trent City Council as part of the emerging Local Plan. This will involve an up-to-date evaluation of energy and sustainability across the sector, with a detailed review of current and emerging policies relevant to the region.

1.1.2 Stoke-on-Trent is a unitary local authority in North Staffordshire. It covers an area of around 93 km^2 and provides a range of services to a resident population of around 257,000. Stoke-on-Trent City Council is committed to tackling climate change and improving energy efficiency, having declared a Climate Emergency in 2019. This Baseline Report will provide an overview of interim results of climate change policies and reduction measures, quantifying the current energy and greenhouse gas (GHG) emissions. It will be presented in two parts.

1.1.3 The first part will provide an estimation of GHG emissions based on existing data. It will include an analysis of Stoke-on-Trent's climate change impacts, identifying current impacts as well as future risks. It will assess how Stoke-on-Trent's climate change impacts compare regionally and nationally, whether the area is aligned with current policy and legislation in the United Kingdom (UK), and how the council compares with other local authorities which share borders with the city.

1.1.4 The second part will provide a summary of global and regional climate change predictions. It will provide a baseline against which future trends in climate are identified, along with the potential impact of climate changes that are expected to result in both opportunities and risks for the region.

1.1.5 The evidence from the Baseline Report will be used as the basis for establishing a range of policy recommendations focusing on policy to meet current government targets. This includes (but is not limited to) the following areas:

- Sustainable Building Design and Construction;
- Carbon Capture, Utilisation and Storage (CCUS) and Natural Capital;
- Sustainable Transport; and
- Renewable and Low Carbon Energy and Storage.

1.1.6 These policy recommendations relating to climate change mitigation and adaptation strategies are considered as part of this report. WA will provide a number of planning policy recommendations which provide holistic interventions to meet targets set by the government, with specific ambition towards the plan period until 2040.

1.2 Location and Environment

1.2.1 The city of Stoke-on-Trent is situated within the county of Staffordshire, in the West Midlands region of England. The six large market towns of Tunstall, Burslem, Hanley, Stoke-upon-Trent, Fenton, and Longton form the urban backbone of the administrative area covered by Stoke-on-Trent City Council. Ordnance Survey data in Figure 1.1 shows the county of Staffordshire as a whole, while Figure 1.2 shows the administrative area covered by Stoke-on-Trent City Council.

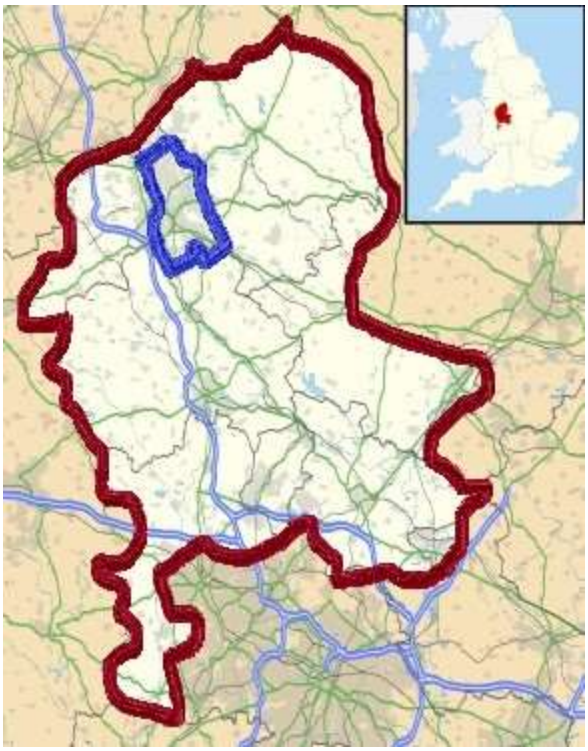

Figure 1.1: Map of Staffordshire, UK, showing administrative borders, coastline, lakes and rivers, roads and railways, and urban areas. Staffordshire border identified by red line. Administrative border for Stoke-on-Trent identiCfied by purple line. Equirectangular map projection on WGS 84 datum, with N/S stretched 165% Geographic limits: West: 2.50W East: 1.40W North: 53.25N South: 52.40N.[1]

[1] This file is licensed under the Creative Commons Attribution-Share Alike 3.0 Un-ported license. Attribution: Contains Ordnance Survey data © Crown copyright and database right.

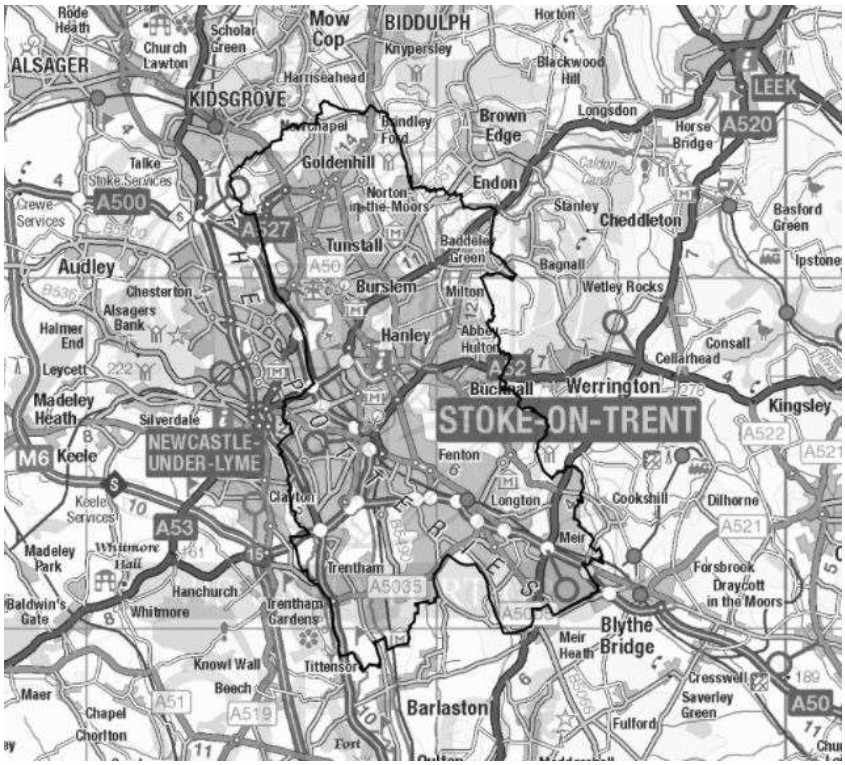

Figure 1.2: Black boundary line depicting the administrative area for Stoke-on-Trent City Council (Source: stoke.gov.uk[2])

1.2.2 The county of Staffordshire is rich in biodiversity and supports a wide range of both nationally and internationally protected species. The region contains many species which are especially sensitive to environmental change and therefore susceptible to the impacts of climate change.

1.2.3 The Natural Environment Valuation Online (NEVO) tool[3] provides an estimate of species richness, defined as the predicted number of species present in the current decade out of 100 priority species chosen by the Joint Nature Conservation Committee. Stoke-on-Trent has the lowest species richness at 42/100 compared to the larger surrounding administrative areas of Newcastle-under-Lyme (44/100), Stafford (48/100), and Staffordshire Moorlands (60/100).

1.2.4 The NEVO tool also indicates the current land cover types for Stoke-on-Trent as shown in Table 1.1.

[2] https://webmaplayers.stoke.gov.uk/webmaplayers8/map.aspx?mapname=DHN [Accessed August 2021].
[3] https://www.leep.exeter.ac.uk/nevo/?x=389373&y=347198&z=6 [Accessed October 2021].

Table 1.1: Land Cover Classification in Stoke-on-Trent (Source: NEVO, 2021).

Land Cover Type	**Area (km^2)**
Agriculture	13
Semi-Natural Grassland	6.2
Urban	71
Water	0.3
Non-Managed Woodland	2.5
Total Land Cover	**93**

1.2.5 The city of Stoke-on-Trent and its neighbouring market town Newcastle-under-Lyme, have a high number of green space areas compared to many other towns and cities in the UK[4]. These are often heavily modified areas as a result of abandoned industry. However, these green spaces are often isolated from other similar areas, limiting opportunities for wildlife species to interact or move from one site to another.

1.2.6 According to the Staffordshire Wildlife Trust[5], there are currently over 40 non-statutory Local Wildlife Sites (LWS) within the city of Stoke-on-Trent. There are also two statutory designated Sites of Special Scientific Interest (SSSIs) within the city which are: Hulme Quarry (Park Hall) SSSI; and Ford Green Reedbed SSSI. Stoke-on-Trent City Council manage their own LWS system which does not follow the same principles as those adopted by the LWS partnership for the rest of Staffordshire.

1.2.7 Engagement with landowners and developers via the planning process is key to achieving suitable climate change mitigation and biodiversity enhancement measures on future development sites. A 2012 partnership project between the Woodland Trust, Stoke-on-Trent City Council and the Forestry Commission saw a total of 35,000 trees planted in Stoke-on-Trent. These now form two 60-acre

[4] http://www.erdf-sunrise.co.uk/ [Accessed September 2021].
[5] Staffordshire Wildlife Trust (2016) 'The State of Staffordshire's Nature: 2016 Technical Report'.

woodlands which support small-scale carbon sequestration in the area[6]. In addition, almost 20 hectares of new wildflower meadows were created on eight species-poor grasslands throughout the city in 2013. These continue to provide a vitally important habitat for pollinating insects and beautiful areas for local communities to enjoy.

1.2.8 The Stoke and Urban Newcastle Rediscovering Its Secret Environment (SUNRISE) project began in 2020 and is the largest nature conservation project in the area. It aims to improve habitat, biodiversity, and connectivity of green spaces and rivers across several selected sites. The SUNRISE project is funded by the European Regional Development Fund and led by the Staffordshire Wildlife Trust. Management of green spaces in Stoke-on-Trent will help to stop biodiversity loss and strengthen resilience to climate change in the city through flood reduction, air quality improvements, and increased opportunities for carbon sequestration.

1.2.9 Vegetation, especially trees, play a vital role in the city to provide habitat for biodiversity, help reduce flooding, stabilise land, and offset carbon. Stoke-on-Trent City Council is currently working with the Woodland Trust to plant over 11,000 trees around the city as part of the 'Big Climate Fightback'. The planting scheme is expected to begin in spring 2022. Pioneer native species will be used for the planting scheme, including Birch, Aspen, Alder, and Oak, alongside shrubs such as Hawthorn and Hazel. The areas proposed are Allendale Walk, Sandy Road, Gill Bank, Dalton Grove, Frodingham Road, Goms Mill, Chelmsford Drive and Bankey Fields. Some locations will be left part planted to allow the local community to get involved with tree planting[7]. Trees for Life calculates six trees offset one tonne of carbon dioxide (CO_2), therefore, 11,000 trees have the potential to save approximately 1,833 tonnes CO_2 per year (although tree saplings will absorb less carbon per year than a fully grown tree).

1.3 Population and Demographics

1.3.1 The changing demographic mix in the fluctuating population over the last century within Stoke-on-Trent is indicated in Figure 1.3, which was extracted from the 2020 update to Stoke-on-Trent's Population, Demography and Migration report[8].

[6] Carbon sequestration is the process of removing carbon dioxide (CO_2) from the atmosphere through capture and storage in carbon sinks, with forest regrowth being a natural form of this process. Soils are the second largest natural carbon sink in the world, with oceans being the first.
[7] https://www.stoke.gov.uk/bigclimatefightback [Accessed September 2021].
[8] Stoke-on-Trent City Council (2020). 'City of Stoke-on-Trent Population, Demography and Migration, March 2020 update.'

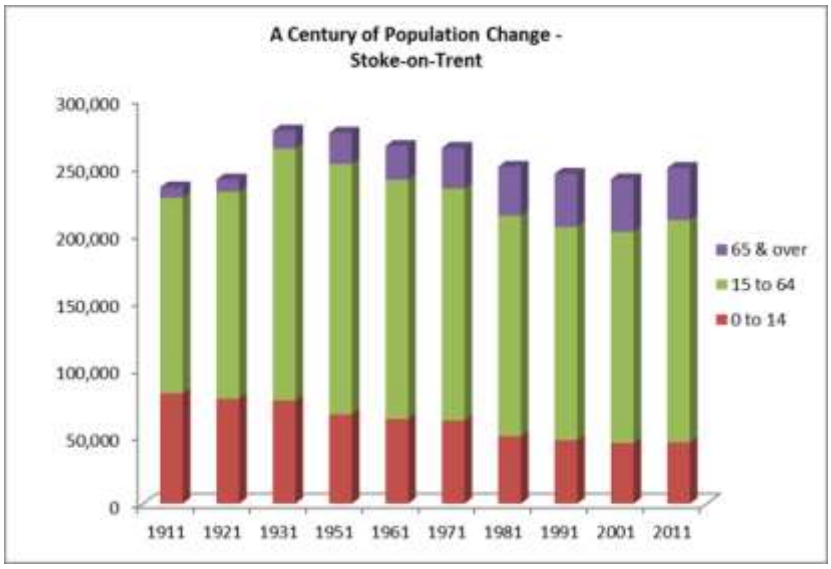

Figure 1.3: Stoke-on-Trent's changing demographic mix in the fluctuating population over the last century (Source: Stoke-on-Trent City Council, 2020)

1.3.2 The aggregate increase of 6.4% (15,400 persons) from 2001 to 2018 – while less than half the national increase (13.2%) and below the regional increase of 11.7% - is above the increase seen in the neighbouring boroughs of Staffordshire Moorlands (4.1% 3,800 persons) and Newcastle-under-Lyme (6.1% - 7,500 persons), and little more than half of the increase in Stafford Borough (12.6% - 15,200 persons).

1.3.3 Average household size for the city decreased over 2001-2011, while it increased for the region and for England as a whole. The 2021 Census data will not be available until mid-2022. The 2011 census suggested that 12.1 % of Stoke-on-Trent's households were single-parent households (compared to 11 % regionally and nationally). Single occupancy in the area is projected to continue to increase to 36.5 % of households by 2041[9]. Consequently, housing demand will be driven up.

1.3.4 The mid-year estimate of the population in 2019 was 256,400, rising to 256,622 in 2020. It is thought that adults with children migrate to neighbouring boroughs while young adults are drawn to Stoke-on-Trent by affordable housing and the two universities. The city's population is projected to grow by 6.3 % from 2016 levels by 2041. The rate of total population change is 0.45 % per annum which is less than similar authorities and England overall (0.75 %).

[9] Stoke-on-Trent City Council (2020). 'City of Stoke-on-Trent Population, Demography and Migration, March 2020 update.'

1.3.5 The Council are currently in the process of updating a number of key evidence base documents to underpin the Local Plan. One of the documents that is currently in the process of being updated is the Local Housing Need which will reflect the proposed plan period of 2020 – 2040. The Local Housing Need indicates that the city requires 679 new residential dwellings per annum over the next 20 years to meet the standard method. This includes a 35% uplift for those urban local authorities in the top 20 cities and urban centres list. Stoke-on-Trent has outperformed both the regional and national economy in recent years, with the creation of a significant number of new jobs (pre-pandemic). This sustained growth is likely to impact the level of carbon emissions per capita in the region.

2 POLICY CONTEXT

2.1 Global Policies and Legislation

2.1.1 The Intergovernmental Panel on Climate Change (IPCC) was formed in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme. It is now the globally recognised United Nations body for assessing the science related to climate change. The IPCC aims to provide policymakers with regular scientific assessments on climate change, its implications and potential future risks, as well as to put forward realistic adaptation and mitigation options. The IPCC does not conduct its own research but allows for open and transparent review by experts and governments around the world.

2.1.2 The IPCC Firth Assessment Report (AR5, 2014)[10] indicated that global greenhouse gas (GHG) emissions will need to drop by half by 2030 and reach net-zero around mid-century to avoid the worst climate impacts. The Sixth Assessment Report (AR6), which is the latest IPCC report published in August 2021[11], highlights how human-induced climate change is already affecting many weather and climate extremes in every region across the world. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical storms has strengthened since AR5.

2.1.3 AR6 states that:

"global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered. Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide (CO_2) and other greenhouse gas emissions occur in the coming decades."

The Paris Agreement

2.1.4 The United Nations Climate Change Conference of Parties (COP) has 197 member countries which have been meeting annually since 1995. The 21st meeting (COP21) was held in Paris in 2015. This made global history with the first legally binding

[10] IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.
[11] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M.Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

international treaty on climate change, commonly referred to as The Paris Agreement. The treaty sets out a global framework which aims to strengthen the global response to the threat of dangerous climate change, by limiting global warming to well below 2 degrees Celsius (°C) above pre-industrial levels, and pursuing efforts to limit the temperature increase this century to 1.5 °C.

2.1.5 The Paris Agreement has now been adopted by 191 countries, including the UK. All member countries are required to prepare, communicate and maintain successive nationally determined contributions (NDCs) that it intends to achieve. NDCs should represent a progression from the previous NDC and reflect the country's highest possible ambition. This includes a requirement to report regularly on emissions and on mitigation implementation efforts. The collective progress towards achieving the purpose of the Paris Agreement will be assessed every five years in a global stocktake of progress. The latest updated NDCs for the UK were published in December 2020, committing the UK to reduce economy-wide GHG emissions by at least 68% by 2030, compared to 1990 levels[12].

2.1.6 According to a recent article published by the World Resources Institute (WRI)[13], the European Union (EU) and 19 other countries and have since adopted net-zero carbon targets, and more than 100 others are considering doing so within the coming years. A rapidly growing number of national governments, local governments and business leaders are now making commitments to reach net-zero emissions in an effort to recognise the urgency of reducing global GHG emissions and tackle climate change.

2.2 National Policies and Legislation

Climate Change Act 2008 (2050 Target Amendment) Order 2019

2.2.1 The Climate Change Act 2008 establishes the framework for the UK to set and deliver greenhouse gas (GHG) emission reduction targets; mainly through the establishment of the Committee on Climate Change (CCC) which ensures targets are evidence based and independently assessed. The Act commits the UK government to reduce GHG emissions to a minimum of 80 % below 1990 baseline levels by 2050. In 2019, this target was amended to be more ambitious and now the commitment is to

[12] UK Government (2020) 'United Kingdom of Great Britain and Northern Ireland's Nationally Determined Contribution' Crown copyright, London.
[13] World Resources Institute (2020). 'Designing and Communicating Net-Zero Targets.' https://www.wri.org/research/designing-and-communicating-net-zero-targets [Accessed June 2021].

reduce GHG emissions to a minimum of 100 % below 1990 baseline levels by 2050 – Net Zero.

2.2.2 The Climate Change Act requires the UK government to set legally-binding 'carbon budgets' which act as key milestones towards achieving net zero by 2050. A carbon budget is a cap on the amount of emissions emitted in the UK over a five-year period, and must be set at least 12 years in advance to allow policy-makers, businesses and individuals enough time to prepare. The UK is currently in the third carbon budget period (2018 to 2022). In April 2021, the UK Government set into law the sixth carbon budget (2033 to 2037) to reduce emissions by 78 % by 2035 (compared to 1990 levels).

2.2.3 The Government is also required to regularly report on emission target progress, assess the risks and opportunities to the UK associated with climate change, and develop preparation and adaptive plans for these. The UK Climate Change Risk Assessment (CCRA) is required to be produced every five years under the Climate Change Act 2008, in order to look at the risks and opportunities arising for the UK from climate change. The latest report was issued in 2017[14]. The UK Government's next progress update, known as CCRA3, is expected to be published in 2022.

2.2.4 The CCC published an independent advice report in June 2021[15] which will inform the CCRA3. This advice report identifies eight risk areas that require the most urgent attention in the next two years. These involve multiple hazards and broadly cover the following areas:

1. Risks to biodiversity in land and water habitats;
2. Risks to soil health through increased flooding and drought;
3. Risks to natural carbon stores leading to increased emissions;
4. Risks to farming (i.e., crops, livestock, commercial forestry);
5. Risks to global distribution networks for vital services (including public procurement and supply chains for food and goods);
6. Risks to people and the economy from climate-related failure of the power system, affecting infrastructure and energy security;

[14] HM Government (2017). 'UK Climate Change Risk Assessment 2017.' Crown copyright, London.
[15] Climate Change Committee (June 2021). 'Independent Assessment of UK Climate Risk: Advice to Government for the UK's Third Climate Change Risk Assessment (CCRA3).' Climate Change Committee, London.

7. Risks to human health, wellbeing and productivity from increased heat exposure in homes and other buildings; and,
8. Multiple risks to the UK from climate change impacts overseas, highlighting need for national resilience as well as business resilience.

2.2.5 In addition to the above reporting, the CCC publishes an annual progress report to parliament that assesses progress in reducing UK emissions over the past year against the set carbon budget. The Joint Recommendations 2021 Report to Parliament[16] offers more than 200 policy recommendations covering every part of Government.

2.2.6 One of the priority recommendations is that the UK Government should aim to be zero carbon in the long term and eliminate emissions from buildings within the next 30 years. Another priority recommendation is for a stable long-term policy framework to be provided to support sustained energy efficiency and heat pump growth at sufficient scale, i.e. 600,000 heat pumps per year in existing homes by 2028.

2.2.7 The CCC also recommends that the Government continues to support widespread deployment of EV charging infrastructure as a priority, to ensure the network can support high EV uptake levels. The Government should aim for there to be around 150,000 public charge points operating by 2025 which should be widely available across all regions of the UK.

National Adaptation Programme (NAP, 2018)

2.2.8 The second National Adaptation Programme (NAP, 2018)[17] sets out the government's response and actions to the second Climate Change Risk Assessment (CCRA) from 2017. The next CCRA is expected to be published in 2022. The NAP shows the current actions that the UK government is taking to address the risks and opportunities posed by a changing climate. It forms part of the five-yearly cycle of requirements laid down in the Climate Change Act (2008) to build climate resilience.

25 Year Environment Plan (2018)

[16] Climate Change Committee (June 2021). 'Joint Recommendations 2021 Report to Parliament.' Climate Change Committee, London.
[17] HM Government, Department for Food & Rural Affairs, (2018) 'The National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting: Making the country resilient to a changing climate.' Crown copyright, Her Majesty's Stationary Office, London.

2.2.9 The 25-Year Environment Plan, published in 2018[18], sets out the UK Government's ambitions for enhancing the natural environment over the coming decades. The strategy includes ten goals across six policy areas. Mitigating and adapting to climate change is goal seven. However, the CCC advise that to meet the challenges of climate change, all of the goals in the Plan will need to be met.

The Ten Point Plan for a Green Industrial Revolution (2020)

2.2.10 The Ten Point Plan[19] is the current overarching paper that was published in November 2020 and lays the foundations for a Green Industrial Revolution. The ten points are:

- Point 1 - Advancing Offshore Wind
- Point 2 - Driving the Growth of Low Carbon Hydrogen
- Point 3 - Delivering New and Advanced Nuclear Power
- Point 4 - Accelerating the Shift to Zero Emission Vehicles
- Point 5 - Green Public Transport, Cycling and Walking
- Point 6 - Jet Zero and Green Ships
- Point 7 - Greener Buildings
- Point 8 - Investing in Carbon Capture, Usage and Storage
- Point 9 - Protecting Our Natural Environment
- Point 10 - Green Finance and Innovation

National Planning Policy Framework (NPPF, 2021)

2.2.11 The policies within the NPPF relevant to climate change can be found in Chapter 14 'Meeting the challenge of climate change, flooding and coastal change'. Those paragraphs most specific to this assessment are detailed below:

Paragraph 152: "The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in

[18] HM Government (2018). 'A Green Future: Our 25 Year Plan to Improve the Environment.' Crown copyright, London.
[19] HM Government (2020) 'The Ten Point Plan for a Green Industrial Revolution: Building back better, supporting green jobs, and accelerating our path to net zero.' Crown copyright, London.

greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."

Paragraph 153: "Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure."

Paragraph 154: "New development should be planned for in ways that: a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards."

Paragraph 155: "To help increase the use and supply of renewable and low carbon energy and heat, plans should: a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts); b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers."

Paragraph 157: "In determining planning applications, local planning authorities should expect new development to: a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption."

Paragraph 161: "All plans should apply a sequential, risk-based approach to the location of development – taking into account the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by: a) applying the sequential test and then, if necessary, the exception test as set out below; b) safeguarding land from development that is required, or likely to be required, for current or future flood management; c) using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques); and d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations."

National Planning Practice Guidance (NPPG, updated 2019)

2.2.12 The National Planning Practice Guidance (NPPG) adds further context to the National Planning Policy Framework (NPPF) and it is intended that the two documents should be read together. The Climate Change Guidance was updated in 2019 and advises how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change.

Building Regulations (Part L and Part F)

2.2.13 Part L of The Building Regulations sets fabric energy efficiency standards, energy efficiency requirements and CO_2 emissions limits for dwellings and non-residential buildings. The Approved Documents provide details on the assessment criteria and methodologies used to test whether buildings are compliant. Aside from any local planning policy requirements it must be demonstrated that a building is compliant with the building regulations to be approved by building control. These regulations are the government's key mechanism for reducing CO_2 emissions in buildings.

Future Homes Standard and Future Buildings Standard

2.2.14 The Future Homes Standard (FHS) and Future Buildings Standard (FBS) sets out improvements to Part L (conservation of fuel and power) and Part F (ventilation) of The Building Regulations. The FHS and FBS were adopted into legislation in December 2021, with changes effective from June 2022.

2.2.15 The FHS/FBS 2021 interim uplift requires a 31 % emissions reduction for new residential dwellings and a 27 % emissions reduction for new non-residential

buildings, achieved using a combination of fabric efficiency and low carbon / renewable energy technologies. These specifications rise to an 75-80 % emissions reduction required for all building types from 2025 onwards. This legislation also introduces a new requirement within Building Regulations to measure a dwelling's 'primary energy use' consumption as well as the projected energy demand. The term 'primary energy use' refers to the direct use or supply at the source of energy that has not been subjected to any conversion or transformation process.

2.2.16 Individual buildings approved prior to June 2022 and commenced prior to June 2023, will remain eligible to be built out under Part L 2013. This transitional period will only apply to individual units and not a development site in its entirety. For transitional arrangements to apply to an individual building on site, developers will need to both:

a) Submit a building / initial notice or deposited plans by June 2022; and

b) Commence work on each individual building by June 2023.

2.2.17 Transitional arrangements will not apply where notices or plans are submitted after June 2022. Where notices or plans are submitted before June 2022, but work on any individual building does not commence by June 2023, the un-commenced buildings for the remaining of the site must be built in line with 2021 Part L standards.

2.2.18 The Planning and Energy Act 2008 has not been amended, meaning that Local Authorities will retain powers to set local energy efficiency standards for new homes, and this provides some certainty around reduction targets in the immediate term. Some Local Authorities are already encouraging consideration of zero carbon homes within their planning policies. This is an area where Stoke-on-Trent City Council can begin to lead the way with their emerging local planning policy to tackle climate change.

Electric Vehicle Charging Infrastructure (Building Regulations Part S)

2.2.19 In the Road to Zero strategy published in 2018[20], the UK Government announced that it wants every new home to have a smart charging point for electric vehicles (EV), where appropriate, to help future proof homes for the transition to low emissions transport. The government consulted on plans to introduce an EV smart charging requirement in the English Building Regulations (a new Part S) and also to transpose the requirements of the European Union (EU) Energy Performance of Buildings Directive (EPBD)3.

2.2.20 In November 2020, the UK Government announced that the phase-out date for the sale of new petrol and diesel cars and vans will be brought forward to 2030, with all new cars and vans to be fully zero emission at the tailpipe from 2035. To enable this transition and support the UK Government's target to achieve net zero GHG emissions by 2050, EVs need to be effectively integrated into and actively support the energy system[21].

2.2.21 The UK Government have confirmed that Building Regulations Part S for EV charging infrastructure will be effective from 2022 and requires:

Policy position: Residential Buildings

- Every new residential building with an associated car parking space to have a charge-point. This requirement applies to buildings undergoing a material change of use to create a dwelling.
- Every residential building undergoing major renovation with more than 10 car parking spaces will be required to have cable routes for electric vehicle charge-points in every car parking space.

Policy position: New Non-Residential Buildings

- Every new non-residential building and every non-residential building undergoing a major renovation with more than 10 car parking spaces will be required to have one charge-point, and cable routes for an electric vehicle charge-point for one in five spaces.

[20] HM Government, Department for Transport (2018) 'The Road to Zero: Next steps towards cleaner road transport and delivering our Industrial Strategy.' Crown copyright, London.
[21] HM Government (2021) 'Electric Vehicle Smart Charging: Government Response to the 2019 Consultation on Electric Vehicle Smart Charging.' Crown copyright, London.

Policy position: Existing Non-Residential Buildings

- Existing non-residential buildings with more than 20 car parking spaces will be required to install at least one charge-point, applicable from 2025.

Net Zero Strategy: Build Back Greener (2021)

2.2.22 The Net Zero Strategy (NZS) document set out the UK Government's long-term plan for a transition to Net Zero emissions by 2050 that will take place over the next three decades, with plans for reducing emissions from each sector of the UK economy. The NZS states that: "By 2035 the UK will be powered entirely by clean electricity, subject to security of supply".

2.2.23 Many of the policies in the strategy will be phased in over the next decade or longer. The NZS includes key policies in the following areas:

- Power;
- Fuel supply and Hydrogen;
- Industry;
- Heat and Buildings;
- Transport;
- Natural resources, waste, and fluorinated gases;
- Greenhouse gas removals; and
- Supporting the transition with cross-cutting action.

Heat and Buildings Strategy (2021)

2.2.24 The Heat and Buildings Strategy (HBS) set out the immediate actions and long-term signals required to reduce emissions from buildings to near zero (between 0 and 2 Mt CO_2e) by 2050. There are about 30 million buildings in the UK. In total, these buildings are responsible for around 30% of our national emissions. The vast majority of these emissions result from heating: 79% of buildings emissions and about 23% of all UK emissions. Upgrading the UK building stock will require a comprehensive package of measures to be implemented in the next decade. This is of particular relevance to Stoke-on-Trent.

2.2.25 The primary focus of the HBS is on reducing emissions from heating as this is the predominant source of emissions from buildings. However, the HBS recognises the

current and potential future demand of cooling. This will be considered further as the Government continue to develop the UK's approach to long-term choices for low-carbon heating.

2.3 Local Policies

2.3.1 A new local plan for 2020-2040 is being prepared by Stoke-on-Trent City Council, which when it comes into effect, will replace the current Newcastle-under-Lyme and Stoke-on-Trent Core Spatial Strategy. This evidence base will feed into the emerging Local Plan policies relating to climate change and emission reductions.

Newcastle-Under-Lyme and Stoke-on-Trent Core Spatial Strategy 2006-2026

2.3.2 The existing local policies relating to climate change and emission reductions are set out in the Newcastle-Under-Lyme and Stoke-on-Trent Core Spatial Strategy 2006-2026. The relevant policies are:

- Strategic Aim 17 (SA17)

"To minimise the adverse impacts of climate change in the move towards zero carbon growth through energy efficiency, promoting the use of renewable energy sources and green construction methods in accordance with best practice."

- Policy CSP1 – Design Quality

"…Ensure a balanced mix of uses that work together and encourage sustainable living in the use of water, energy and re-use of materials and minimises the impact on climatic change..."

- Policy CSP3 – Sustainability and Climate Change

"Development which positively addresses the impacts of climate change and delivers a sustainable approach will be encouraged.

The highest standards of energy and natural resource efficiency will be achieved by: -

1. Requiring that all new development, as a minimum, complies with on-site or near-site renewable or low carbon energy targets set out in current or future national guidance and the Regional Spatial Strategy and takes positive measures to reduce carbon emissions to the levels set out in the Regional Spatial Strategy.

2. Ensuring the use of construction methods which minimise the use of non-renewable resources and which maximise the use of recycled and locally sourced materials.

3. Requiring all new developments to incorporate the use of Sustainable Urban Drainage Schemes (SUDS).

4. Developing habitat systems which are resilient to climate change in accordance with latest best practice.

5. Supporting local initiatives to address climate change such as the North Staffordshire Warm Zone and other initiatives that may emerge.

6. Requiring best practice standards where supported by future local or regional evidence.

7. All new development shall be located in locations at lowest possible flood risk as identified in the SFRA and all suitable flood mitigation measures shall be investigated and where possible incorporated into the development. Opportunities will be sought to open up culverted watercourses to alleviate flood risk, create and improve habitats and develop green corridors.

Where these requirements are impractical and/or unviable, the onus will be on the developer to demonstrate that this is the case."

- Policy CSP4 – Natural Assets

"The quality and quantity of the plan area's natural assets will be protected, maintained and enhanced…"

Local Development Frameworks Supplementary Planning Document (SPD) Sustainability and Climate Change (2012)

2.3.3 The primary objective of this SPD is to take forward the policy within the Core Spatial Strategy and deliver measurable improvements to the sustainability of the built environment. There are a number of additional objectives that the SPD seeks to achieve which are:

- A quantifiable improvement over the minimum standards as set out in Building Regulations of a development's performance in relation to sustainability;

- Ensure that all aspects of sustainable design are considered and addressed, not just mitigation;
- Provide an efficient and consistent tool to assess the sustainability of development proposals;
- Provide development proposals of all sizes the opportunity to consider sustainability (not just larger proposals);
- Encourage applicants to demonstrate the sustainability of their development proposal in a method other than a formal assessment through a nationally prescribed best practice standard (such as BREEAM assessments methods);
- To enable a realistic picture of what sustainability measures and standards can or cannot be delivered through development proposals in terms of viability;
- To increase the level of decentralised energy supply including District Heat Network (DHN); and
- To enable applicants to familiarise themselves with providing more sustainable and/or lower carbon developments prior to the formal introduction of the Government's requirement for all new homes to be 'zero carbon' by 2016.

Stoke-on-Trent Air Quality Management Action Plan (2014)

2.3.4 The Stoke-on-Trent Air Quality Action Plan (2014) seeks to tackle air quality problems at a city-wide and localised level to ensure compliance with national air quality objectives, recognising that the whole of Stoke-on-Trent is a designated Air Quality Management Area. It identifies a number of city-wide measures for improving air quality, such as promoting walk to school schemes, delivering sustainable transport access to new and existing areas of employment and promoting the efficient and cleaner operation of HGVs, buses, coaches, vans and taxis. Localised actions such as town centre traffic management schemes and targeted road corridor improvements are also identified.

Stoke-on-Trent and Newcastle-under-Lyme Borough Council Energy and Climate Change Technical Paper (2016)

2.3.5 The purpose of the Energy and Climate Change Technical Paper published in 2016 was to identify the issues and options for the review of the Joint Plan.

2.3.6 The Technical Paper identifies the following key points:

- Stoke-on-Trent were one of six partners participating in the Planning for Energy Efficient Cities (PLEEC) project. This was a European Union funded project designed to examine existing strategies and best practices to develop a model for energy efficiency and sustainable city planning. An Energy Efficiency Action Plan covering the period 2016-2020 was produced.
- Stoke-on-Trent has experienced limited historic flooding events due to its setting and vicinity to the head of the River Trent, however, climate change was anticipated to increase the risk of flooding from a variety of sources within the city and neighbouring borough.
- Stoke-on-Trent has successfully bid for funding to deliver the county's first fossil-free district heating plant and network in the city;
- Energy inefficient nineteenth century housing stock in Stoke-on-Trent has led to large-scale energy inefficiency and increasing fuel poverty and is hard to bring up to modern standards;
- There are barriers to greater use of the sustainable transport network in Stoke-on-Trent and lack of non-car access to parts of the urban area.

Housing Revenue Account – Renewable Energy Strategy 2017-2022

2.3.7 The Housing Revenue Account (HRA) Renewable Energy Strategy was developed to provide Stoke-on-Trent City Council with a strategic direction on opportunities that exist for making use of renewable energy technology in their housing stock. Delivery of the strategy aims to support:

- A co-ordinated approach to reducing fuel poverty in council housing in the city;
- The delivery of renewable energy technology schemes in the council's housing stock; and
- The council to generate income from its housing stock and renewable energy schemes.

2.4 Other Relevant Guidance and Development Strategies

Planning and Compulsory Purchase Act (2004) - Section 19(1A)

2.4.1 Section 19(1A) of the Planning and Compulsory Purchase Act (2004) requires local planning authorities to include in their Local Plans "policies designed to secure that the development and use of land in the local planning authority's area contribute to the mitigation of, and adaptation to, climate change". This will be a consideration when the emerging Local Plan is examined by the Secretary of State prior to adoption of the local policies. This Baseline Report seeks to provide the supporting evidence for this.

Accounting for the Effects of Climate Change: Supplementary Green Book Guidance

2.4.2 Supplementary planning guidance on climate change was issued in 2014 with the aim to advise "how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change." This provides guidance to authorities for the implementation of climate change considerations into Local Plans but is helpful in outlining the topic areas for review and suggestions of general mitigation and adaptation methods.

2.4.3 The Accounting for the Effects of Climate Change Supplementary Green Book Guidance[22] was published by The Department for Environment, Food, and Rural Affairs (DEFRA) in November 2020. This is supplementary guidance to the Green Book guidance issued by Her Majesty's (HM) Treasury on how to appraise policies, programmes and projects. This supplementary guidance supports analysts and policymakers to ensure, where appropriate, that policies, programmes and projects are resilient to the effects of climate change, and that such effects are being taken into account when appraising options.

The Climate Crisis – A Guide for Local Authorities on Planning for Climate Change (2021)

2.4.4 The Town and Country Planning Association (TCPA) and Royal Town Planning Institute (RTPI) have published an updated guide for Local Authorities on planning for climate change. This document is designed as an introduction to some of the key issues and is intended to inform the preparation of strategic and local development plans. However, it does not contain detailed material on important elements such as green infrastructure, biodiversity, and food security. It can be used as a useful

[22] HM Government, Department for Environment, Food, & Rural Affairs (2020). 'Accounting for the Effects of Climate change: Supplementary Green Book Guidance.'

signpost to government agency guidance and practical advice from cross-sector organisations.

3 METHODOLOGY

3.1 General Approach

3.1.1 The assessment of climate change impacts will be carried out in accordance with the following guidance:

- WBCSD and WRI, 2015. Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard;
- BS EN ISO 14064-1:2019 – Part 1: Specification with guidance at the organization level of quantification and reporting of greenhouse gas emissions and removals;
- DBEIS and DEFRA, 2019. Environmental Reporting Guidelines: Including streamlined energy and carbon reporting guidance;
- IPCC, 2021: Sixth Assessment Report (AR6);
- The Met Office UK Climate Projections Models;
- IEMA, 2017, 'Assessing Greenhouse Gas Emissions and Evaluating their Significance;
- 'Methodologies for the Assessment of Project GHG Emissions and Emission Variations: European Investment Bank, 2020'
- IEMA (2020) 'Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation';
- The Task Force on Climate-related Financial Disclosures Framework (2017).

3.2 Estimating Baseline Emissions

3.2.1 A baseline of for the region will be established by estimating the existing levels of greenhouse gas (GHG) emissions. This will include fuel consumption for all types of fuels, the energy efficiency ratings of existing housing, Low and Zero Carbon (LZC) energy generation, and Ultra-Low Emission Vehicle (ULEV) uptake in the city.

Emission Scopes

3.2.2 Greenhouse Gas (GHG) emissions are divided into 3 Scopes according the GHG Protocol, as depicted in Figure 3.1.

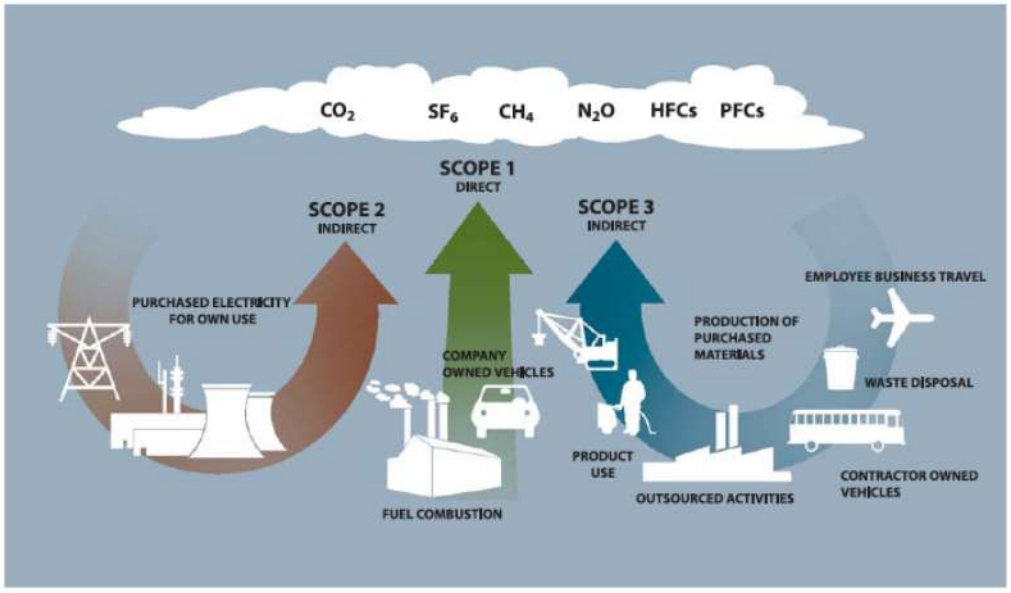

Figure 3.1: Sources of GHG Emissions and Emissions Categories (Source: GHG Protocol)

3.2.3 Direct GHG emissions (also termed as 'Scope 1 emissions') include emissions that occur from sources that are owned or controlled by the Council, for example, emissions from Council-owned or controlled boilers, furnaces, vehicles, and emissions from production in owned or controlled process equipment.

3.2.4 Indirect GHG emissions (also termed as 'Scope 2 emissions') accounts for GHG emissions from the generation of purchased or acquired electricity, steam, heat or cooling consumed by the Council. In this instance it will generally refer to purchased electricity, which is defined as electricity that is purchased or otherwise brought into the organisational boundary of the reporting company.

3.2.5 Indirect GHG emissions occurring within the Supply Chain (also termed as 'Scope 3 emissions') have not been included in the emissions assessment as they are a consequence of the activities of the Council but are not owned or controlled by the Council. This includes upstream and downstream emissions such as those associated with the production of fuels, the transport movements of goods and services, workers, supply chain and visitors to the city. There is no publicly available information which allows for an assessment of these emissions.

3.2.6 The baseline report estimates some of the anticipated changes in GHG emissions that may arise as a result of new development along with broader national trends. The report will offer an up-to-date evaluation of all current climate change impacts, including total Scope 1 and 2 GHG emissions, current energy strategy and

sustainability policies, and current climate adaptation and mitigation measures in place.

Calculating Emissions

3.2.7 There are several greenhouse gases including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Different greenhouse gases have different levels of impact on the climate. It is standard practice to report GHG emissions in terms of CO_2 equivalent (CO_2e). This is a universal metric used to measure and compare the emissions from various GHG on the basis of their global-warming potential (GWP). GWP is a measure of the amount of infrared radiation captured by a gas in comparison to an equivalent mass of CO_2 over a fixed lifetime. The amounts of other GHG are converted to the equivalent amount of CO_2 with the same GWP to give CO_2e. Throughout this report, the term 'emissions' is used to refer to CO_2e unless explicitly state otherwise.

3.2.8 Emissions for Stoke-on-Trent have been compared against those of surrounding authorities and the UK. In some cases, data for Northern Ireland were not available so emissions figures for Great Britain have been used instead of UK. The surrounding authorities for Stoke-on-Trent are those adjacent to it - Newcastle-under-Lyme, Stafford, Staffordshire Moorlands, and also Staffordshire as a whole.

3.2.9 Emissions data for all local authorities of the UK are published annually by the Department for Business, Energy and Industrial Strategy (BEIS) and the Department for Environment, Food & Rural Affairs (DEFRA). Throughout this report, in most cases, emissions from the year of 2019 are referred to. Although some emissions data from 2020 are available, due to the covid-19 pandemic, they are not considered to be representative of a typical year.

3.2.10 Where emissions data are not directly available, they are calculated from activity data and emission factors. Activity data can be given in units of energy consumed, volume of fuel consumed, distance travelled, mass of material, etc. Emission factors are generally given in mass of CO_2e per corresponding unit. Emissions are calculated using the following formula:

$$\textbf{GHG Emissions} = \textbf{Activity Data} \times \textbf{Emission Factor}$$

3.2.11 Activity data have been obtained from UK government public databases. Transport data (i.e., vehicle distances) are published by the Department for Transport.

3.2.12 Emission conversion factors are also published annually by BEIS and DEFRA. It is standard industry practice to use the conversion factors for the year which corresponds to the year the data was reported for (e.g., 2019 data will use 2019 conversion factors, etc.). In the case of commercial transport vehicles where the emission factors depend on the mass of load transported, those for average loads have been used.

3.2.13 In addition to the above, the Place-Based Carbon Calculator (PBCC) is a useful free online tool which estimates the per-person carbon footprint for every Lower Super Output Area (LSOA) in England. LSOAs represent small statistical areas in the UK with a population of around 1,500 to 3,000. The PBCC draws on a wide range of data and research to give a representative view of how carbon footprints vary across the country. A summary of the PBCC data is provided in each relevant section as part of the complete overview of estimated baseline emissions for Stoke-on-Trent.

3.3 Climate Change Projections

3.3.1 The IEMA guidance 'Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation' (2020) explains how our climate is changing but there remain uncertainties in the magnitude, frequency and spatial occurrence, either as changes to average conditions or extreme conditions, which generally makes it difficult to assess the impacts of climate change in relation to a specific region or development project. Therefore, scientific assumptions must be made in order to assess the resilience of new developments to any future changes in climate.

3.3.2 Climate change projections for the UK (UKCP18) are based on global climate simulation models to explore regional responses to climate change. UKCP18 considers the effects arising from a series of emissions scenarios and Representative Concentration Pathways (RCP) which project how future climatic conditions in the UK are likely to change at a regional level, taking account of naturally occurring climate variations. Probabilistic projections provide a range of possible climate change outcomes and their relative likelihoods (ranging across 10th to 90th percentiles).

3.3.3 The region of Stoke-on-Trent has been assessed against a low, medium, and high emissions scenario to allow for comparisons between the projected best and worst case outcomes for climate change over the next 80 years. The RCPs show how the climate could change up to the year 2100, compared to a 1982-2000 baseline.

3.3.4 The 10% probability level is used as a lower limit and the 90% probability level as an upper limit, with the 50th probability level providing a conservative estimate for the likelihood of climate impacts occurring. These scenarios and probability levels have been used to provide credible projected changes including an indicative level of uncertainty.

3.3.5 An assessment of the transitional and physical risks and areas of opportunity that climate change presents in relation to Stoke-on-Trent is based on the framework devised by The Task Force on Climate-related Financial Disclosures (TCFD).

3.4 Data Limitations

3.4.1 Wardell Armstrong accepts no responsibility for inaccuracies in third-party data. The calculations within the assessment are based on the information supplied by the City Council at the time of assessment, as well as publicly available datasets.

3.4.2 According to the IPCC's 2018 Special Report on Global Warming of 1.5°C[23], there is high confidence that climate-related risks for natural and human systems depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options. The report states:

"Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (high confidence). These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (medium confidence)."

3.4.3 Measures can be implemented to reduce the impacts and increase climate resilience according to global and regional climate projections with relevance to the scale of the development proposed. However, the uncertainties associated with probabilistic climate projections cannot be fully mitigated against. Intelligent design, preparation,

[23] IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

and responsible construction can help to minimise future risks. A whole systems approach should be adopted, with all new planning proposals to consider climate adaptation and mitigation throughout.

4 ASSESSING THE BASELINE: GREENHOUSE GAS EMISSIONS

4.1.1 This section evaluates the current level of sustainability and energy across sectors within the city of Stoke-on-Trent, with a focus on current Greenhouse Gas (GHG) emissions, air quality, existing and emerging climate change mitigation strategies and potential risks and opportunities these will create for the city. Emissions have been compared against those of surrounding authorities and the United Kingdom (UK) as a whole.

4.2 Overview of Emissions

4.2.1 The Climate Change Committee (CCC) reports how lockdown measures due to the COVID-19 pandemic led to a record decrease in UK emissions in 2020, falling by 13% overall. The largest falls were in aviation (-60%), shipping (-24%), and surface transport (-18%). However, home energy use increased, with residential buildings the only sector to show an overall increase in emissions (+2%). Without underlying structural changes to UK operations, emissions are likely to rebound in most sectors in 2021 to pre-pandemic levels[24].

4.2.2 The Place-Based Carbon Calculator (PBCC)[25] provides summary statistics for the overall carbon footprint for the Local Authority area of Stoke-on-Trent compared to the rest of England, and this is shown in Figure 4.1. These statistics indicate that emissions per person in Stoke-on-Trent are below the national average. However, as demonstrated by the bold black line in Figure 4.1, there is still a long way to go to meet the legally binding 2032 emissions reduction target of 68% (compared with 1990 levels) and even further to meet the six carbon budget of 78% by 2035, and to achieve Net Zero carbon emissions by 2050.

[24] Climate Change Committee (CCC) (2021) 'Progress in reducing Emissions 2021 Report to Parliament'. CCC.
[25] Morgan, Malcolm, Anable, Jillian, & Lucas, Karen. (2021). A place-based carbon calculator for England. Presented at the 29th Annual GIS Research UK Conference (GISRUK), Cardiff, Wales, UK (Online): Zenodo. http://doi.org/10.5281/zenodo.4665852 [Accessed August 2021]

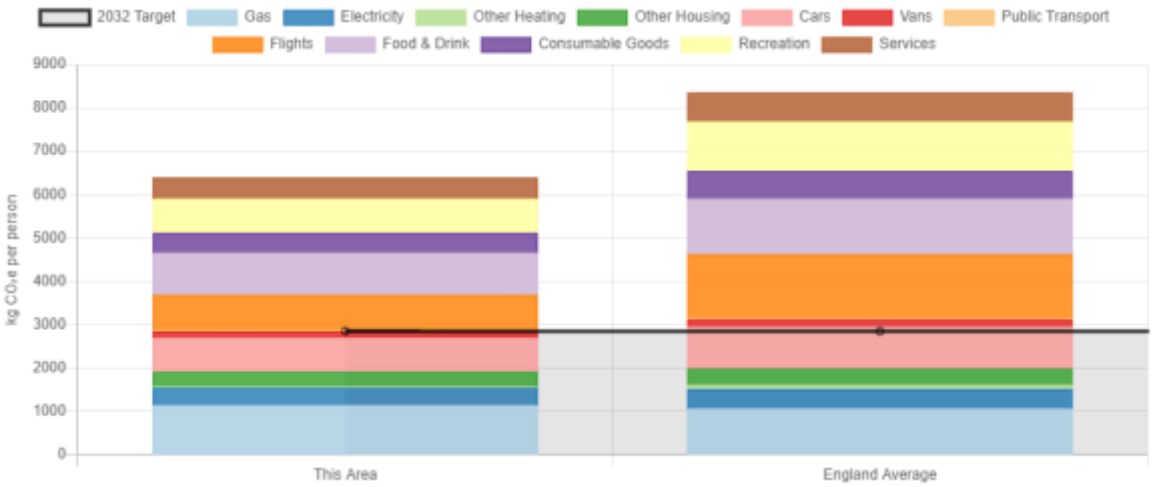

Figure 4.1: Overall Carbon Footprint for Stoke-on-Trent compared to rest of England (Source: PBCC, 2021)

4.2.3 Emissions for Stoke-on-Trent published by DEFRA and BEIS are summarised by sector in Figure 4.2. This shows that emissions per square kilometre (km^2) fell from 14.2 kilo-tonnes (Kt) CO_2e in 2018 to 13.5 Kt CO_2e in 2019, a reduction of 0.7 Kt CO_2e. Emissions data for 2020 is not currently available.

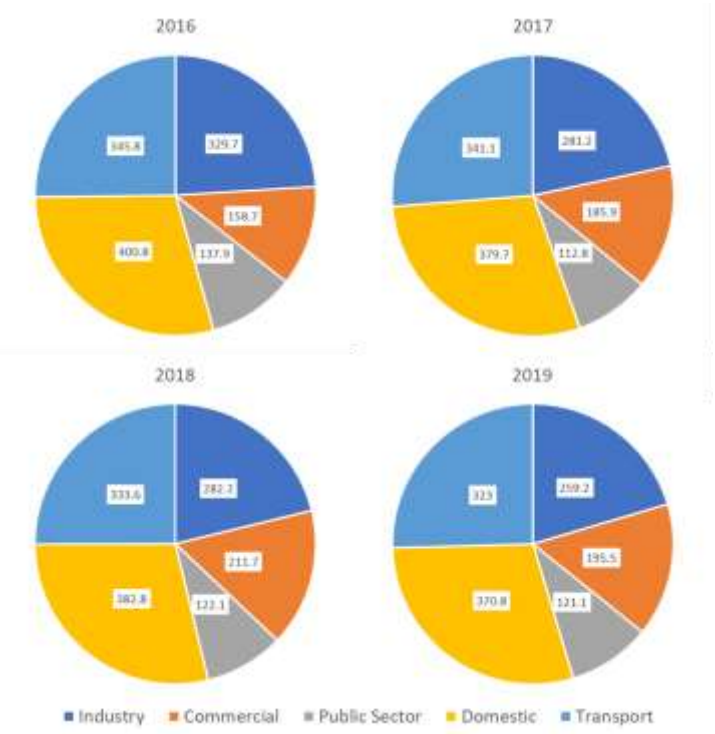

Figure 4.2: Summary of Emissions (Kt CO_2e) per Year and by Sector for Stoke-on-Trent[26]

[26] Data Source: UK local authority and regional carbon dioxide emissions national statistics: 2005-2019, BEIS/DEFRA.

4.2.4 The UK national statistics for local authorities and regions data indicates that net emissions for Land Use, Land Use Change, and Forestry (LULUCF) are negative year on year in Stoke-on-Trent. In 2019 these were minus 4.2 kt CO_2e. The LULUCF sector covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities. Carbon is absorbed (sequestered) by forestry and grassland, while carbon losses occur on existing cropland, grassland, and natural land that is converted to cropland or settlements. This sector has been a net carbon sink since 1998 and is projected to remain a net carbon sink beyond 2050. The UK has a range of options to increase carbon sequestration and reduce emissions in the LULUCF sector, which include planting more trees such as is happening in Stoke-on-Trent, and the restoration of peatlands[27].

4.2.5 **Table 4.1** is a summary of data from the UK national statistics for local authorities and regions[28] and shows how emissions per person (per capita) in Stoke-on-Trent were 5.4 tCO_2e in 2016, and this has fallen year on year to 4.9 tCO_2e in 2019. Overall emissions in Stoke-on-Trent for 2019 have fallen by 29% compared to 2005 emission levels.

Table 4.1: Summary of Greenhouse Gas Emissions for Stoke-on-Trent

Year	**2016**	**2017**	**2018**	**2019**
Population (mid-year estimate)	253.7	255.4	255.8	256.4
Per capita emissions (t CO_2e)	**5.4**	**5.1**	**5.2**	**4.9**
Area (km^2)	93.4	93.4	93.4	93.4
Emissions per km^2 (kt CO_2e/km^2)	**14.6**	**13.9**	**14.2**	**13.5**

[27] Committee on Climate Change Factsheet: Land Use, Land Use Change and Forestry.
[28] Data Source: UK local authority and regional carbon dioxide emissions national statistics: 2005-2019, BEIS/DEFRA

4.3 Transport Emissions

4.3.1 The International Energy Agency reports global transport emissions increased by less than 0.5 % in 2019 (compared with 1.9 % annually since 2000)[29]. The IEA indicate that this is owing to efficiency improvements, electrification, and greater use of biofuels. However, transportation is still responsible for 24 % of direct CO_2 emissions from fuel combustion. This demonstrates that transportation and travel is a significant cause of global GHG emissions, accounting for 27 % of all GHG emissions in the UK[30]. Primarily these emissions come from the burning fossil fuels to power cars, trucks, ships, trains, and planes. Road vehicles account for nearly three-quarters of global transport CO_2 emissions, and emissions from aviation and shipping continue to rise.

4.3.2 According to the PBCC (2021), the transport sector is the only sector of the UK economy where emissions are still rising. Electric vehicles (EV) reduce emissions overall, however, high volumes of emissions are released during the battery manufacturing process. EV still contributes to air pollution (from particulates from their tyres and brakes), traffic congestion, and road deaths. The CCC advises that the UK needs to drive less, overall, to be in with any chance of meeting the emission reduction targets designed to tackle human-induced climate change.

Road Haulage Emissions

4.3.3 Road haulage emissions account for a large proportion of transport emissions in the UK, largely because the majority of Light and Heavy Goods Vehicles (LGVs and HGVs) are fuelled by diesel. There are currently no viable alternative options for this vehicle type although the industry is working hard to try to rectify this as soon as possible.

4.3.4 According to the Vehicle Licensing Statistics issued annually by the Department for Transport[31], Stoke-on-Trent had over 2,300 licensed HGVs and 14,300 LGVs in 2020 who were estimated to travel over 246 million kilometres during the year. The emissions from these vehicles equates to approximately 213 kt CO_2e, which is around 66% of the total transport emissions for the city.

[29] International Energy Agency (IEA) (2020), Tracking Transport 2020, IEA, Paris https://www.iea.org/reports/tracking-transport-2020 [Accessed September 2021].
[30] Department for Business, Energy & Industrial Strategy (2021) 'National Statistics: 2019 UK Greenhouse Gas Emissions, Final Figures.' Crown copyright, London.
[31] Data on all licensed and registered vehicles, produced by Department for Transport, Statistical dataset: VEH0105; and Statistical dataset TRA8905a for vehicle kilometres by local authority in Great Britain.

Modes of Travel

4.3.5 Emissions from cars and vans in Stoke-on-Trent, as summarised by the PBCC, are compared against the UK national average in Figure 4.3 (cars) and Figure 4.4 (vans). These emissions data are based on registered keeper details and data from Ministry of Transport (MOT) vehicle tests and cover the period 2010 to 2018.

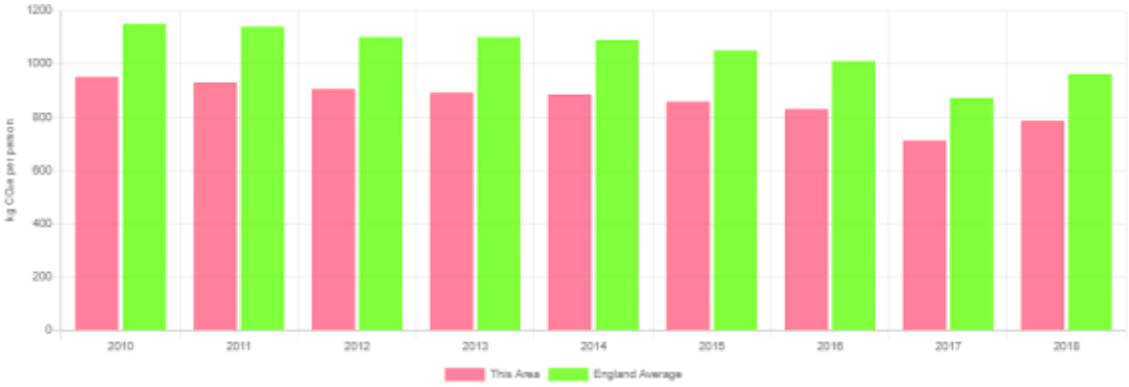

Figure 4.3: Emissions from cars in Stoke-on-Trent from 2010-1018, compared against the national average for England (Source: PBCC, 2021).

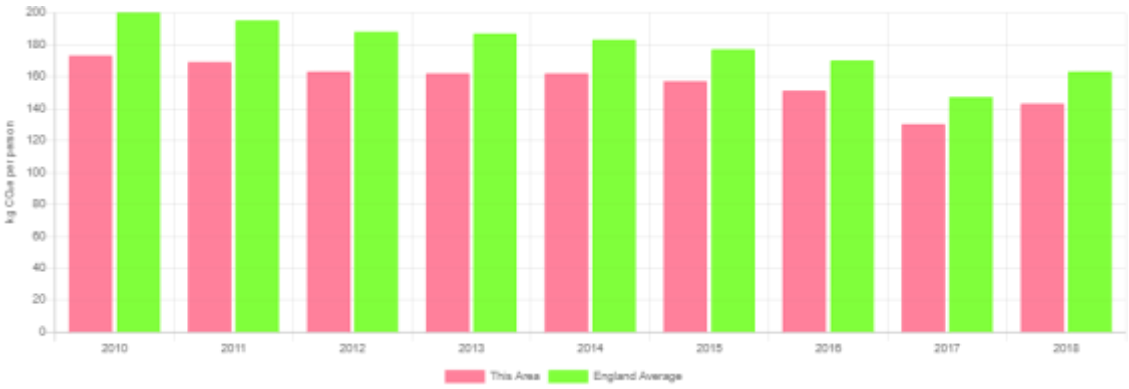

Figure 4.4: Emissions from vans in Stoke-on-Trent from 2010-1018, compared against the national average for England (Source: PBCC, 2021).

4.3.6 These statistics from PBCC indicate that emissions from cars and vans in Stoke-on-Trent have been continuously below the national average for England.

4.3.7 Cars in 2010 accounted for 950 Kg CO_2e per person, compared to 1,150 Kg CO_2e per person across England. This has fallen to 786 Kg CO_2e per person in 2018, compared to 962 Kg CO_2e per person across England. There has been a similar trend in vans. Vans in Stoke-on-Trent in 2010 accounted for 173 Kg CO_2e per person, compared to 200 Kg CO_2e per person across England. This has fallen to 143 Kg CO_2e per person in Stoke-on-Trent in 2018, compared to 163 Kg CO_2e per person across England.

4.3.8 This could be because car ownership in this region is generally lower than in England, as indicated in the Stoke-on-Trent Local Transport Plan 3 (LTP)[32]. The area suffers from a depressed economic situation which can heavily influence travel behaviours and car ownership. Based on the 2011 Census, 30.9% of households in Stoke-on-Trent had no cars or vans compared with 25.8% in England[33]. Comparable data from the 2021 Census is not currently available.

4.3.9 Commuting accounts for about 20 % of all trips in the UK. A breakdown of transport emissions of Stoke-on-Trent in relation to the route type is provided in Figure 4.5, based on data from BEIS/DEFRA[34].

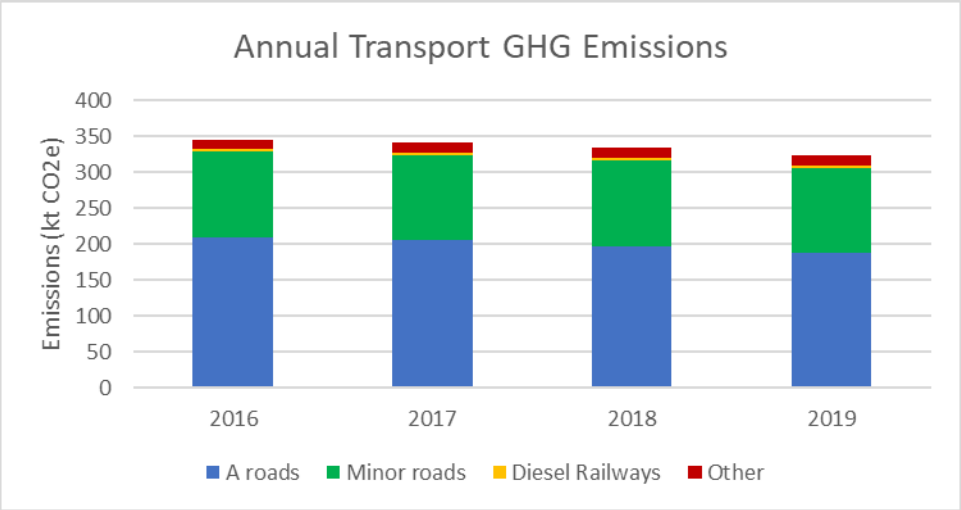

Figure 4.5: Annual Greenhouse Gas (GHG) emissions for transport in Stoke-on-Trent, based on data from BEIS/DEFRA.

4.3.10 Transport emissions depend heavily upon the types of vehicles being used. The PBCC describes how not all vehicles have the same carbon emissions for each kilometre they travel. For example, smaller and lighter cars require less energy to move and so have lower emissions. Buses and trains can carry more people and so emissions per person will reduce for these modes of transport, providing that the routes are well used. Improvements in engine design can also reduce fuel consumption and emissions.

[32] Stoke-on-Trent Local Transport Plan 3 2011/12-2025/26.
[33] City of Stoke on Trent Council (2019). 'Stoke-on-Trent Joint Strategic Needs Assessment 2019.'
[34] Data Source: UK local authority and regional carbon dioxide emissions national statistics: 2005-2019, BEIS/DEFRA.

4.3.11 Figure 4.6 summaries the vehicles by type in Stoke-on-Trent in 2020 based on data extracted from the UK vehicle databases[35]. It clearly shows how petrol cars currently make up a high proportion of the transport mix in Stoke-on-Trent, and there are currently very few Ultra Low Emissions Vehicles (ULEV) registered in the local area.

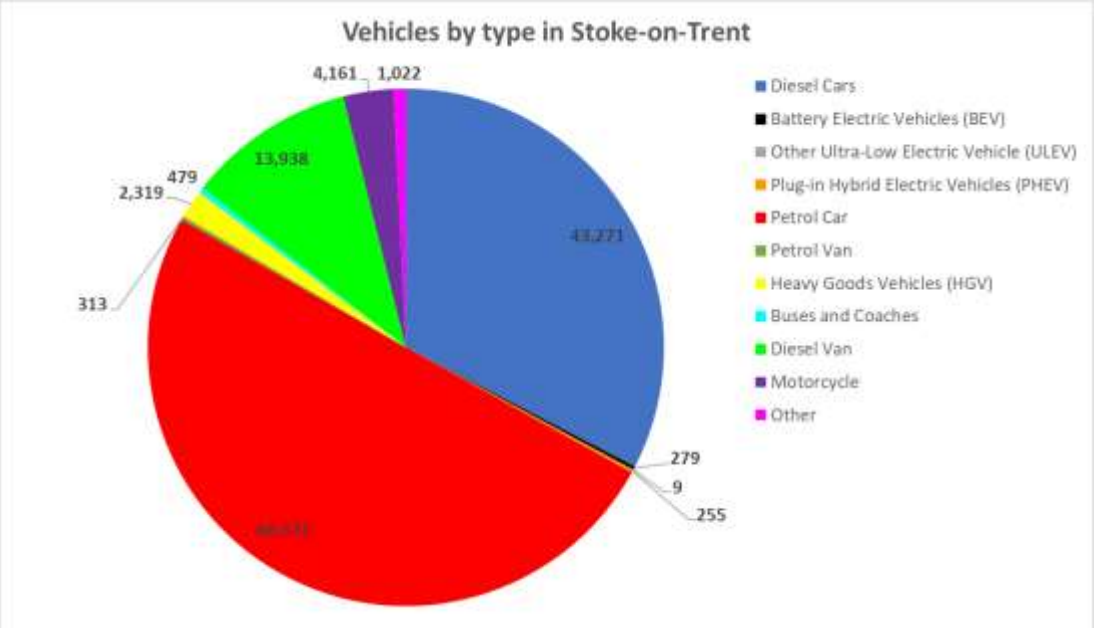

Figure 4.6: Registered vehicle types in Stoke-on-Trent in 2020 (Source: Department for Transport, databases VEH0122 & VEH0134).

4.3.12 The PBCC use the 2011 Census data for Stoke-on-Trent to indicate the proportion of commuters by each travel mode as shown in the inner ring in Figure 4.7, and reinforces the data depicted in Figure 4.6. Despite low car ownership in Stoke-on-Trent, it is clear that the dominate form of travel is by car or van. This is the same in most areas across the UK. The 2011 Census is now a decade out of date but, according to PBCC, travel patterns in the UK have been stable for many years.

4.3.13 The outer ring in Figure 4.7 shows the proportion of people who could cycle to work in the future as 17.4 %, based on analysis from the Propensity to Cycle Tool (PCT). The PCT only considers direct commutes which limits the maximum distance people can travel for work. If commuting journeys combined cycling with public transport, then more people could cycle than the PCT analysis indicates.

[35] Data on all licensed and registered vehicles, produced by Department for Transport, Statistical dataset: VEH0122 and VEH0134.

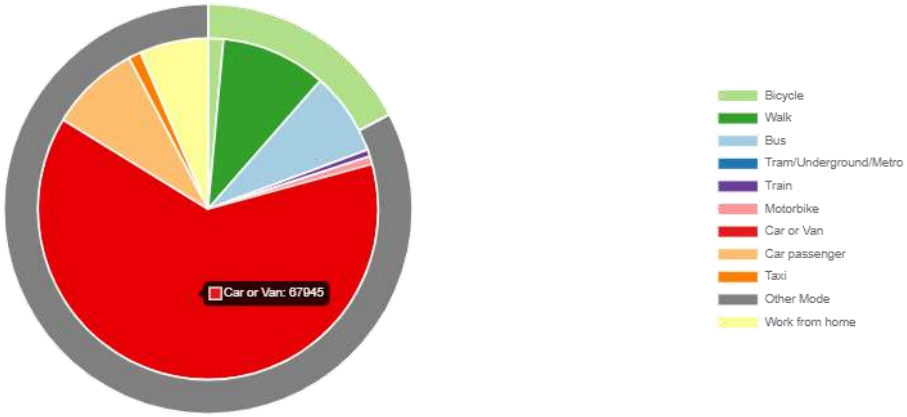

Figure 4.7: Proportion of commuters by each travel mode in Stoke-on-Trent, based on 2011 Census data as 2021 Census data is not currently available (Source, PBCC, 2021)

4.3.14 The CCC reports how the impact of the COVID-19 pandemic on UK travel demand led to a 29 % fall in transport emissions in 2020[36]. It is unclear how exactly commuting will change after the COVID-19 pandemic. However, a significant increase in working from home is expected when the 2021 Census is published in 2022. This has the potential to reduce transport emissions on a short-term basis.

Facilitating the use of ultra-low emissions vehicles (ULEVs), public transport, and human-powered modes of transport will lower emissions in the longer term. The following statistics using the latest available data for 2020 have been derived from vehicle databases (VEH0105, VEH0122, VEH0134[37] and TAXI0105[38]) published by the Department for Transport (unless stated otherwise).

Ultra-Low Emissions Vehicles

4.3.15 ULEVs are currently defined by the UK Vehicle Certification Agency (VCA) as having less than 75 grams of CO_2 per kilometre (g/km) from the tail pipe. Recognising advances in technology, the VCA expect to redefine an ULEV as a car or van that emits less than 50g/km CO_2 from 2021. Pure EV and other plug-in EV when driving in the all-electric mode, produce no tailpipe CO_2 or pollution[39].

4.3.16 0.49 % of registered cars in Stoke-on-Trent are ULEVs, 0.25 % being battery electric vehicles (BEV) and 0.23 % plugin hybrid electric vehicles (PHEV). There are 60 electric

[36] Climate Change Committee (CCC) (2021) 'Progress in reducing Emissions 2021 Report to Parliament'. CCC.
[37] Data on all licensed and registered vehicles, produced by Department for Transport, Statistical dataset: VEH0105, VEH0122 and VEH0134.
[38] Department for Transport, Taxis, private hire vehicles and their drivers (TAXI), Statistical data set TAXI0105.
[39] https://www.vehicle-certification-agency.gov.uk/fuel-consumption-co2/fuel-consumption-guide/zero-and-ultra-low-emission-vehicles-ulevs/ [Accessed September 2021].

vehicle charge points (EVCPs) over 20 sites, of which 7 sites have free to use EVCPs, and 19 sites are planned to be set up in the city over the next 10 years. With the introduction of a Building Regulations Part S in 2022 that will require all new builds to provide smart EV charging infrastructure, the uptake of EV in Stoke-on-Trent should be encouraged as a means to reduce overall transport emissions in the region.

Public Transport

4.3.17 As of 2020, the city has a bus and coach fleet of over 479. The total annual distance travelled by buses and coaches has been estimated as 13.7 million km for the year of 2020. The carbon saving for one bus passenger compared to one car is approximately 70 grams CO_2e per km[40]. This gives a total carbon saving of 959 kt CO_2e than if they had each used a car. Fifty buses are set to be upgraded as part of a project in efforts to cut levels of air pollution in Stoke-on-Trent, with the City Council considering bus gate proposals and Clean Air Zones (CAZ) with the Joint Air Quality Unit (JAQU).

4.3.18 Park and ride schemes can offer integrated transport that allows private transport users to park their vehicles at a large car park and travel into the city centre using a public transport mode, thus reducing emissions within the city centre and improving local air quality. A scheme has been trialled in Stoke-on-Trent and found not to be a viable option due to the limited availability of suitable land for car parking within a reasonable distance outside of the city centre.

4.3.19 Rail is a comparatively low-carbon way of travelling and moving goods and contributed only 1.4 % of the UK's domestic transport emissions in 2019[41]. The West Midlands Railway operates the rail network with mainline routes linking Stoke-on-Trent to the rest of the UK. Currently there is only one mainline train station for Stoke-on-Trent which is approximately 3.5 km away from the city centre in Hanley, and a limited number of other smaller stations. Subject to viability and funding, there are plans to rejuvenate old disused train stations and install a light rail or tram route to improve inner city connections and promote uptake of public transport usage across the city.

[40] This is the difference in emissions factors between the average local bus and the average for petrol and diesel cars.

[41] Department for Transport (2021) 'Rail Environment Policy Statement: On Track for a Cleaner, Greener Railway'. Crown copyright, London.

Taxi Fleet

4.3.20 As of 2020, the city has a taxi fleet of 181 (0.7 per thousand). The total annual distance travelled by taxis in the city has been estimated as 35,345,252 km for the year of 2019[42]. Assuming all these taxis were large diesel vehicles, this equates to approximately 7.3 kt CO_2e for 2019 associated with Stoke-on-Trent's licenced taxi fleet.

4.3.21 Stoke-on-Trent City Council are proposing to reintroduce an upper age limit for private hire vehicles and Hackney carriages as part of an updated taxi licensing policy, designed to stop deterioration in the taxi fleet and reduce vehicle emissions.

Cycle Network

4.3.22 There have been no changes to the cycle network in Stoke-on-Trent since the last audit which was completed in 2015. There are approximately 181 km of cycle lanes throughout the city, 30.5 km of which form part of the national cycle networks.

4.3.23 There is currently one 'in-app' mobile bike hire company, Brompton Bike Hire, which operates in the city with a docking point next to the train station. These bikes are stored in a covered docking station and neatly fold away for easier storage while on loan to the user for up to 30 days at a time. This is different to other public bike-share schemes found in many UK cities and towns, such as London, which offer docked and dock-less public cycle hire schemes on a larger scale.

4.3.24 Cycling can play an important part in reducing transport emissions. A recent report by Brand, et al.[43] found that people who switch just one trip per day from car driving to cycling reduce their carbon footprint by about 0.5 tonnes over a year, representing a substantial share of average per capita CO_2 emissions.

4.3.25 According to Sustrans[44], public cycle share schemes should ensure full coverage throughout urban areas, particularly in neighbourhoods where ownership of adult bicycles is low, where multiple occupancy housing make secure cycle parking difficult

[42] This distance was calculated by dividing the total annual earnings by taxi drivers in the city (available at: https://www.able-systems.com/taxi-driver-uk/) by the average taxi cost per unit distance (available at: https://www.numbeo.com/taxi-fare/in/Stoke-On-Trent).

[43] Christian Brand, Thomas Götschi, Evi Dons, Regine Gerike, Esther Anaya-Boig, Ione Avila-Palencia, Audrey de Nazelle, Mireia Gascon, Mailin Gaupp-Berghausen, Francesco Iacorossi, Sonja Kahlmeier, Luc Int Panis, Francesca Racioppi, David Rojas-Rueda, Arnout Standaert, Erik Stigell, Simona Sulikova, Sandra Wegener, Mark J. Nieuwenhuijsen, (2021) 'The climate change mitigation impacts of active travel: Evidence from a longitudinal panel study in seven European cities.' Global Environmental Change, Volume 67, 2021, 102224, ISSN 0959-3780.

[44] https://www.sustrans.org.uk/our-blog/policy-positions/all/all/our-position-on-public-cycle-share-schemes

to provide, and in low-income areas. Public bike scheme operators should work with local authorities to take steps to reduce street clutter and incentivise users returning their bikes to suitable locations such as alongside existing on-street cycle parking.

Local Transport Plan

4.3.26 The LTP looks in detail at the transport-related problems and challenges within the city, including transport behaviours. The implementation plan involves the following approaches:

- making best use of using the existing transport network and assets within the city and maintaining them appropriately;
- making the adoption of more sustainable travel behaviours easier for people by improving the viability of other travel modes such as public transport; and
- providing information on health, safe, and sustainable travel.

4.3.27 Cross boundary initiatives to improve the effectiveness of climate change policies should be considered, to develop the policy approach where it would lead to the reduction of emissions across Stoke-on-Trent and surrounding areas, including the neighbouring borough of Newcastle-under-Lyme.

4.4 Air Quality

4.4.1 There are strong interactions between efforts to improve air quality and address climate change. Aerosols can affect the regional as well as the global climate. The relationship between air quality and climate change is highly complex but is an important consideration due to the direct risk to human health[45]. For example, when atmospheric pressure increases, pollutants are concentrated to the ground, resulting in increased respiratory health issues. Climate variations across regions will affect air quality differently. Increased precipitation aids the clearing of pollutants from air, whilst warmer, drier conditions stalls air that is saturated in pollutants, e.g. smog. Higher temperatures associated with climate change can also lead to an increase in ozone, a harmful air pollutant[46].

[45] Air Quality Expert Group (2007) 'Air Quality and Climate Change: A UK Perspective.' Crown copyright, London.
[46] https://www.cdc.gov/climateandhealth/pubs/air-quality-final_508.pdf

Air Quality Monitoring Areas

4.4.2 The UK monitors air quality nationally through a number of networks of monitoring stations. Local authorities also carry out air quality monitoring as part of their statutory duties to review and assess local air quality. Areas that are found likely to exceed the national air quality objective for a specific pollutant are designated as Air Quality Management Areas (AQMAs).

4.4.3 The whole of the Stoke-on-Trent area is currently designated as an AQMA for exceedances in Nitrogen Dioxide (NO_2). This was first declared in 2006 and updated in 2011 to include annual mean and hourly mean exceedances of acceptable NO_2 levels in the city. The adjoining areas covering parts of Newcastle-under-Lyme and Staffordshire Moorlands have also been designated AMQAs for this specific pollutant.

4.4.4 The Stoke-on-Trent City Council 2020 Air Quality Annual Status Report (ASR) highlights how over recent years, air quality monitoring has indicated that economic expansion, changes in living habits and fuel use, together with the local drive towards regeneration are all contributing towards increasing levels of pollution in the city and surrounding areas. An important continuing action is to review and comment on planning applications with regard to air quality, alerting planners if there are any concerns that a development may result in air quality which may be harmful to local health.

Air Quality in Stoke-on-Trent

4.4.5 This section addresses the level of pollutants in the city. The pollutants that have been measured are nitrogen dioxide (NO_2), ozone (O_3) and particulate matter (small particles up to 2.5 ($PM_{2.5}$) or 10 (PM_{10}) microns in diameter).

4.4.6 Pollution levels have been measured in the city and those from 2016 to 2019 are used in this analysis. Some pollutants have been measured at just one site, while others have been measured at multiple sites across the city. The Diffusion Tube Locations across Stoke-on-Trent where air quality has been monitored are shown in Figure 4.8. Further information regarding the Diffusion Tube Locations can be found in the Air Quality Annual Status Report by Stoke-on-Trent City Council.

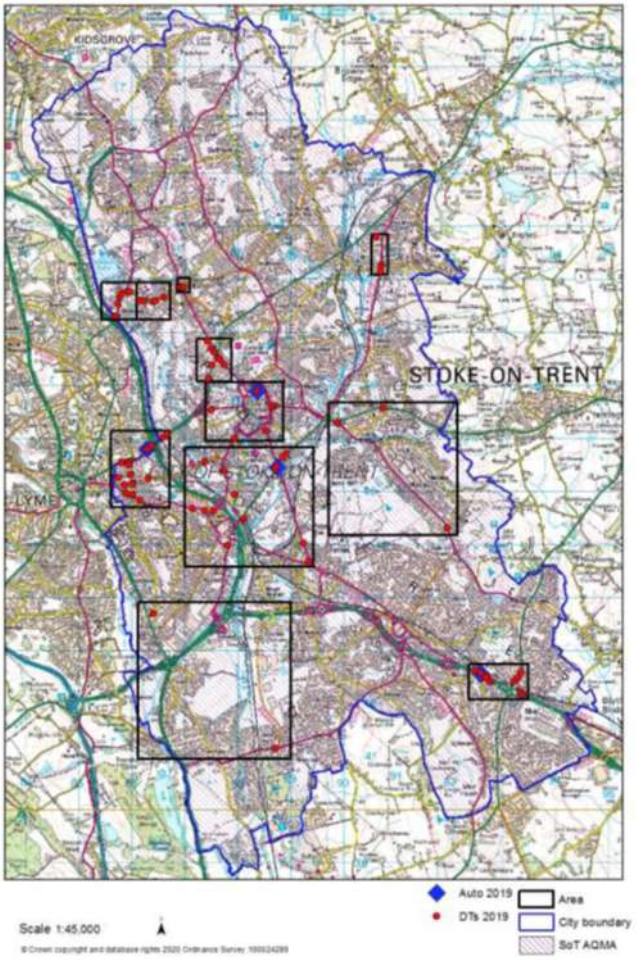

Figure 4.8: Diffusion Tube Locations for Air Quality Monitoring in Stoke-on-Trent (Source: 2020 Air Quality Annual Status Report, Stoke-on-Trent City Council)

4.4.7 Data from 2020 are not expected to be representative of usual levels due to the Coronavirus (COVID-19) pandemic so these have been omitted from the baseline. An 'n/a' entry means that no data were recorded for the period.

Nitrogen Dioxide

4.4.8 Nitrogenous gases play an important role in global climate change and are a source of acid rain. Nitrogen Dioxide (NO_2) is not classed as a greenhouse gas in itself, but it is a pollutant of concern as it contributes to the creation of ozone which is a particularly potent greenhouse gas. Therefore, NO_2 emissions from transport and industry do impact on global warming. NO_2 is harmful to humans, even in small quantities, and high concentrations can also reduce plant growth.

4.4.9 The limit set by the national air quality objective for NO_2 is 40 µg/m^3 (micrograms of pollutant per cubic metre of air) measured as an annual mean. A maximum limit of

200 µg/m^{3,} measured as a 1-hourly mean must not be exceeded more than 18 times in a year. Pollution levels shown in Table 4.2 have been averaged across over several diffusion tube locations in Stoke-on-Trent (50 sites in 2016 and 29 sites in 2019).

Table 4.2: Annual Nitrogen Dioxide (NO_2) Pollutant Levels in Stoke-on-Trent (Source: 2020 Air Quality Annual Status Report, Stoke-on-Trent City Council)

Year	2016	2017	2018	2019
Average concentration (µg/m^3)	41.7	40.2	37.9	38.1
Days per year limit exceeded	6	2	1	n/a

4.4.10 In urban areas, such as Stoke-on-Trent, the main source of NO_2 is vehicle emissions. The A500 Queensway dual carriageway is a major primary A-road which passes through Stoke-on-Trent, linking parts of Staffordshire and Cheshire. The A50 is another major trunk road in Stoke-on-Trent which experiences higher volumes of traffic. Both of these roads are managed by Highways England. In the exceedance areas, where traffic is a main source, NO_2 concentrations range between 31-81 µg/m³. Away from road sources, the concentration of NO_2 is typically between 20-25 µg/m³ [47].

4.4.11 The data in Table 4.2 indicates that there is a weak downward trend in NO_2 levels in the city, with the average concentration meeting the UK national air quality objective in the latter two years. However, there has been at least one instance every year where the NO_2 limit has been exceeded and the AQMA remains current. Overall concentrations of this pollutant reman high in the vicinity of Stoke-on-Trent and surrounding areas.

Ozone

4.4.12 Ozone (O_3) has a very high initial GWP of about 1000. Over 20 years its GWP is reduced to 62-69 which is still high. The high GWP has a detrimental effect on the climate when O_3 is formed in the wrong places through chemical interactions with other gases such as NO_2. Ozone has a cooling effect in the stratosphere and protects from solar radiation. Human activity is leading to a breakdown of stratospheric ozone and an increase in O_3 levels closer to ground-level which has a global warming effect. Inhalation of ground-level O_3 can cause severe respiratory problems.

[47] Stoke-on-Trent City Council (2014) 'City-wide Air Quality Action Plan: In fulfilment of Part IV of the Environment Act 1995 Local Air Quality Management'. Public Protection Division of Stoke-on-Trent City Council

4.4.13 Table 4.3 sets out the average maximum measurements in an eight-hour window recorded in the city centre for the past four years. The UK limit set by the national air quality objective for O_3 is 100 µg/m^3.

Table 4.3: Annual Ozone (O_3) Pollutant Levels in Stoke-on-Trent (Source: 2020 Air Quality Annual Status Report, Stoke-on-Trent City Council)

Year	2016	2017	2018	2019
Average concentration (µg/m^3)	53.6	54.6	60.1	53.8
Days per year limit exceeded	n/a	n/a	n/a	10

4.4.14 The data in Table 4.3 indicates that there is no clear increase or reduction in the O_3 concentration over time, and although the limit was exceeded for 10 days in 2019, the concentration is on average well below the national air quality objective for this specific pollutant.

Particulate Matter

4.4.15 Particulate matter (PM) are very small microscopic solid or liquid particles which are suspended in air (commonly soot (carbon), dust, or dirt), and affect air quality. PM are not gases and have no global warming potential, therefore, PM do not contribute to climate change. However, changes in climate will affect how PM is suspended in the air at any given moment in time.

4.4.16 PM can cause respiratory problems, especially those smaller than 10 microns in diameter as they can penetrate deep into the lungs. The UK limit set by the national air quality objective for PM, measured as an annual mean, is 40 µg/m^3 for PM_{10} and 25 µg/m^3 for $PM_{2.5}$. A maximum limit of 50 µg/m3, measured as a 24-hour mean, must not be exceeded more than 35 times in a year for PM_{10}.

4.4.17 Table 4.4 sets out the average maximum measurements in an eight-hour window recorded in the city centre for the past four years for both sizes of PM which are monitored by national air quality objectives.

Table 4.4: Annual Particulate Matter (PM_{10} and $PM_{2.5}$) Pollutant Levels in Stoke-on-Trent (Source: 2020 Air Quality Annual Status Report)

Year	2016	2017	2018	2019
PM_{10} average concentration (µg/m^3)	20	41	42	19
Days per year limit exceeded	5	3	1	11
$PM_{2.5}$ average concentration (µg/m^3)	13	13	13	13
Days per year limit exceeded	n/a	n/a	n/a	8

4.4.18 The larger PM_{10} particles have exceeded the limit in two out of the previous four years, and at least once in every year, even when average annual concentrations have been below the limit. The average concentration of 19 µg/m^3 in 2019 was well below the national air quality objective of 40 µg/m^3, however, the limit was exceeded on 11 occasions during that year.

4.4.19 Average annual concentrations of the finer $PM_{2.5}$ particulates have been consistent across the past four years and well below the national air quality objective limit of 25 µg/m^3. However, in 2019 there were 8 recorded instances where the limit was exceeded even through the annual average was only 13 µg/m^3.

Air Quality Improvements

4.4.20 It is clear from these data that the City Council needs to improve air quality in some locations of the city. Taking actions to improve air quality will not only support a healthier population but will also mitigate against the impacts of climate change.

4.4.21 One of the measures being considered is the implementation of a 'Clean Air Zone' (CAZ) to tackle air quality within the city, where daily charges are put in place at certain locations to try to restrict travel by older vehicles that have higher emissions. The UK Government has four types of CAZ, Class A to D. Stoke-on-Trent City Council are looking at CAZ Class C, which would apply to buses, coaches, taxis, private hire vehicles, heavy goods vehicles, vans, and minibuses above minimum emission standards. Recent modelling has demonstrated that a CAZ C area that encompasses Victoria Road and the city centre should be capable of delivering air quality compliance, making it a potentially viable option for reducing NO_2 levels in the area to acceptable levels by 2023[48].

[48] https://www.stoke.gov.uk/news/article/942/clean_air_zone_to_be_considered_for_stoke-on-trent

Other Air Pollutants

4.4.22 There are other air pollutants that have an effect on climate change and human health which can be monitored by the national air quality objectives for the UK. These air pollutants include:

- Nitrous Oxide (N_2O), better known as laughing gas, is an especially potent greenhouse gas with a GWP of 300. It traps far more infrared radiation than both carbon dioxide (CO_2) and methane (CH_4). Prolonged exposure to N_2O can have health impacts, such as hypoxia.
- Sulphur Dioxide (SO_2) is not a greenhouse gas but when coupled with elemental carbon, it forms aerosols which could have a warming effect. SO_2 pollution is the main cause of acid rain which is harmful to ecosystems. In high concentrations, SO_2 affects the respiratory system, particularly lung function, and can also irritate the eyes.

4.4.23 Monitoring data for these air pollutants for the Stoke-on-Trent region was not available at the time of this report. However, Stoke-on-Trent City Council continues to operate a rigorous monitoring regime. The Council, where appropriate and subject to resources, endeavours to carry out specific monitoring to help measure the effectiveness and impact of each action proposed in the latest Air Quality Management Action Plan.

4.4.24 The Council recognises that actions to improve air quality cannot be achieved in isolation and aim to work closely with other council plans, projects and strategies, as well as colleagues in public health, planning, transport, and economic development. Recent work of note during 2020 is the funding bids for Transforming Cities, and for Taxi and Private Hire Electric Vehicle Charging Infrastructure.

4.4.25 The 2020 ASR also highlights a number of examples where the City Council are seeking to engage public and community support to achieve a reduction in air pollutant levels across the city, particularly at major roads and junctions where NO_2 remains the pollutant of concern.

Methane

4.4.26 Methane (CH_4) is also a powerful greenhouse gas which causes climate change, with a GWP of 28-36 over 100 years or 86 over 20 years. According to Public Health

England[49], high levels of CH_4 can reduce the amount of oxygen breathed from the air, resulting in all sorts of side effects including mood changes, slurred speech, vision problems, memory loss, nausea, vomiting, facial flushing, and headache.

4.4.27 CH_4 is emitted by human activities such as leakage from natural gas systems, landfill sites, and the raising of livestock, as well as by natural sources such as wetlands. Domestic gas in the UK is mostly composed of CH_4 as it is a major constituent of the natural gas used for cooking and heating. In industry, CH_4 is used to refine petrochemicals and to produce plastics, fertilisers, anti-freeze and fabrics.

4.4.28 This gas does not have a national air quality objective as it is subject to separate monitoring and control requirements for activities causing fugitive CH_4 emissions which could impact on both local air quality and national emissions reduction targets. Fenton Manor Landfill Site, Hanford Household Waste Recycling Centre, and Walleys Quarry Landfill in Silverdale, are all potential sources of methane gas in Stoke-on -Trent.

4.5 Industry and Public Sector

Commercial Industries

4.5.1 The Fame database is a definitive source of company information for over 11 million companies based in the UK and Ireland. It shows that there are currently 703 companies in Stoke-on-Trent with 20 or more employees, including schools and other education establishments. To avoid potential duplication, this figure of 703 does not include subsidiary companies which may be owned or operated by the same organisation.

4.5.2 Emissions from the industrial, agricultural and commercial sectors, as summarised from the annual data produced by BEIS/DEFRA, are shown in Table **4.5**. Emissions for all these sectors were 454.7 kt CO_2e in 2019, which contributed 36 % of total emissions.

Table 4.5: Breakdown of Industrial and Commercial Emissions in Stoke-on-Trent (kt CO_2e)[50]

[49] Public Health England. Centre for Radiation, Chemical and Environmental Hazards. Compendium of Chemical Hazards: Methane (2019) 'Methane General Information'. PHE publications gateway number: 2014790.
[50] Data Source: UK local authority and regional carbon dioxide emissions national statistics: 2005-2019, BEIS/DEFRA.

Sector	2016	2017	2018	2019
Industry Electricity	100.4	93.2	87.3	72.8
Industry Gas	167.8	128.1	133.9	128.1
Industry 'Other Fuels'	55.7	57.9	59.1	56.3
Large Industrial Installations	3.9	0.1	0.1	0.1
Agriculture	1.9	1.9	1.9	1.9
Industry Total (kt CO_2e)	**329.7**	**281.2**	**282.2**	**259.2**
Commercial Electricity	49.3	40.5	38.0	35.4
Commercial Gas	109.1	145.4	173.4	159.8
Commercial 'Other Fuels'	0.3	0.1	0.3	0.3
Commercial Total (kt CO_2e)	**158.7**	**185.9**	**211.7**	**195.5**

4.5.3 One of Stoke-on-Trent's emissions hotspot industries are the ceramics. The ceramics industry is energy-intensive and consumes approximately 4.7 Terawatt-hour (TWh) per year nationally, with gas accounting for over 80-82 % of the overall energy mix[51]. Decarbonisation of the ceramics sector is a priority for Stoke-on-Trent and Staffordshire, but one that is challenging and represents a key undertaking for these regions as they seek to maintain competitiveness. Government are seeking to support the ceramics industry with the transition to low carbon by 2050 and have devised The Ceramic Sector Industrial Decarbonisation and Energy Efficiency Roadmap Action Plan. Long-term planning is essential for this industry as it is very capital intensive with long-investment cycles[52].

4.5.4 The latest UK National Atmospheric Emissions Inventory (NAEI)[53] identifies Norcros Group (Holdings) Ltd as a Large Industrial Installation in Stoke-on-Trent. This global company manufactures ceramic wall and floor tiles, and in the UK offers a wide range of bathroom and kitchen products for both domestic and commercial applications. In 2018, this company was responsible for 21 kt CO_2e of emissions from

[51] Ceramic Sector: industrial decarbonisation and energy efficiency roadmap action plan, 2017, BEIS
[52] Stoke-on-Trent & Staffordshire Enterprise Partnership (2018) 'Energy Strategy: Stoke-on-Trent and Staffordshire LEP Energy Strategy.' Encraft Ltd.
[53] https://naei.beis.gov.uk/laco2app/ [Accessed October 2021]

industry in the Stoke-on-Trent area, falling to 6 kt CO_2e in 2019. The company's annual report for 2019 attributes the fall in emissions to the impacts of the COVID-19 pandemic in part, but also to a number of principle measures taken to improve energy efficiency within their operations and products.

4.5.5 The University Hospital of North Staffordshire (NHS) Trust is also identified by the NAEI as a Large Industrial Installation in Stoke-on-Trent, producing 31 kt CO_2e in 2018[54]. The University Hospitals of North Midlands have since installed CHP units in two hospitals in the area, including Royal Stoke University Hospital. This is reported to offset 2,792 tCO_2e per year for both sites, which is approximately 8 % of the Trust's total emissions[55]. Despite this, the NAEI shows emissions from The University Hospital of North Staffordshire (NHS) Trust have risen to 59 kt CO_2e in 2019. This could be due to an increased demand for health services around this time in the lead up to the global COVID-19 pandemic.

Public Sector

4.5.6 One of the largest public sector employers in the city is Stoke-on-Trent City Council. The last carbon footprint report issued by the City Council published a figure of 37,159 tCO_2e for 2014 to 2015. Comparing this to the 2016 emissions total, it would have accounted for approximately 8 % of industrial and commercial emissions.

4.5.7 Total public sector emissions in 2019 for Stoke-on-Trent were 121 kt CO_2e[56]. This accounts for only 1 % of the UK total for public sector emissions in this year. However, it is important for these public sector emissions from City Council operations and other public bodies working in the region to be reduced as part of the climate emergency which the City Council declared in 2019.

4.5.8 Schools account for around 2 % of the total emissions in the UK. The carbon footprint report from 2014-2015 reported emissions from schools in Stoke-on-Trent to be 11,407,933 tCO_2e. The main sources of emissions for schools are the heating of school buildings, the behaviours of students and staff generating waste, and the activities of companies providing goods and services to schools. Updated figures for

[54] https://naei.beis.gov.uk/laco2app/ [Accessed October 2021]
[55] Data available at: https://www.centricabusinesssolutions.com/case-study/taking-care-co2-emissions
[56] Department for Business, Energy and Industrial Strategy (BEIS) UK local authority and regional carbon dioxide emissions national statistics: 2005-2019.

these Scope 3 emissions were not found to be available for Stoke-on-Trent at the time this 2021 baseline was established for the emerging Local Plan.

Climate Risks to Businesses

4.5.9 In the latest UK Business Sector Briefing for Climate Change Risk[57], the top climate risks to UK businesses needing additional action in the next five years were identified as being:

i) the risk of flooding and extreme weather events;

ii) the risks from disruption of supply chains and distribution networks; and

iii) the risk of climate change outside the UK that affects UK businesses through investment, supply chains, distribution networks, and other business relationships.

4.5.10 This highlights that, in addressing the issues of climate change though their policies, the City Council and other Local Authorities should work closely with local industries in planning and implementing the journey to net zero, especially in terms of utilising available new technologies and linking training skills with new technology to reduce overall emissions in Stoke-on-Trent.

4.5.11 The Stoke-on-Trent and Staffordshire City Deal was signed in 2014 and aims to create around 23,000 local jobs over the next decade by encouraging economic growth in the region, putting Stoke-on-Trent at the forefront of the development of renewable and low carbon energy projects.

4.5.12 The UK Government's Net Zero 2050 strategy will be a driving factor in moving all areas including Stoke-on-Trent towards meeting the targets. As part of the strategy there is a pledge for financial resources to help support access to more energy efficient development and properties and a more renewable supply, alongside a pledge to stop sale of new gas boilers with funding for new technologies available. The funding available is substantial, but equally limited when considered across the country and therefore it will need to be established how best Stoke-on-Trent may access and maximise the potential for this.

[57] Surminski, S. (2021) Business and industry. In: The Third UK Climate Change Risk Assessment Technical Report [Betts, R.A., Haward, A.B. and Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London.

4.6 Housing

Current Housing Stock

4.6.1 The City of Stoke-on-Trent Property and Environment report for 2020[58] indicates that since 2001, more than 8,000 properties have been constructed and over 1,750 demolished across the city. There are currently more than 3,700 empty properties across the city, with large concentrations in the former housing market renewal areas adjacent to the city centre.

4.6.2 The report states that:

"the city continues to exhibit a perceived low-quality environment with a disjointed physical infrastructure and a preponderance of derelict industrial premises. This perception is further supported by a housing stock comprising large numbers of traditional terraced properties (31% of the City's housing stock – compared with 25% nationally) and large post-war local authority estates (18% of the City's housing stock – compared with 9% nationally)".

4.6.3 The PBCC uses the 2011 Census data to indicate the proportion of each building type in Stoke-on-Trent (see Figure 4.9). Each neighbourhood within Stoke-on-Trent has a different mix of house types. This affects both carbon emissions and the difficulty of energy efficient retrofit for older buildings. It is common for larger detached houses to require more heating compared to smaller terraced houses and flats, but inefficient buildings of any size will always require more energy to keep warm in winter or cool in summer. Figure 4.9 indicates that the predominant house type in the city is semi-detached, closely followed by terraced properties.

[58] Stoke-on-Trent City Council (2020). 'City of Stoke-on-Trent Property and Environment, March 2020.'

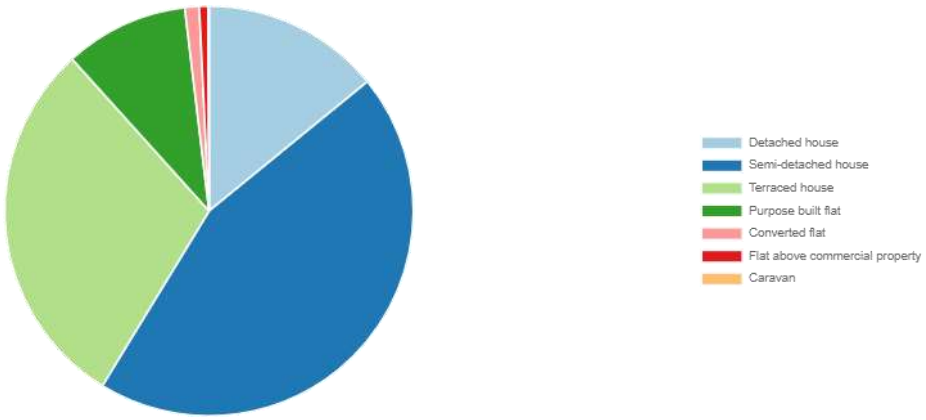

Figure 4.9: Breakdown of Building Types in Stoke-on-Trent, based on 2011 Census (Data Source: PBCC, 2021).

4.6.4 Building regulations are minimum standards legally required for the design, construction and alterations for almost every building in the UK. The regulations are developed by the UK government and approved by Parliament, and are periodically updated as building standards and technology evolve. The PBCC describes how older buildings were usually built to lower standards and so need more energy to keep warm. Typically, buildings built before the 1930s have solid walls which are harder to insulate retrospectively than modern cavity walled buildings.

4.6.5 Figure 4.10 from the PBCC shows the breakdown of properties by age in Stoke-on-Trent, based on the 2011 Census data. This clearly shows the majority of buildings in the city were built before 1964.

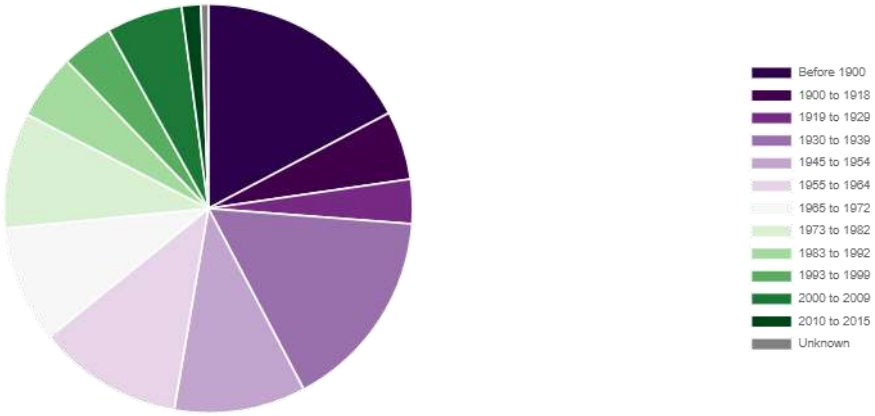

Figure 4.10: Breakdown of Building Age in Stoke-on-Trent, based on 2011 Census (Data Source: PBCC, 2021).

4.6.6 The Ministry of Housing, Communities and Local Government (MHCLG) provides statistical data on dwelling stock for Local Authorities. MHCLG was renamed the Department for Levelling Up, Housing and Communities (DLUHC) in September 2021. The latest data for 2020 shows housing stock for Stoke-on-Trent was 122,973 for a population of 256,622. A breakdown of types of housing is provided in Figure 4.11.

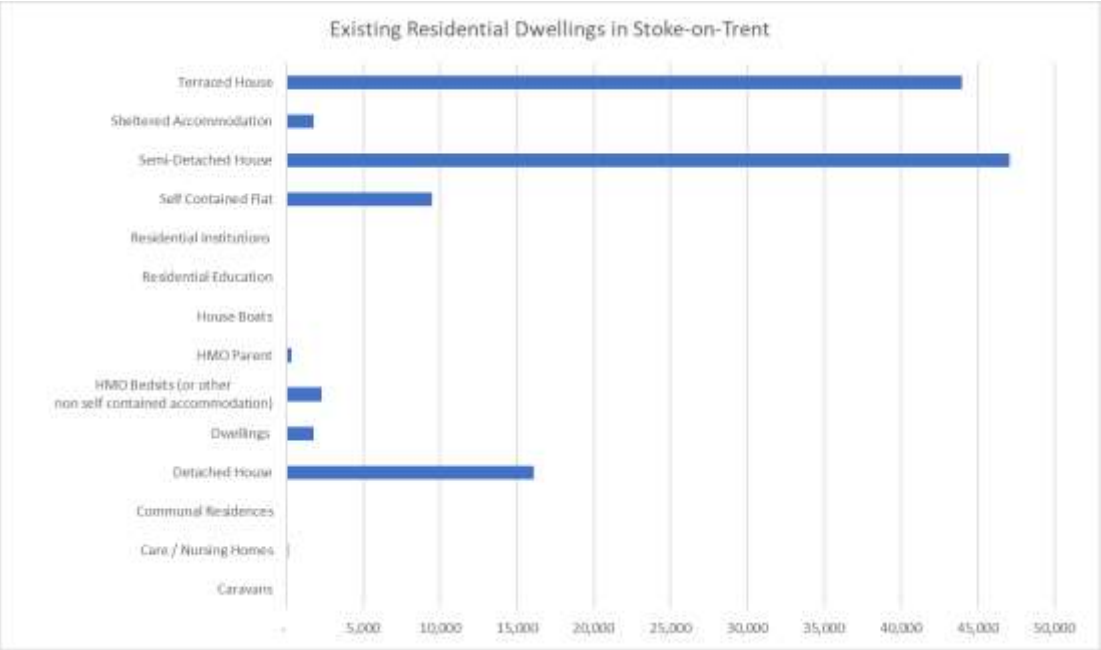

Figure 4.11: Breakdown of existing residential dwellings in Stoke-on-Trent for the year 2020 (Source: DLUHC)

Emissions from Buildings

4.6.7 Buildings generated nearly 40 % of annual global CO_2 emissions in 2020, with building operations responsible for 28 % annually[59]. Since 2008, houses in the UK which are to be sold, rented, or are newly constructed, are required to get an Energy Performance Certificate (EPC) which are valid for up to 10 years.

4.6.8 An EPC measures the current energy efficiency of a property on a scale of A (most efficient) to G (least efficient). The energy performance is rated in terms of the energy use per square metre of floor area, with energy efficiency based on fuel costs, and environmental impact based on CO_2 emissions.

[59] United Nations Environment Programme, Global Alliance for Buildings and Construction, (2020). '2020 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector.' Nairobi.

4.6.9 An EPC provides a range of energy indicators, such as whether the property would benefit in terms of upgrades to heating, insulation, lighting, glazing, etc. The EPC also provides the likely potential performance arising from the application of those improvement measures and associated notional costs for installation. Sometimes EPC ratings are given based on a number of assumptions according to the age of the property and building standards in place at the time it was built, so the energy efficiency should be taken with a bit of caution but is a useful guide.

4.6.10 Figure 4.12 summarises the EPC ratings for properties in Stoke-on-Trent, taken from PBCC data analysis. It shows that under half of buildings have a D rating, with only about a quarter rated at C. The average EPC rating for a home in the UK is a D.

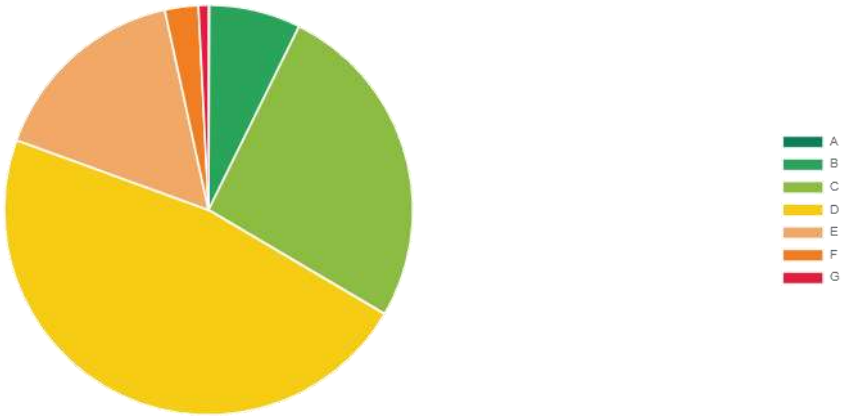

Figure 4.12: Summary of Energy Performance Certificate (EPC) ratings for existing buildings in Stoke-on-Trent (Source: PBCC, 2021).

4.6.11 The chart in Figure 4.13 is from PBCC and shows the mix of building types based on EPC data. This should be compared with the similar chart in Figure 4.9 which is based on the 2011 Census data. The EPC data is more up to date but does not cover all homes within the area so is less comprehensive. Together the two charts (Figure 4.9 and Figure 4.13), and the chart for 2020 (Figure 4.11), show that the predominant house type in the city is semi-detached, closely followed by terraced properties.

4.6.12 When compared with the profile of the rest of the English housing stock in 2012, these types of buildings in England often had the worst energy efficiency ratings with EPC F and G[60].

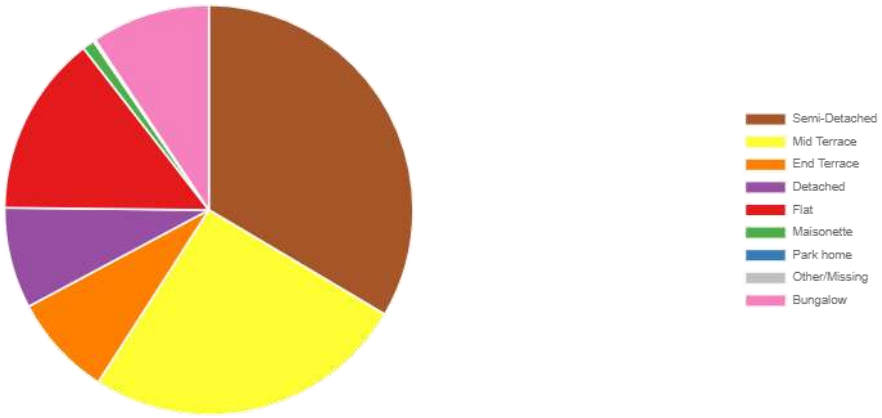

Figure 4.13: Summary of Building Types in Stoke-on-Trent based available data from Energy Performance Certificates. The EPC data is more up to date that the 2011 Census data but does not cover all homes within the area. (Data Source: PBCC, 2021).

4.6.13 The energy efficiency of the English housing stock has increased over the last decade, with the proportion of dwellings in the lowest energy efficiency bands F and G having fallen from 14 % in 2008 to 4 % 2018[61].

4.6.14 It is likely that the overheating of buildings in summer and the associated thermal discomfort for occupiers will be an increasing impact of climate change. In 2018, around half (47 %) of English households reported always being able to cool down at night by opening a window. However, 9 % of households living in urban areas were less likely to be able to cool down at night by this method.

4.6.15 The Headline Report 2019-20[62] states that the energy efficiency of the English housing stock continues to improve. This was evident in all tenures apart from local authority dwellings where there was no significant increase. The social sector remains more energy efficient than the private sector.

[60] Department for Communities & Local Government. National Statistics (2014) 'English Housing Survey: Energy Efficiency of English Housing 2012'. Crown copyright, London.
[61] Ministry of Housing, Communities & Local Government. National Statistics (2020) 'English Housing Survey: Energy efficiency, 2018-19'. Crown copyright, London.
[62] Ministry of Housing, Communities & Local Government. National Statistics (2020) 'English Housing Survey: Headline Report, 2019-20'. Crown copyright, London.

Energy Efficiency in Stoke-on-Trent

4.6.16 U-values are a measure of the rate of heat energy lost through building fabric (walls, floors, ceilings, and windows). High fabric efficiency means a low U-value. Current building regulations require dwelling walls to have a minimum U-value of 0.3 W/m^{2}K, which is most easily met by installing insulation. From a DLUHC dataset of 69,050 residential properties in Stoke-on-Trent, it is estimated that around 45 % are not adequately insulated, if at all. 26 % have EPC ratings of E or below. Only around 5 % are considered highly energy efficient with EPC ratings of B or A.

4.6.17 Stoke-on-Trent City Council offers grants for home improvement measures through the Safe and Warm Home Grant Scheme. Eligible customers who meet certain criteria related to income and health can receive help with:

- first-time gas central heating;
- boiler repair or replacement;
- loft insulation;
- cavity wall insulation;
- replacing single-glazed windows;
- advice and help to keep warm and safe; and
- measures to help to prevent slips, trips and falls.

4.6.18 Since 2018, through the Safe and Warm Home Grant Scheme, 64 properties have been insulated with loft, cavity wall, internal wall, roof, or under floor insulation, or a combination of these measures. This is a small contribution and more can be done to increase the average EPC rating in the city to C or above (see Figure 4.12).

4.6.19 About 35 % of heat is lost through a building's walls, 25 % through the roof, 15 % through the floors, and 10 % through windows and doors[63]. This highlights the importance of adaptation and retrofit measures to improve the existing housing stock in Stoke-on-Trent and across the UK. The CCC recommends that to meet UK climate change emission reduction targets, all homes and other buildings need to be upgraded (wherever feasible) to reach an A or B rating as soon as possible.

[63] Morgan, Malcolm, Anable, Jillian, & Lucas, Karen. (2021). A place-based carbon calculator for England. Presented at the 29th Annual GIS Research UK Conference (GISRUK), Cardiff, Wales, UK (Online): Zenodo. http://doi.org/10.5281/zenodo.4665852.

4.6.20 The Governments Net Zero 2050 strategy should be considered in this context and how grant funding for new technology will enable greater energy efficiency and reduce reliance on gas, for example. The Local Plan can set out carbon targets for new development and retrofits, and include a policy to control the use of carbon offsetting by developers to account for residual emissions on-site within new and retrofit developments.

Domestic Emissions

4.6.21 The PBCC describes how houses are a significant source of carbon emissions, with the two main sources of emissions being electricity for lights and appliances and, more significantly, the energy used to heat homes and provide hot water. These can be referred to as domestic emissions.

4.6.22 Domestic emissions depend on the configuration of house, occupancy and building materials. Detached, poorly insulated, and singly occupied houses generally produce more emissions per person. Domestic emissions are estimated using local electricity and gas consumption data. A breakdown of domestic emissions for Stoke-on-Trent based on regional statistics provided by the UK Government is shown in Figure 4.14[64].

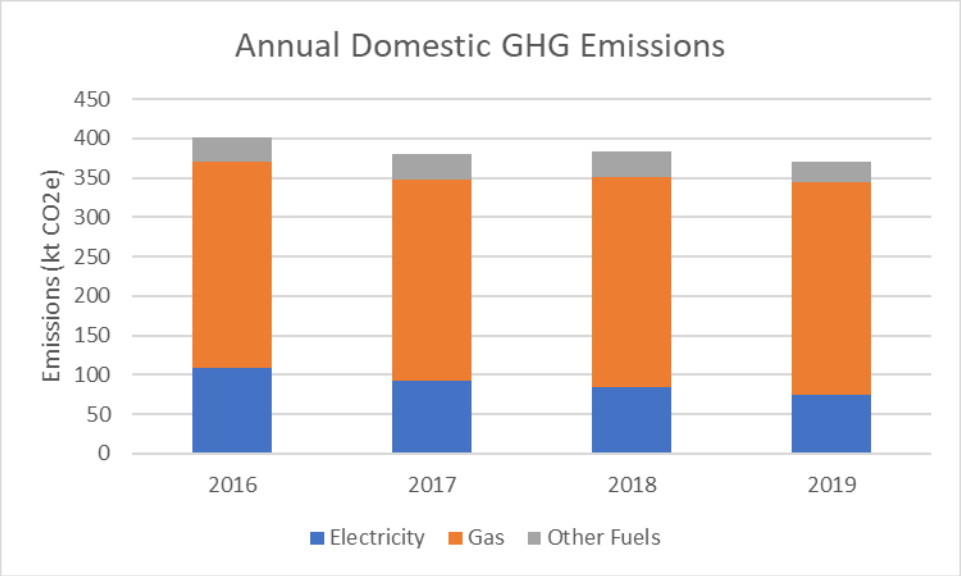

Figure 4.14: Breakdown of annual domestic emissions in Stoke-on-Trent (Source: UK local authority and regional carbon dioxide emissions national statistics: 2005-2019, BEIS/DEFRA)

[64] UK local authority and regional carbon dioxide emissions national statistics: 2005-2019, BEIS/DEFRA.

4.6.23 Domestic emissions represent approximately one third of all emissions in the city. Domestic gas produced 270.5 kt CO_2e in 2019 which equates to 21 % of total emissions of the city, most of which is likely used for heating buildings. Improving fabric efficiency of existing houses can vastly reduce heating demand and could reduce domestic gas consumption significantly. The energy use of a home can also vary widely according to the choices and behaviours of the occupants. Encouraging a beneficial change in the way occupants use their heating, ventilation or hot water can achieve significant savings in both cost to households and reduction in domestic emissions. The aforementioned pledges from the Government are certainly of relevance here.

Fuel Poverty

4.6.24 Fuel poverty is a growing concern across the UK and especially in Stoke-on-Trent. In general, the term fuel poverty relates to households that must spend a high proportion of their household income to keep their home at a reasonable temperature. Differences in methodology used to define and measure fuel poverty means that it cannot be directly compared across the nations of the UK. However, in the latest estimates, around 13 % of households in England were classed as fuel poor, 25 % in Scotland, 12 % in Wales, and 18 % in Northern Ireland[65].

4.6.25 In 2014, the Government introduced a statutory fuel poverty target for England to improve as many fuel poor homes as is reasonably practicable to a minimum energy efficiency rating of band C by the end of 2030. This will mean warmer, healthier homes and lower energy bills. Interim milestones were set for England, aiming to improve as many fuel poor homes as is reasonably practicable to EPC band E by 2020 and EPC band D by 2025,

4.6.26 Fuel poverty in England is now measured using the Low-Income Low Energy Efficiency (LILEE) indicator rather than the old Low-Income High Costs (LIHC) indicator. There are three important elements in determining whether a household is fuel poor:

- household income;
- household energy requirements; and
- fuel prices.

[65] Suzanna Hinson and Paul Bolton, House of Commons Library Briefing (2021) 'Fuel Poverty'. UK Parliament.

4.6.27 According to the UK Government, under the LILEE indicator, a household in England is considered to be fuel poor if:

"they are living in a property with a fuel poverty energy efficiency rating of band D or below, and, when they spend the required amount to heat their home, they are left with a residual income below the official poverty line."[66]

4.6.28 Figure 4.15 is from the most recent UK Government statistics for England and indicates the proportion of households in fuel poverty by Local Authority as of 2019[67].

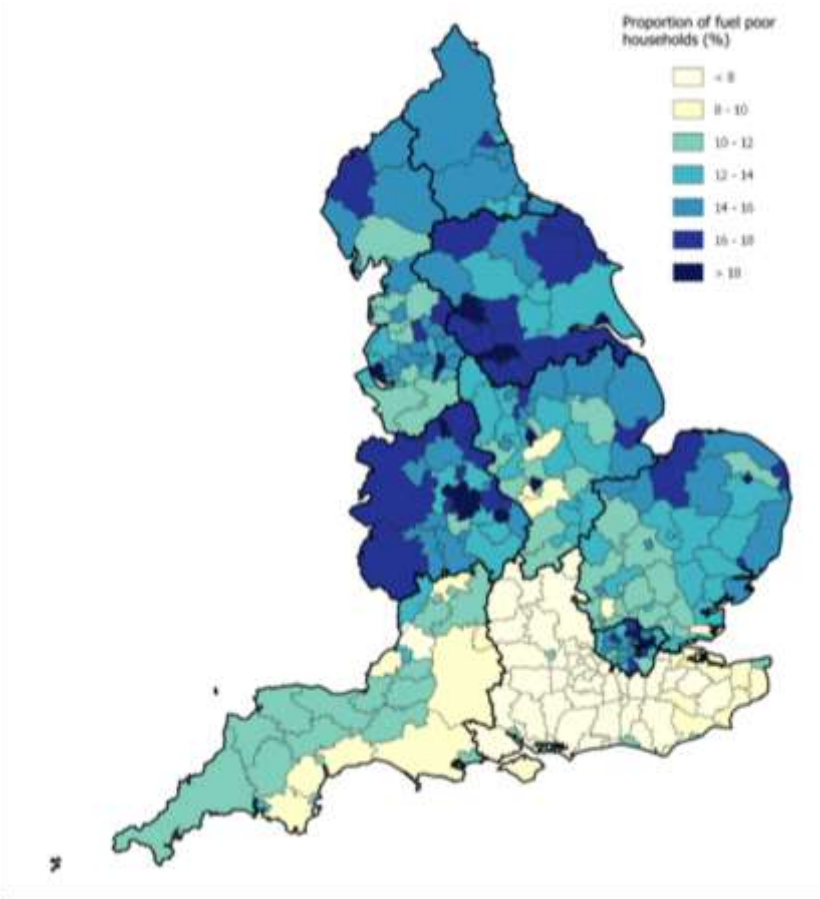

Figure 4.15: Map showing proportion of English households in fuel poverty, by Local Authority, in 2019 (Source: BEIS, 2021).

4.6.29 Stoke-on-Trent is ranked second highest out of 151 Local Authorities in the UK based on 2019 data, with 21.8 % of households in fuel poverty - compared to 17.5 % in the

[66] Department for Business, Energy & Industrial Strategy, National Statistics (2021) 'Annual Fuel Poverty Statistics in England, 2021 (2019 data).' Crown copyright, London.
[67] Department for Business, Energy & Industrial Strategy, National Statistics (2021) 'Annual Fuel Poverty Statistics in England, 2021 (2019 data).' Crown copyright, London.

West Midlands and 13.4 % in the whole of England[68]. There were seven Local Authorities with a fuel poverty rate above 20 % in 2019. Stoke-on-Trent is mentioned in the fuel poverty sub-regional report as having one of the highest rates of fuel poverty, along with three other West Midlands authorities and three London boroughs. However, the revised LILEE measure for fuel poverty gives a much higher percentage of fuel poverty in the city than the previous LIHC measure.

4.6.30 Stoke-on-Trent City Council has undertaken analysis to provide an indication of the distribution of fuel poverty by each Ward in the city, as shown in the map in Figure 4.16[69]. This is representative of the situation in 2019

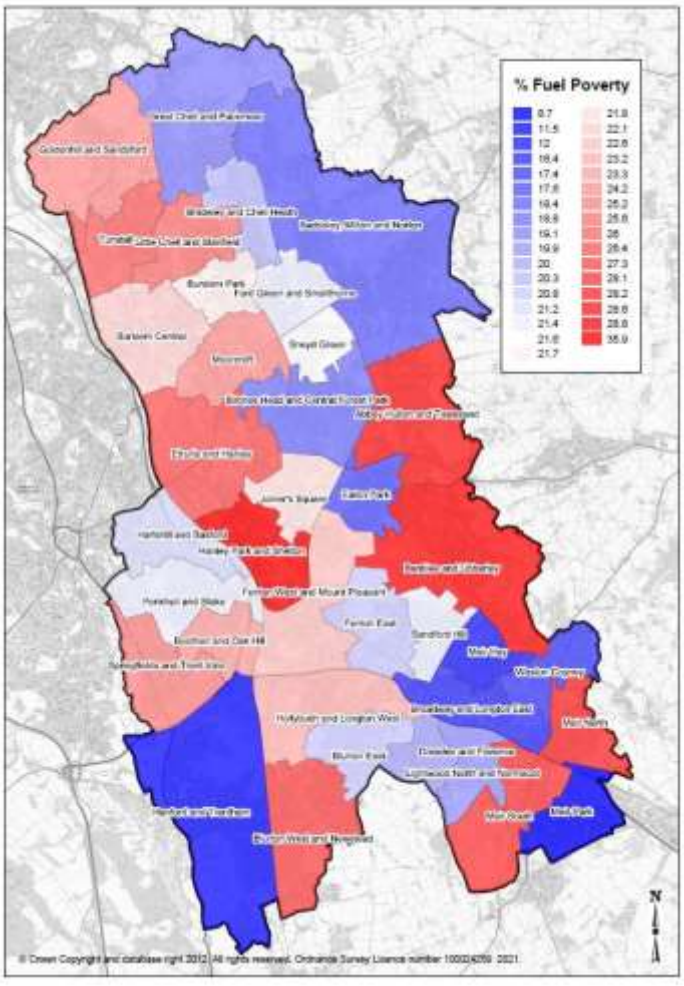

Figure 4.16: Map showing distribution of fuel poverty by each Ward in the city of Stoke-on-Trent (Source: SoTCC, 2021)

[68] Department for Business, Energy & Industrial Strategy, Experimental Statistics (April 2021) 'Sub-regional Fuel Poverty in England, 2021 (2019 data).' Crown copyright, London.
[69] Stoke-on-Trent City Council, 'Stoke-on-Trent Fuel Poverty Strategy 2016-2020'.

4.6.31 Figure 4.16 indicates that the ward of Hanley Park and Shelton remains one of the most deprived areas with an estimated 38 % of households in fuel poverty. Conversely, the ward of Meir Park has a similar number of households but is among the least deprived areas with 7 % estimated to be in fuel poverty. The measure of fuel poverty used in these datasets was LIHC, whereas the more recent measure and data based on LILEE give a much higher level of fuel poverty in the city.

4.6.32 The primary causes of fuel poverty are low incomes, high energy bills, and energy inefficient homes. An energy efficient home can require less energy to heat and so reduce domestic emissions. However, The Centre for Sustainable Energy highlights how this is a potential area of tension within planning policies. A policy that is helping to reduce fuel bills and fuel poverty is in some instances likely to lead to increased energy consumption and carbon emissions. Policies should be prioritised which both reduce carbon emissions and alleviate fuel poverty, and which avoid impeding progress in the other[70].

Energy Consumption

4.6.33 According to the PBCC, about 90 % of houses in England use natural gas for central heating and hot water. Figure 4.17 shows the type of heating system recorded in the 2011 Census for Stoke-on-Trent. This chart should be compared with the similar chart in Figure 4.18 which is based on an extract of EPC data from 2020. While the EPC data is more up to date it does not cover all homes in the area.

4.6.34 Together these two charts from the PBCC should give a representative view of heating types in the city, at least until the 2021 Census results are published sometime in 2022[71].

[70] Dr Toby Bridgeman, Joshua Thumim, Simon Roberts OBE (2018) 'Tackling fuel poverty, reducing carbon emissions and keeping household bills down: tensions and synergies: Report to the Committee on Fuel Poverty '. Centre for Sustainable Energy, Bristol.

[71] Morgan, Malcolm, Anable, Jillian, & Lucas, Karen. (2021). A place-based carbon calculator for England. Presented at the 29th Annual GIS Research UK Conference (GISRUK), Cardiff, Wales, UK (Online): Zenodo. http://doi.org/10.5281/zenodo.4665852.

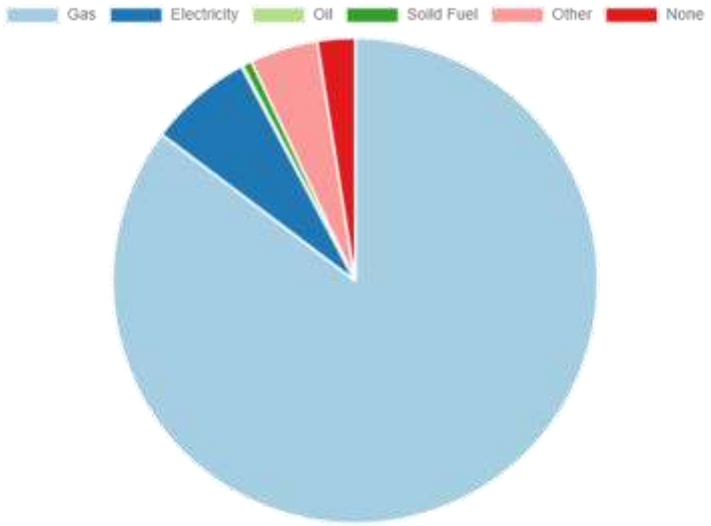

Figure 4.17: Breakdown of the type of heating system recorded in the 2011 Census for houses in Stoke-on-Trent (Source: PBCC, 2021).

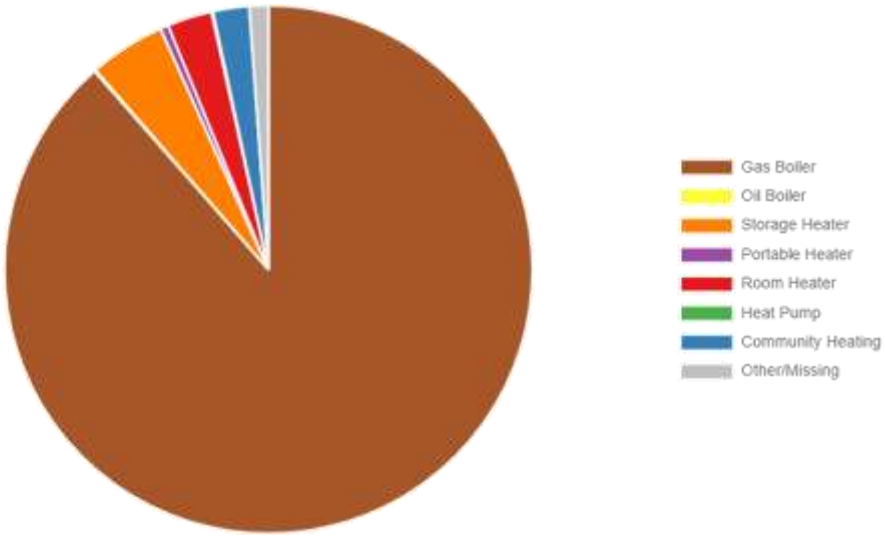

Figure 4.18: Breakdown of the type of heating system recorded in Energy Performance Certificates for houses in Stoke-on-Trent from 2008 to 2020 (Source: PBCC, 2021).

4.6.35 As the above two Figures show, most homes have gas central heating. This is often (but not always) with a condensing boiler which is able to collect the gas generated through the burning of fossil fuels and use it to heat water entering the system. Condensing boilers save money and reduce carbon emissions in the process.

4.6.36 A conventional boiler has an efficiency rating of 75 %, whereas a condensing boiler that is properly installed and maintained can have higher efficiencies at 90 % or above. The PBCC describes how an efficient heating system uses less energy than an

inefficient system to provide the same amount of heating. However, a very efficient heating system may not be low carbon and therefore, through the release of GHG emissions, may have a significant impact on climate change in the longer term. For example, gas is a fossil fuel and so a highly efficient condensing gas boiler which burns gas to provide heat is still a high carbon heating system.

4.6.37 Stoke-on-Trent is a densely urbanised area. Therefore, it is unlikely for homes in Stoke-on-Trent to be off the main grid network for gas and electricity supplies. This could be possible in very rural locations which tend to rely on high carbon heating systems such as oil boilers, Liquefied Petroleum Gas (LPG), electric storage heaters, or even coal fires. Biomass boilers - if installed, used, and maintained correctly – are often thought of as a lower carbon alternative to high carbon fossil fuel heating systems for householders living off the mains network or for large commercial properties. However, burning biomass releases more CO_2 per unit of energy than coal or gas and is therefore no longer a preferable low carbon technology in the global transition to Net Zero emissions.

4.6.38 According to the CCC, the UK needs to replace all reliance on high carbon heating systems as soon as possible, moving towards low carbon and renewable heating systems such as air, ground, or water source heat pumps. The recent funding pledge should be considered in detail in terms of how households and businesses in Stoke-on-Trent can maximise the opportunity for such technology.

Emissions from Energy Use

4.6.39 Total annual energy emissions relating to both electricity and gas usage for Stoke-on-Trent are shown in Figure 4.19.

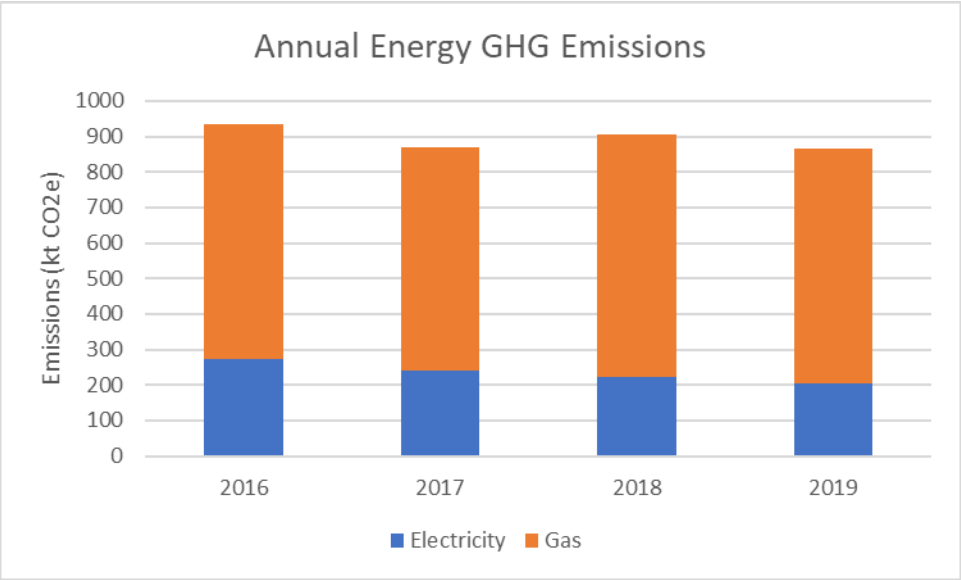

Figure 4.19: Summary of annual energy CO_2e emissions for Stoke-on-Trent (Source: UK local authority and regional carbon dioxide emissions national statistics: 2005-2019, BEIS/DEFRA).

4.6.40 Energy emissions accounted for 69 % of all emissions in Stoke-on-Trent in 2019 - electricity accounted for 16 % of total emissions and gas 52 %, with the remaining 1 % from 'other' fuels. Transitioning from gas combustion to electricity where possible will result in lower emissions with the decarbonising national grid.

4.6.41 According to the PBCC, Heating Controls help save energy by turning off the heating when it is not needed, such as when the optimum temperature has been reached within the building. Common types of heating control include thermostats, timers, and Thermostatic Radiator Valves (TRVs). Upgrading heating controls can be a low-cost and effective way to achieve a small reduction in overall energy use. All new builds should be fitted out with the latest and most efficient systems.

4.6.42 Another effective and low-cost way to achieve reductions in emissions is through a wastewater heat recovery system (WWHR). A WWHR system extracts heat from wastewater (typically from showers or sinks) and uses this to warm incoming mains water, thereby reducing heating demands. Cold mains water is passed around a copper hot water waste pipe to exchange heat before continuing 'pre heated' to the boiler. This technology is relatively simple, as there are no electrical components and requires minimal maintenance. Despite its simplicity, it may result in an overall emissions reduction of approximately 5 % as a result of the reduced heating demand and should be considered for all new buildings.

4.6.43 Micro Combined Heat and Power (mCHP) systems are now emerging on the market, which is a technology that generates heat and electricity simultaneously from the same energy source. Low carbon and renewable forms of mCHP should also be considered where feasible to reduce energy demand in individual homes or buildings.

4.7 Renewable Energy Generation

Existing Grid Network

4.7.1 Western Power Distribution (WPD) are the Distribution Network Operator (DNO) responsible for maintaining the electricity network infrastructure for Stoke-on-Trent. The area currently has four primary substations and two bulk substations. As indicated in Figure 4.20, the substation located at Boothen is nearing full capacity (red status) and any connections will likely need significant grid reinforcement. Likewise, the substation located at Whitfield has limited capacity (amber status) and connections may also require substantial grid reinforcement.

Figure 4.20: Location of Substations in Stoke-on-Trent and Network Capacity Status (Source: WPD, 2021)

Installed Capacity from Renewable Technologies

4.7.2 Stoke-on-Trent currently has installed capacity from solar photovoltaics (PV), wind power, and micro combined heat and power (mCHP).

4.7.3 The Feed-in Tariffs (FIT) scheme was a government programme which was introduced in 2010 and closed to new applicants in 2019. It was designed to promote the uptake of renewable and low-carbon electricity generation technologies. The scheme is overseen by the Office of Gas and Electricity Markets (OFGEM), the independent national regulatory authority for energy in the UK.

4.7.4 OFGEM hold a FiT database and publish annual reports for domestic and commercial renewable installations across the UK. The 2021 data[72] shows that that total installed capacity for these renewable technologies in Stoke-on-Trent is currently 6964 kilowatts (kW): installed capacity from solar PV is 6,947 kW, 15 kW for wind, and 1.99 kW for mCHP.

Solar Photovoltaics – Existing Installed Capacity

4.7.5 Solar PV technology collects and converts solar radiation directly into electricity. The use of PV arrays can displace the requirements for grid electric and can be used for lighting, ventilation systems, EV charging and other electrical appliances. There are numerous solar PV panels available in a range of sizes and efficiencies.

4.7.6 Figure 4.21 uses data extracted from the 2021 FiT installation report and shows how the solar PV installed capacity for Stoke-on-Trent is the highest in Staffordshire.

[72] OFGEM (2021). 'Feed-in Tariff Installation Report (01 April 2010 - 31 March 2021) - Part 1.' OFGEM, London.

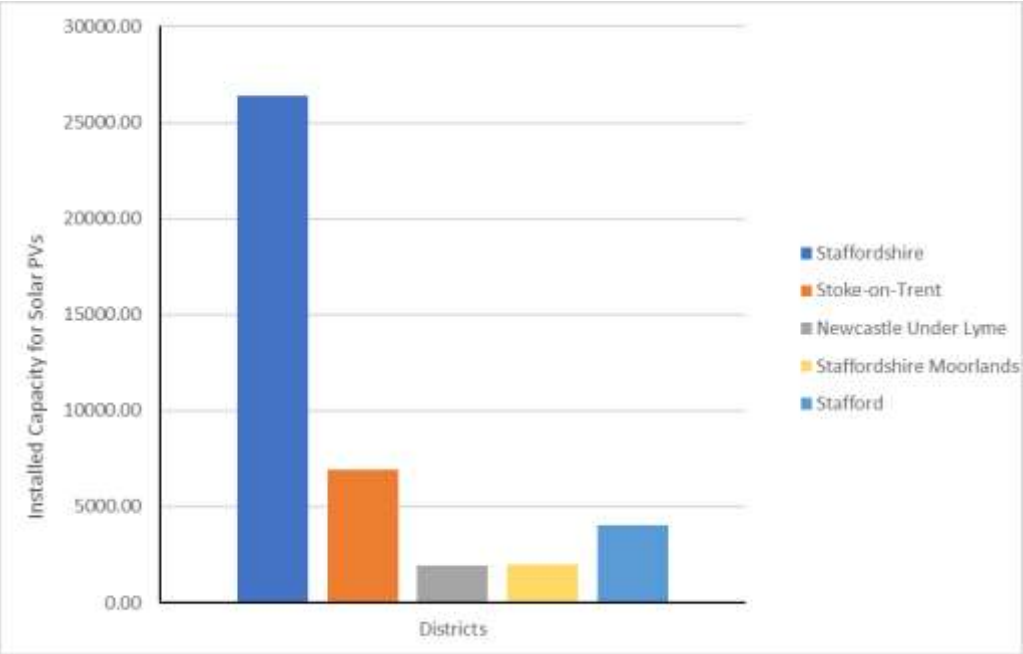

Figure 4.21: Comparison of current installed capacity from solar PV, showing how Stoke-on-Trent compares to surrounding administrative areas in Staffordshire (Data extracted from OFGEM FiT installation report 2021).

4.7.7 Stoke-on-Trent City Council's Community Energy Scheme offers the people from Stoke-on-Trent affordable, renewable electricity. To date, the scheme has installed over 4,670 council-owned properties with solar PV arrays and provided free energy efficient light-emitting diode (LED) light bulbs to local residents.

4.7.8 Over the period of the scheme's operation to date, the saving achieved provide a blended average of approximately £230 annually per customer. This suggests the Community Energy Scheme has provided circa £3 million customer savings to date. Savings of carbon are dependent on customer uptake, energy production, and grid carbon factor. The total estimated carbon savings to date are 12,000 tCO_2e (2,900 tonnes in 2018/9, 4,500 tonnes in 2019/20, and 4,500-5,250 tonnes in 2020/1). The scheme reports to save 3,802 tCO_2e every year, which is the equivalent of over 11,000 trees[73].

[73] Stoke-on-Trent City Council, Housing and Customer Services Division (2020). 'Home Energy Conservation Act Report 2019'. Stoke-on-Trent.

Energy from Waste

4.7.9 In addition to the above installed capacity from renewable technologies, Stoke-on-Trent currently has one operational Waste Incinerator Plant. This provides energy from waste (EfW). The EfW plant is fitted with two specialist boilers, each one is capable of burning up to 12.5 tonnes of mixed municipal waste and producing up to 36 tonnes of steam per hour which is converted to electricity. This EfW plant has been operational since 2010 for generating electricity and has an installed capacity of 14.2 to 15 Megawatts (MW). The plant is contracted until 2025. It is not currently CHP enabled, but the Council are working on the replacement of the plant by a CHP facility which will be carbon capture ready and will connect to the District Heating Network (DHN).

4.7.10 According to the UK Government[74], energy from residual waste is a partially renewable energy source, sometimes referred to as a low carbon energy source. However, changes in waste composition could drive EfW impacts above those of a traditional landfill, leading to increases in emissions from which will adversely impact on climate change. A standard approach for comparing the climate change impacts of different energy generation technologies is to refer to carbon intensity – this is the amount of carbon by weight emitted per unit of energy consumed (CO_2/energy). Lower impact (greener) electricity sources have a lower carbon intensity.

4.7.11 Results from a recent technical report by Zero Waste Scotland[75] show that the carbon intensity of EfW plants is twice as high as the national grid average. This is why there is debate about referring to EfW as a low carbon technology in the UK. In the Sixth Carbon Budget for UK emissions[76], the CCC stress that rising emissions from EfW need to be carefully managed and carbon capture and storage utilised to limit any adverse impacts on climate change.

[74] HM Government. Department for Environment, Food, and Rural Affairs (DEFRA) (2014) 'Energy from waste: A guide to the debate.' Crown Copyright, London.
[75] Zero Waste Scotland (2020) 'The climate change impacts of burning municipal waste in Scotland'. Scotland.
[76] Committee on Climate Change (CCC) (2020) 'The Sixth Carbon Budget: Waste' CCC, London.

Potential for Renewable Energy Generation

4.7.12 As the UK moves towards net zero emissions it must ensure that the infrastructure needed for decarbonisation of the national grid is in place, to enable effective adaptation and mitigation for climate change. Large-scale infrastructure projects, including renewable energy generation projects above 50 MW, are classed as Nationally Significant Infrastructure Projects (NSIP). Decisions regarding applications for NSIP are not determined by the Local Planning Authority, as these are required to be examined by the Planning Inspectorate. Opportunities for small to medium scale renewable energy projects (i.e., outputs below 50 MW) can be explored for Stoke-on-Trent which will contribute to decarbonisation across the UK.

4.7.13 Using GIS to model the city and constraints to renewable energy development, sites were identified as being potentially feasible for future development. Solar PV, battery storage, wind energy, and hydropower generation were investigated.

Solar Photovoltaics – Potential New Installation

4.7.14 Solar PV technology is commercially proven and large multi-megawatt generating plants (Solar Farms) have been operating since the 1990s. Capital costs associated with PV are relatively high but are continually falling. The technology is well-known and reliable as a source of renewable energy generation.

4.7.15 Large plants are based either on fixed solar panels inclined at a latitude related angle, or tracker systems that move either horizontally, vertically or both ways in order to maximise the sunlight received. Fixed systems are more widely available, easier to maintain, have a limited environmental impact and can easily be removed from the site. Commercial/non-domestic and domestic roof mounted PV can be deployed parallel to the roof surface on pitched roofs, or at an angle on flat roofs, to improve the solar energy captured. Ground-mounted PV arrays, and innovations such as solar canopies, can also be deployed at suitable locations.

4.7.16 Solar thermal devices use solar radiation to generate hot water but generally compete with solar PV for roof space. The Renewable Energy Hub UK[77] states that an average UK household requires between 3000 kWh-5000 kWh worth of water heating annually. Solar thermal systems are not able to produce all of a property's

[77] The Renewable Energy Hub UK "Is Solar Thermal Worth The Investment?". Available at: https://www.renewableenergyhub.co.uk/main/solar-thermal-information/is-solar-thermal-worth-the-investment/ [Accessed 30/03/2021].

hot water demand but may provide between 40 % and 60 %. Solar PV installations can be fitted with a diverter system so that zero carbon hot water can be provided to the premises as well as electricity.

4.7.17 High-level constraints mapping indicates that ground-mounted solar PV development may be feasible at several locations throughout the city, with approximately 3.6 km^2 of land providing potentially suitable sites as indicated in the map in Appendix A.

4.7.18 If a percentage of potentially viable land was developed for large-scale solar plants, subject to feasibility of grid connection and other planning constraints, the additional installed capacity in Megawatt peak (MWp) for the city could be as follows:

- 10 % has the potential to provide approximately 18 MWp which would offset around 37 kt CO_2e per year;
- 20 % has the potential to provide approximately 36 MWp which would offset around 74 kt CO_2e per year;
- 30 % has the potential to provide approximately 54 MWp which would offset around 110 kt CO_2e per year; and
- 50 % has the potential to provide approximately 90 MWp which would offset around 184 kt CO_2e per year[78].

4.7.19 Roof-mounted solar PV arrays are also a potential option, as although it is small-scale, there are fewer constraints. This may be a preferred option for both domestic and commercial developments, and may also be practical for some retrofit projects.

4.7.20 The Fame database shows that there are 703 companies in Stoke-on-Trent with 20 or more employees, including education establishments. If a percentage of these companies had buildings which were suitable for roof-top solar PV development, with on average no existing installations and each with 10 kWp capacity, the total additional installed capacity would be as follows:

- 10 % has the potential to provide approximately 0.7 MWp which would offset around 1 kt CO_2e per year;
- 20 % has the potential to provide approximately 1.4 MWp which would offset around 2 kt CO_2e per year;

[78] Based on 2 hectares of land per MW of solar power. Available at: https://www.nfuonline.com/assets/21480

- 30 % has the potential to provide approximately 2.1 MWp which would offset around 3 kt CO_2e per year; and
- 50 % has the potential to provide approximately 3.5 MWp which would offset around 6 kt CO_2e per year.

4.7.21 It is important to note that these are very high-level estimations only for the potential additional solar PV capacity within the administrative area of Stoke-on-Trent and areas have not been fully assessed for feasibility. The results of high-level GIS constraints mapping indicating the potential location of areas that may be suitable to support this type of renewable energy technology - subject to full viability assessments, landowner permissions, and the usual planning approvals process - is contained in Appendix A.

Battery Storage

4.7.22 National Grid ESO[79] indicates that energy storage could help manage constraints on the electricity transmission network between 2022 to 2030. As the electricity system decarbonises, constraints costs are expected to rise significantly between now and 2030. This is because renewable generation connects faster than new transmission capacity can be built. After 2030, planned increases in transmission network capacity are expected to significantly reduce the level of constraints.

4.7.23 According to Wadia et al. (2011)[80], batteries have great promise for facilitating the grid integration of renewable energy and powering electric vehicles. High costs of implementation currently remain a critical barrier to the widespread scale-up of battery energy storage. Enabling facilities within Stoke-on-Trent for local battery storage to capture renewable energy generation will help the city to be more resilient to future climate.

4.7.24 The national planning legislation for NSIPs was relaxed in 2020, allowing for battery storage projects above 50 MW in England (and 350 MW in Wales) to proceed without approval through the national planning regime. Development proposals that include battery storage would need to be discussed on a case by case basis with the

[79] https://www.nationalgrideso.com/news/how-could-energy-storage-help-manage-constraints [Accessed August 2021]

[80] Wadia, Cyrus & Albertus, Paul & Srinivasan, Venkat. (2011). 'Resource constraints on the battery energy storage potential for grid and transportation applications.' Journal of Power Sources. 196. 1593-1598. 10.1016/j.jpowsour.2010.08.056.

Distribution Network Operator (DNO) to ensure viability of connection to the national grid, or the creation of local micro grid networks.

Wind Turbines

4.7.25 Wind generation in the UK has increased over ten-fold since 2007. Wind turbines harness the power of the wind and use it to generate electricity. The amount of electricity generated depends on a number of factors including the wind speed, the rotor diameter and the generator efficiency. The power generated is proportional to the cube of the wind speed and the square of the rotor diameter. It is therefore advantageous to site turbines in locations where they can receive high wind speeds and to maximise the size of the rotor to capture the most power from the wind. Wind farms are carefully planned to make sure they are located in areas with a reliable amount of wind all year round, which tends to be on the summit of a hilltop with lots of open space around or in coastal locations.

4.7.26 High-level constraints mapping indicates that medium to large-scale wind development is not possible or very unlikely within the administrative area of Stoke-on-Trent. This is due to the urbanicity and topography of the region preventing optimum wind conditions. Wind turbines require a constant minimum wind speed of 5 m/s (metres per second) at 45 metres above ground-level, and an offset from dwellings so that background noise does not exceed acceptable levels[81]. Due to the density of existing buildings in the city, no suitable areas outside of a 300 metres buffer zone from the nearest dwellings were found. Therefore, medium-large wind turbines are not considered a feasible form of onsite low carbon power generation at this location.

4.7.27 However, several small wind turbines are currently in the planning system and will likely add capacity for renewable generation of a few hundred kilowatts. Small-scale standalone wind turbines intended for connection to the national grid typically require minimum wind speeds of 4 m/s to effectively generate electrical power. Subject to localised feasibility studies and planning approval, small-scale wind renewable energy technology could be considered for commercial properties in the city.

[81] Centre for Sustainable Energy (2015) 'Guidance note: How to identify suitable areas for onshore wind development in your neighbourhood plan.'

Hydropower

4.7.28 To create hydroelectric power, generators are driven by turbines that convert the potential energy of falling or fast-flowing water into mechanical energy which is then converted into electricity. A suitable body of water is required that has suitable flow rates to produce a significant amount of energy.

4.7.29 The proportion of electricity generated by hydropower over the past 30 years has remained at around 2 % of total power generation in UK. According to a recent report by the International Hydropower Association (IHA)[82], the UK has a total hydropower installed capacity of over 4,700 MW. This includes over 2,800 MW of pumped storage. The majority of installed capacity is currently located in the wet and mountainous regions of Wales and northwest Scotland.

4.7.30 Hydropower supports the development of the UK's variable renewable sector by providing peaking, balancing and other grid services. The IHA describes how small-scale hydropower projects, including community-led projects, are being developed across the UK. Innovations in small hydropower turbines have allowed for some hydropower to be applied at sites with very low heads and low flows. This is the case in the neighbouring areas of Stafford and Staffordshire Moorlands. Staffordshire Moorlands has two FiT registered domestic hydropower facilities with a combined installed capacity of 14.75 MW, while Stafford has one with installed capacity of only 2.76 MW[83].

4.7.31 Despite these innovations, future development of hydropower in Stoke-on-Trent are extremely unlikely. High-level constraints mapping indicates that there are no suitable bodies of water in the region and the local topography and urbanicity of Stoke-on-Trent do not lend themselves to effective use of this type of technology.

4.8 District Heating Networks

4.8.1 As defined by the UK Government, a District Heating Network (DHN) supplies heat from a central source to consumers, via a network of underground pipes carrying hot water. Heat networks can cover a large area or even an entire city, or be fairly local supplying a small cluster of buildings. This avoids the need for individual boilers or electric heaters in every building. Heat networks form an important part of the UK

[82] International Hydropower Association (2021). '2021 Hydropower Status Report Sector trends and insights.' IHA, London.
[83] OFGEM (2021). 'Feed-in Tariff Installation Report (01 April 2010 - 31 March 2021) - Part 1.' OFGEM, London.

Government's plan to reduce carbon and cut heating bills for both domestic and commercial customers. Currently, just over 2% of buildings heat in the UK is served by DHNs. The CCC estimates that around 18% of UK heat will need to come from heat networks by 2050 if the UK is to meet its carbon targets cost effectively[84].

4.8.2 Gas emissions account for about half of total emissions in Stoke-on-Trent, mostly for space heating. The Stoke-on-Trent and Staffordshire City Deal was published in 2014 outlining plans for a deep geothermal DHN as a low carbon and low-cost heating system. The first cluster of the city wide network is being constructed around the University Quarter with a heat demand of 10.5 MW. This first cluster will be initially powered by gas CHP before connecting to low carbon heat source(s) when the network grows and reaches location of those sources.

4.8.3 Heat will be generated by geothermal wells located in Etruria Valley. The DHN will distribute heat generated through an 18 km network of insulated pipes around four clusters – University Quarter, Stoke Town, Festival Park, and Hanley (see map in Figure 4.22). The first phase began in 2017 with 2 km of pipework installed underground between Leek Road and Boughey Road. The second phase started in 2019 with 1.4 km of pipework being installed under College Road in Shelton. The DHN scheme was originally due to be completed in 2019 with full loads estimated to be connected by the end of 2020[85] [86]. However, the COVID-19 pandemic has delayed the building of the DHN infrastructure. A revised plan for drilling and testing to commence in Q2/Q3 2021, with the DHN installation operational by March 2022, has also been delayed.

4.8.4 The Council is working on a new Hanford Energy Recovery Facility (ERF) that will connect to the DHN. Eventually, an estimated 45 GWh heat will be supplied annually to 110 properties, mainly public owned buildings (and some large residential blocks). Anchor load customers are Staffordshire University campus, City Council-owned buildings, and various other public sector buildings representing 60% of the total heat demand. There are no on-site carbon emissions resulting from the DHN and up to 11,500 tonnes of CO_2 will be saved per year. Heating costs for properties connected to the DHN will also be lowered by up to 10 %[87].

[84] Department for Business, Energy & Industrial Strategy (2018) 'What is a heat network?'
[85] Stoke-on-Trent City Council 'The Housing Revenue Account – Renewable Energy Strategy 2017-2022.'
[86] Department for Business, Energy & Industrial Strategy (2020) 'HEAT NETWORKS: 2020 Q1 PIPELINE'.
[87] Encraft Ltd (2018). 'The Stoke-on-Trent and Staffordshire Local Enterprise Partnership (LEP) Energy Strategy'.

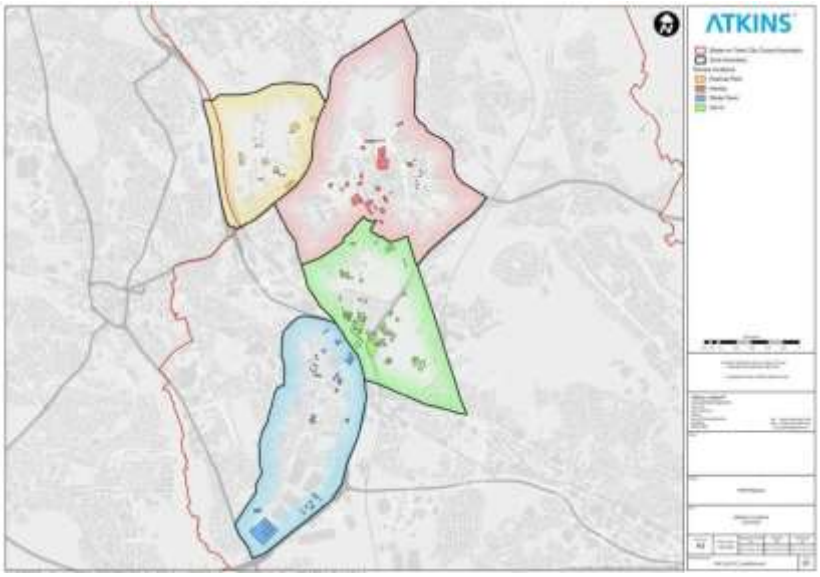

Figure 4.22: Map showing the four clusters for Stoke-on-Trent's District Heating Network (Source: Stoke-on-Trent City Council)

Figure 4.23: Map showing District Heating Network route for pipework installations (Source: Stoke-on-Trent City Council)

4.8.5 District heating networks can be expanded across the city, and there are opportunities for renewable heat from mine water, heat recovery from industry and sewer network. This resource could potentially be used to provide heat elsewhere in the city as an alternative low carbon heating source.

4.8.6 The Stoke-on-Trent and Staffordshire Local Enterprise Partnership (LEP) Energy Strategy[88] describes how local planning policy is crucial to encouraging the uptake of renewable technologies, stating that new developments should have an obligation to consider connection to local DHN if within a suitable distance (and providing it is viable to do so). The current Stoke-on-Trent City Council's Local Development Framework SPD for Sustainability and Climate Change provides an existing policy regarding this.

4.8.7 There are two specific policies for Stoke-on-Trent which aim to drive adoption of DHN in the city in the long term. These are currently under consultation and are:

- Heat Network Zoning (BEIS) – Consultation started in October 2021, and the timeframe for implementation of this national policy is scheduled for 2025.
- Future Homes Standard and Future Buildings Standard (MHCLG) –The 2021 interim uplift to Part L and Part F of the Building Regulation standards will be implemented from June 2022, with full introduction of the higher Building Regulation standards in 2025.

4.9 Mitigation

Stoke-on-Trent City Council have already begun to adopt mitigation measures to reduce emissions from Council-controlled sources. The most recent actions are:

Public Buildings - Civic Centre

- Installation of 198 solar PV panels on the Civic Centre roof.
- Installation of energy efficient light-emitting diode (LED) lighting throughout the Civic Centre public building saving £198,000 p.a. and 362 tCO_2 per year.
- Commissioning of a micro Combined Heat and Power (mCHP) for the Civic Centre, saving £193,000 p.a. on energy costs and 1,170 tCO_2 per year in natural gas emissions.

[88] Encraft Ltd (2018) 'The Stoke-on-Trent and Staffordshire Local Enterprise Partnership (LEP) Energy Strategy'.

- Tuning up of Civic Centre heating system, saving 6.2% gas consumption and improving level of comfort in the building.

Roof-mounted Solar PV on Social Housing

- 5,364 houses have been fitted with roof-mounted solar PV, saving an average £230 annually per household, equating to saving a total of 5,250-6,000 tCO_2 emissions annually.

Street Lighting and Signal LED Replacement Programme

- Replacement of all street lighting with LED heads and upgrading of columns nearing completion in 2021. And all traffic lights and illuminated signs replaced with LED, giving combined savings of up to 5,340 tCO_2 per year.

Public Sector Decarbonisation Scheme

- Upgrade of the Building and Energy Management Systems (BEMS) and controls for 11 public buildings.
- Commissioning of two new microchip at Fenton Manor and Dimension leisure centres, alongside lighting system modification and transition to LED.
- Installation of Air Source Heat Pumps at Fenton Manor.
- Planned Solar PV installation across corporate estate (1 MW to be initially installed, 16MW roof potential identified, plus 5 MW ground-mount option under a separate scheme to be agreed by the Council).
- Mechanical Energy Efficiency Upgrades.

4.9.1 All these current works in the pipeline to decarbonise Stoke-on-Trent City Council operations are forecasted to save up to 14,000 tCO_2 per year. This equates to around 35% of the Council's emissions and 0.11% of the city's overall emissions.

5 CLIMATE CHANGE SUMMARY

5.1.1 This section provides a summary of past and future climate change in Stoke-on-Trent. It highlights the potential impact of climate changes that are expected to result in both opportunities and risks in the region, and how this compares to the rest of the UK.

5.2 Baseline Climate Conditions

5.2.1 The most frequently used climate classification map is that of Köppen-Geiger[89]. The re-analysed Köppen-Geiger map from 2017[90] provides a higher resolution and is representative for the 25-year period 1986-2010. Figure 5.1 shows how the majority of the UK, including England, is classified under Köppen-Geiger as having a 'Cfb' climate.

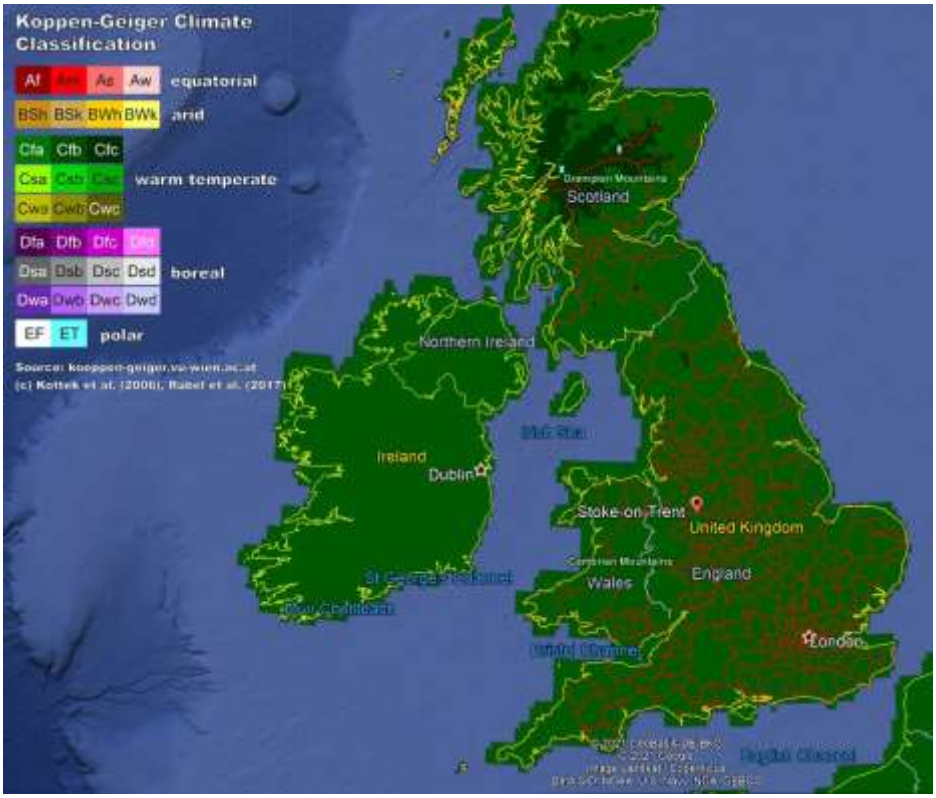

Figure 5.1: The Köppen-Geiger climate classification map shows England as having a warm temperate oceanic climate, Cfb (Source: http://koeppen-geiger.vu-wien.ac.at/)

[89] Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: World Map of the Köppen-Geiger climate classification updated. Meteorol. Z., 15, 259-263. DOI: 10.1127/0941-2948/2006/0130.
[90] Rubel, F., K. Brugger, K. Haslinger, and I. Auer, 2017: The climate of the European Alps: Shift of very high resolution Köppen-Geiger climate zones 1800-2100. Meteorol. Z., 26, 115-125.

5.2.2 A Cfb climate is more commonly known as a temperate oceanic climate. Temperate oceanic climates are typically mid-latitude climates with warm summers and mild winters. The average temperature in all months will be below 22 °C and there is not an identifiable dry/wet season (i.e., precipitation rates are similar year-round).

5.2.3 The city of Stoke-on-Trent is located on the upper valley of the River Trent at the south-west foothills of the Pennines, with the Peak District to the north-east. Stoke-on-Trent ranges from 96 to 250 metres (315 to 820 feet) above sea level. The average annual rainfall in the area is around 820 millimetres (mm) and the average annual temperature is 9.4 °C[91].

5.3 Historic Weather Events and Impacts

5.3.1 The UK, including the Staffordshire area, has a history of adverse weather events. An increase in mean temperature intensifies adverse weather and increases the frequency of extreme events. Details of historic adverse weather events between 1990-2000 were obtained from weather records held by the UK Meteorological Office (Met Office)[92]. A comparison of UK events to localised Stoke-on-Trent events is provided in Appendix B. Figure 5.2 provides a summary of these historic adverse weather events in Stoke-on-Trent between 1990 and 2000.

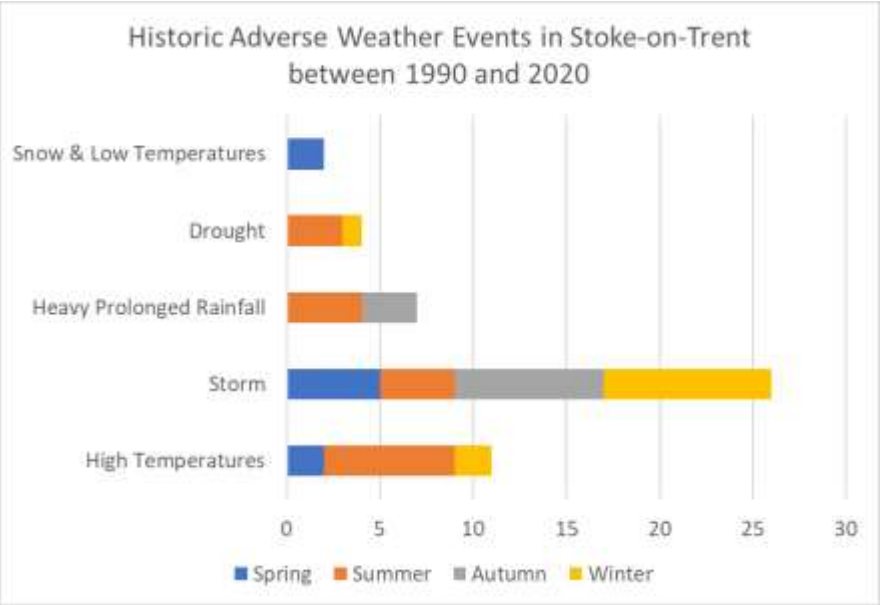

Figure 5.2: Summary of historic adverse weather events in Stoke-on-Trent between 1990 and 2000 (Data obtained from Met Office records for UK).

[91] https://en.climate-data.org/europe/united-kingdom/england/stoke-on-trent-295/ [Accessed August 2021]
[92] https://www.metoffice.gov.uk/weather/learn-about/past-uk-weather-events [Accessed August 2021]

Historic Adverse Temperatures

5.3.2 Figure 5.3 indicates that between 1990 and 2000, there were 21 instances of adverse temperatures in Stoke-on-Trent, of which 16 were associated with extreme heat. Maximum temperatures in summer 2013 were 38.5°C. The Met Office predict that summers as hot as this could happen every other year in the UK by the year 2050 as a result of climate change due to human activities.

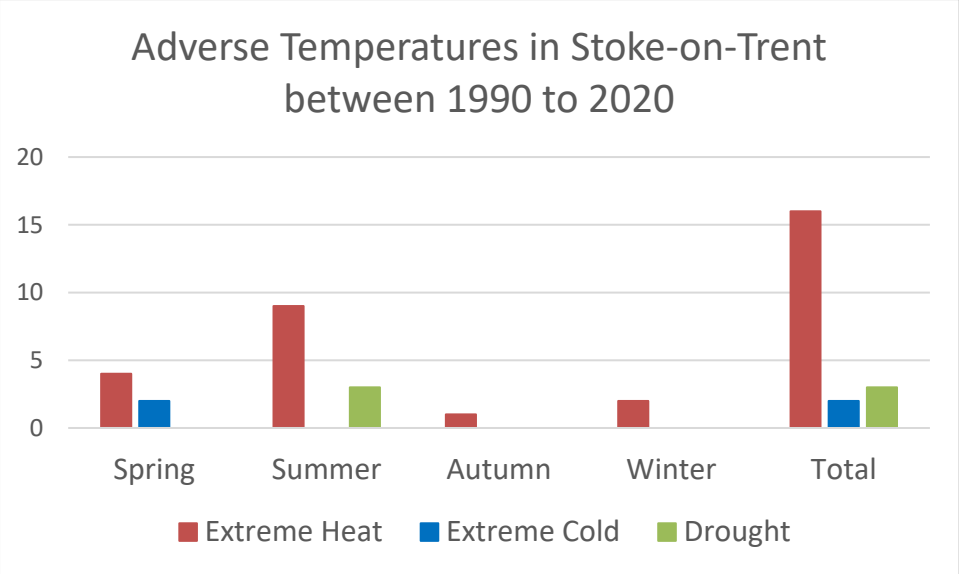

Figure 5.3: Adverse Temperatures in Stoke-on-Trent between 1990 to 2020 (Data obtained from Met Office records for UK).

Historic Adverse Rainfall

5.3.3 Figure 5.4 indicates that between 1990 and 2000, there were 16 instances of adverse rainfall events in Stoke-on-Trent, of which 11 were above average. For example, October 2019 saw persistent wet weather with 65 mm of rainfall in 3 days - 79 % of average rainfall for entire month of October. This led to severe flash flooding occurring in parts of Stoke-on -Trent, impacting on health and livelihoods. Flash flooding from surface water is becoming more frequent in parts of Staffordshire, including Stoke-on-Trent, as was seen in 2020 and early 2021 following winter storm events. A period of intense heavy rainfall in the summer of 2021 also caused considerable disruption with 26 reported instances of flooding in the city.

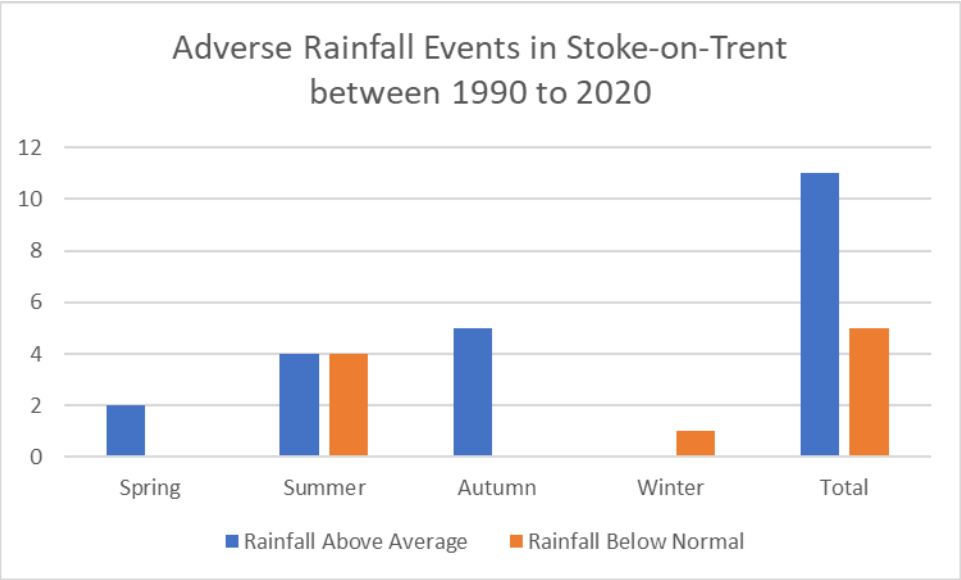

Figure 5.4: Adverse Rainfall Events in Stoke-on-Trent between 1990 to 2020 (Data obtained from Met Office records for UK).

Historic Storm Events

5.3.4 As shown in Figure 5.5, there were 25 instances of named storms in Stoke-on-Trent between 1990 and 2020 with maximum wind speeds varying between 30-66 knots. Storm systems are named when it has the potential to cause an amber or red adverse weather warning on the basis of impacts from the wind, rain, and snow.

5.3.5 Overall, according to the Met Office records, the period from mid-December 2013 to mid-February 2014 was the stormiest period of weather the UK has experienced for at least 20 years. However, it is difficult to attribute human induced climate change to any particular extreme weather event.

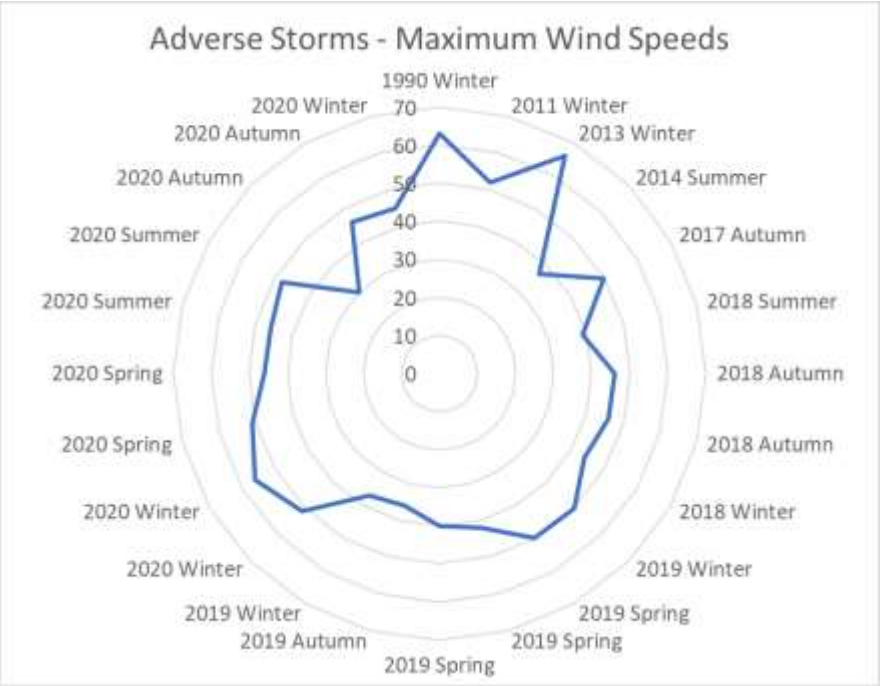

Figure 5.5: Maximum Wind Speeds during Storm events in Stoke-on-Trent between 1990 and 2020 (Data obtained from Met Office records for UK).

Summer Months

5.3.6 On average, the hottest summer day of the past 30 years in Stoke-on-Trent was 32.2°C. If global average temperatures increase by 2°C above pre-industrial levels, the hottest summer day in the future could be 34.6°C in this area. Under the worst-case emissions scenario, if global temperatures rise by 4°C, the maximum summer temperature on any given day could rise to 39.7°C. The Met Office state that summers as hot as 2003 could happen every other year in UK by the year 2050 as a result of climate change due to human activities.

5.3.7 On the wettest summer day of the past 30 years, 44 mm of rain fell in Stoke-on-Trent. At a 2°C rise in global temperatures above pre-industrial levels could see average summer rainfall increase to 48 mm. Under the worst-case emissions scenario, if global temperatures rise by 4°C, the maximum summer rainfall on any given day could rise to 57 mm. This is 28 % more rainfall than is currently experienced in the region which could increase the risk of flash flooding events is summer.

Winter Months

5.3.8 The warmest winter day of the past 30 years in Stoke-on-Trent was 17.4°C. If global average temperatures increase by 2°C above pre-industrial levels, the warmest

winter day in the future could be 17.6°C in this area. Under the worst-case emissions scenario, if global temperatures rise by 4°C, the maximum winter temperature on any given day could rise to 19.5°C. Warmer winters means wetter winters.

5.3.9 On the wettest winter day of the past 30 years, 35mm of rain fell in Stoke-on-Trent. At a 2°C rise in global temperatures above pre-industrial levels could see average winter rainfalls remaining at similar levels to that of now. Under the worst-case emissions scenario, if global temperatures rise by 4°C, the maximum winter rainfall on any given day could rise to 43mm. This is 23% more rainfall than is currently experienced in the region which could increase the risk of severe flooding in winter.

5.3.10 The Met Office describes how not every winter will necessarily be rainier than the one before, and not every summer will be exceptionally hot or dry, but both climate trends could potentially have big impacts on human interactions.

5.4 Future Climate Baseline

Global Climate Change Projections

5.4.1 Global probabilistic projections provide a wider sampling of uncertainty and are useful for considering the wider context of future changes in climate. Table 5.1 highlights the main projected global climate change issues.

Table 5.1: Projected Global Impacts of Climate Change

Climate Change Issue	Projected Global Impacts
Solar Radiation	Long term projected changes in surface solar radiation, as a result of global warming, would suggest a decrease in available solar power due to a decrease in downwelling shortwave radiation, likely linked to the increase of water vapour. This is considered to be anthropogenic strengthening of "natural" decadal variability in irradiance, known as global dimming and brightening, which is influenced by synoptic weather patterns, cloud variations and atmospheric aerosols.
Heat Waves	The Intergovernmental Panel on Climate Change (IPCC) predict that temperature extremes will increase more rapidly than global mean surface temperature, with the number of hot days projected to increase in most land regions. In the 1.5°C warming scenario heat waves in mid latitudes could warm by up to 3°C.
Extreme Rainfall and Flooding	IPCC and Met Office both suggest a general uncertainty in the projection of changes in heavy precipitation for the UK due to position in the transition zone between north and south Europe's contrasting projected changes. It is generally agreed the northern parts of the UK will experience overall increases of up to 10%, whilst southern areas may experience decreases of up to 5%. Overall, the UK is expected to see a general increase in precipitation trends up to the year 2100.
Rising Sea Levels	The most recent modelling indicates global sea level rise of 0.26-0.77m by 2100, under a 1.5°C warming scenario. Risk is amplified on small islands and in low lying coastal areas and deltas.
Storms and Winds	Atmospheric circulations have large variability across interannual through to decadal time scales, which makes forming projections with any reasonable confidence very difficult. There is more robust evidence in the Northern Hemisphere that since the 1970s there has been a general poleward shift of storm tracks and jet streams and near-surface terrestrial wind speeds have been declining by approximately 0.1-0.14 m s-1 per decade across land. Despite anemometers being used for decades to measure near surface wind speed, the data has rarely been used to analyse trends and lacks important instrumentation meta data. In general, confidence is low in wind speed projections due to large uncertainties across global data sets.
Cold Spells and Snow	It has been observed the spring snow cover has been continuing to decrease in extent in the Northern Hemisphere and that cold temperature extremes are projected to decrease along with the number of frost days

Regional Climate Change Projections

5.4.2 Climate change will have both direct (operational and performance-based) and indirect (securing of supplies and rising energy costs) impacts on residents and visitors to the city. The Climate Change Projections for the UK (UKCP18) are used to study the regional impacts of climate change. Regional and Local projections represent small scale climate changes through a narrower sampling of uncertainty and provide the detail needed to inform local decision-making regarding adaptation.

UK Climate Projections

5.4.3 The UKCP18 dataset provides future climate change projections for land and marine regions as well as observed climate data for the UK. Analysing time series plume data from UKCP18 provides an indication of climate projections for the regional 25 km grid that encompasses the city of Stoke-on-Trent and surrounding area.

5.4.4 Figure 5.6 to Figure 5.11 are based on the four Representative Concentration Pathways (RCP) and show how the climate in the region could change up to the year 2100, compared to a 1982-2000 baseline. The RCPs are used to analyse how different emission scenarios could affect climate projections. These range from RCP 2.6 where atmospheric emission concentrations are strongly reduced through to the worst-case scenario, RCP 8.5, where emission concentrations continue to rise unmitigated. Comparison against UK average under the same modelling conditions for RCP 6.0 are shown in Figures 5.7, 5.9, and 5.11.

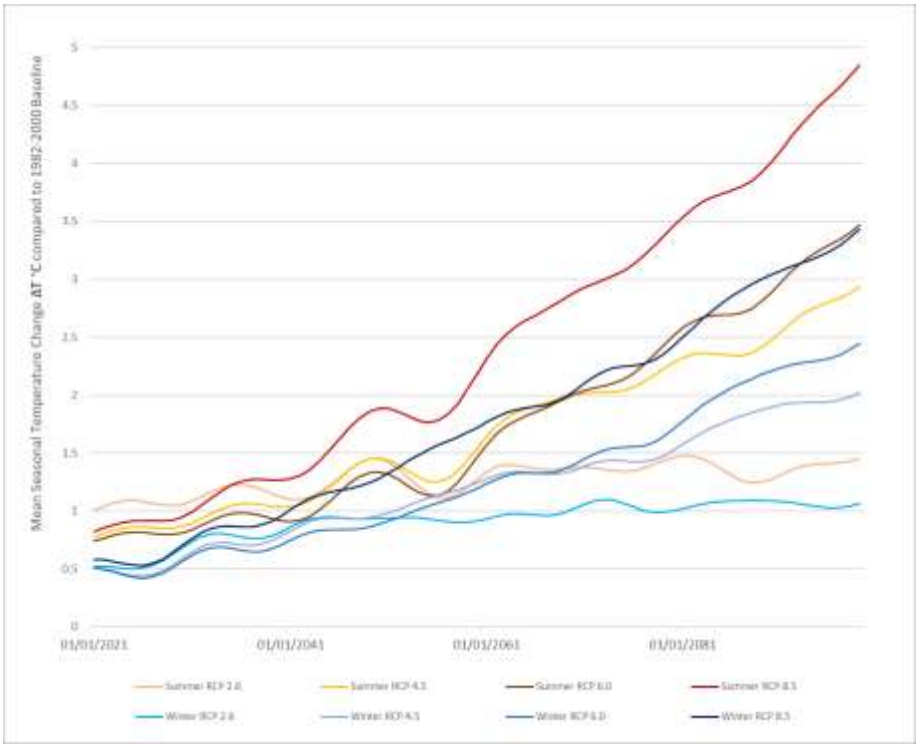

Figure 5.6: Projected changes in seasonal Mean Air Temperature across four RCP scenarios, from 2021-2099 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile) for a 25Km Grid around Stoke-on-Trent.

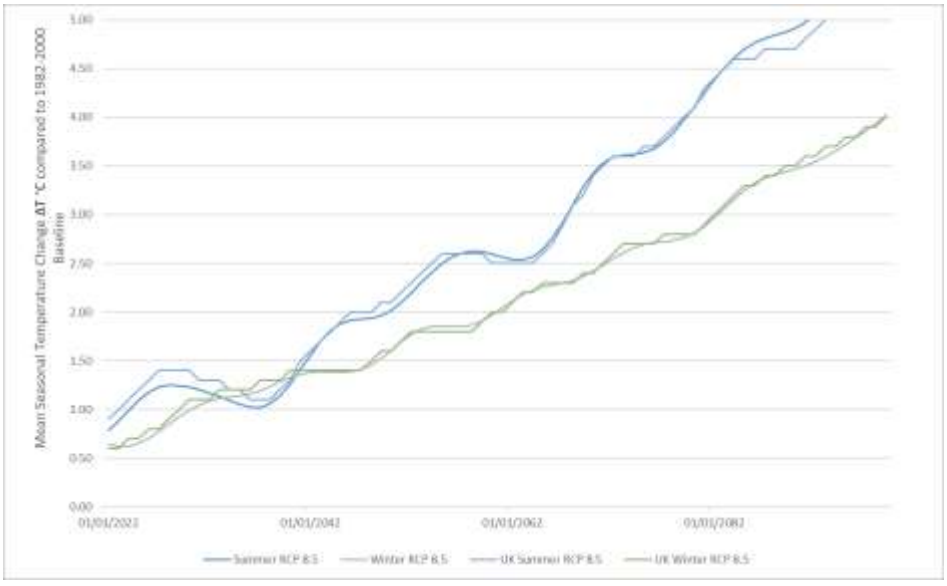

Figure 5.7: Projected changes in summer and winter mean air temperature for the RCP scenarios, from 2019-2100 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile). Comparison against UK average under the same modelling conditions.

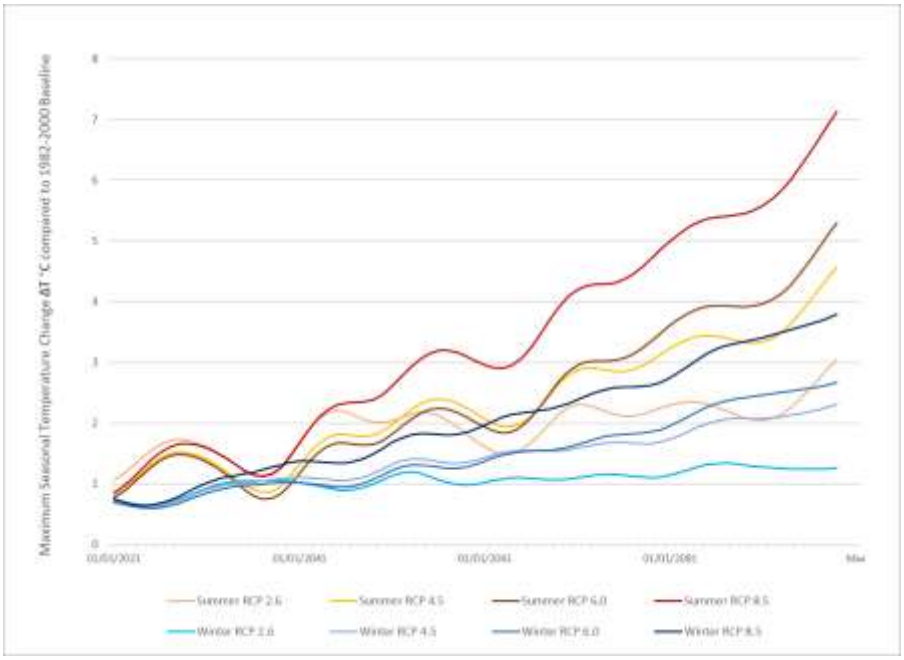

Figure 5.8: Projected changes in seasonal Maximum Air Temperature across four RCP scenarios, from 2021-2099 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile) for a 25Km Grid around Stoke-on-Trent.

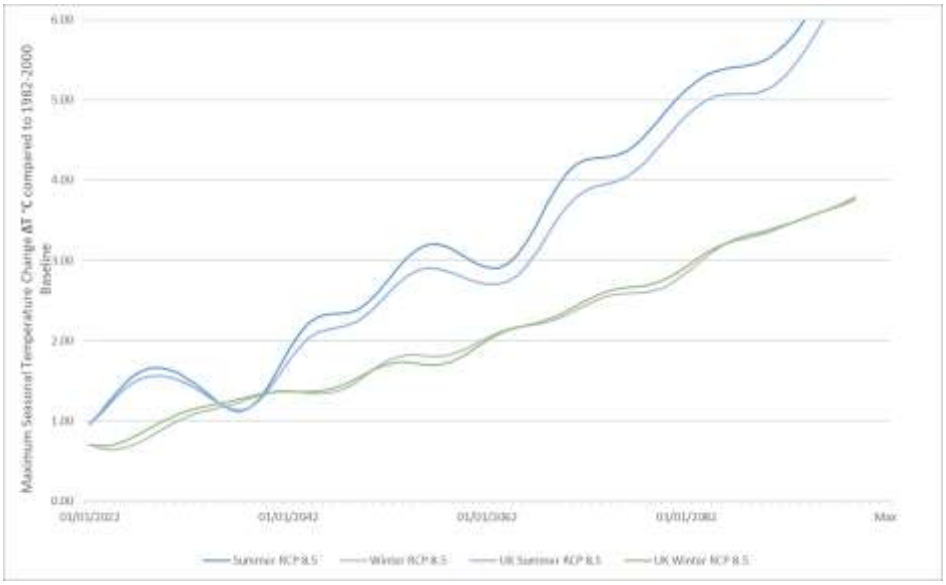

Figure 5.9: Projected changes in summer and winter maximum air temperature for the RCP scenarios, from 2019-2100 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile). Comparison against UK average under the same modelling conditions.

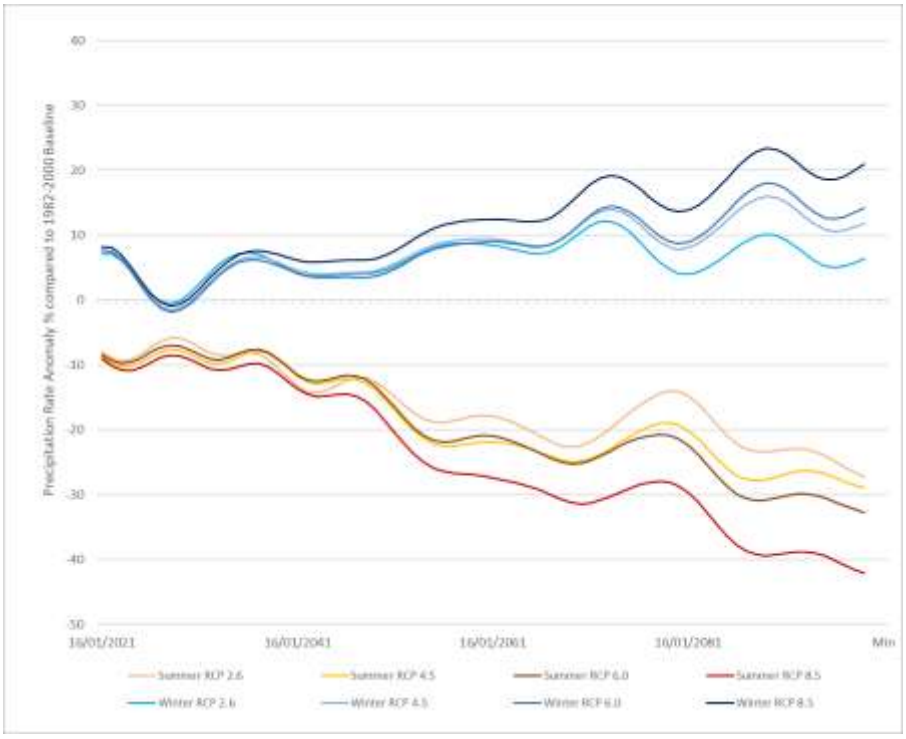

Figure 5.10: Projected changes in seasonal Precipitation across four RCP scenarios, from 2021-2099 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile) for a 25Km Grid around Stoke-on-Trent.

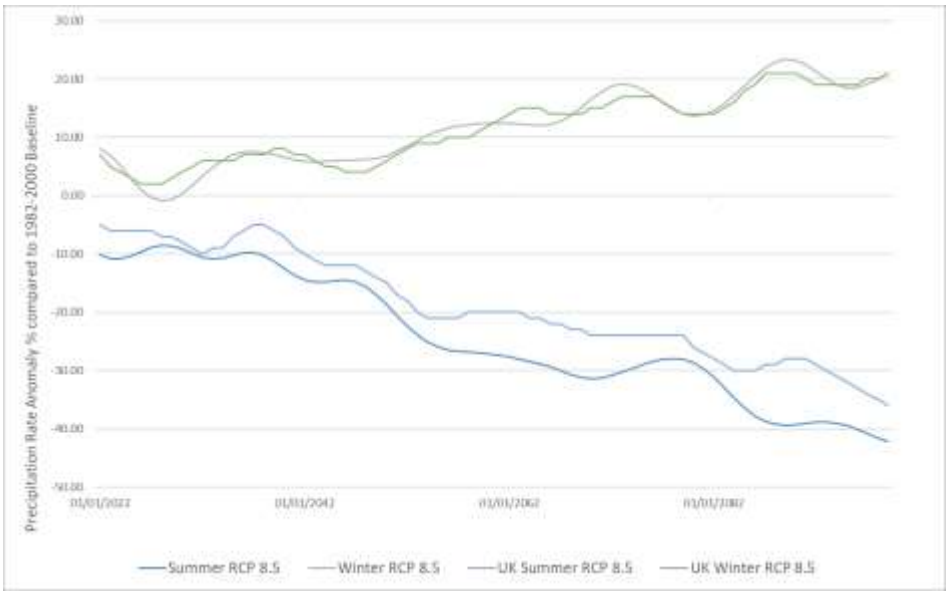

Figure 5.11: Seasonal average precipitation rate anomaly (%) for 2019-2100 compared to the 1981-2000 baseline for the RCP scenarios using probabilistic projections (50th percentile). Comparison against UK average under the same modelling conditions.

5.4.5 All areas of the UK are projected to experience warming, which will be greater in the summer than in the winter. By 2050, the chance of summers being hotter than in 2018 is around 50 %. Not every summer will be hotter than the last, but heatwaves are likely to be longer and happen more often. Both summer and winter temperature records are expected to be regularly broken in the coming years. Between 2061 and 2080, an average temperature increases of 3°C to 6°C is predicted for the West Midlands area across all emissions scenarios.

5.4.6 Rainfall measurements fluctuate from year to year, making projections challenging but assumptions are possible based on previous trends. Summer rainfall is expected to occur from short-lived, high intensity showers and decrease overall, whereas winter precipitation is expected to increase. By 2070, extreme hourly rainfall intensity from a typically biennial event will increase by 25 %.

5.4.7 Extreme weather is predicted to become more frequent and intense. A summary of a range of projected changes to climate variables can be used to build-up a holistic view of future climate and assess potential impacts to determine a future climate baseline, using RCP 8.5 as a conservative approach. According to UKCP18, relative probabilities for specific outcomes are typically much higher near the 50 % cumulative probability level (median) of the distribution, than for outcomes lying either below the 10 % cumulative probability level or above the 90 % cumulative probability level.

5.4.8 The worst-case scenario presented in Figure 5.12 indicates an increase in mean temperature in both summer and winter, which corresponds with seasonal precipitation increasing in winter and decreasing in summer. This highlights the need for all new development to be able to deal with the potential risks for both increased flooding and increased heatwaves.

Quantitative Summary of the Future Baseline for Key Climatic Variables in Stoke-on-Trent, UK

Season	Climate Variable	Time Period*	Projected Change at				
			Lower Probability		**Median**	Higher Probability	
			5th percentile	10th percentile	**50th percentile**	90th percentile	95th percentile
Winter	Mean Temperature (ºC)	**2030s**	-0.99	-0.61	**0.71**	2.03	2.40
		2050s	-0.50	-0.11	**1.31**	2.75	3.16
		2070s	-0.19	0.30	**2.04**	3.82	4.33
		2090s	0.41	0.98	**2.97**	5.07	5.64
	Mean Precipitation (%)	**2030s**	-31.4	-24.5	**4.4**	32.4	39.6
		2050s	-29.2	-20.6	**8.1**	38.2	47.6
		2070s	-25.4	-16.8	**14.9**	48.8	58.9
		2090s	-27.6	-16.9	**19.3**	58.9	70.1
Summer	Mean Temperature (ºC)	**2030s**	-0.88	-0.46	**1.03**	2.55	2.97
		2050s	-0.46	0.01	**1.69**	3.44	3.96
		2070s	0.18	0.74	**2.83**	5.05	5.70
		2090s	0.83	1.53	**4.08**	6.84	7.63
	Mean Precipitation (%)	**2030s**	-63.9	-52.2	**-10.0**	39.0	52.4
		2050s	-68.3	-58.6	**-19.5**	45.1	54.7
		2070s	-80.3	-70.2	**-29.2**	47.4	59.6
		2090s	-88.1	-77.9	**-37.4**	54.2	67.4

*UKCP18 provides 20-year time slices, hence averages taken for: 2030s (2020-2039), 2050s (2040-2059), 2070s (2060-2079), 2090s (2080-2099) under RCP 8.5.

Figure 5.12: Quantitative Summary of the Future Baseline for Key Climatic Variables in Stoke-on-Trent, UK, based on the UKCP18 climate change projections for RCP8.5 emissions scenario.

5.5 Climate Change Impacts

Development and People

5.5.1 The Design for Future Climate Report (2010)[93] identified three broad risk categories to buildings from future climate change in the UK. These are as follows:

- **Risk to comfort and energy performance:** warmer winters will reduce heating requirements, however, the increased use of cooling systems in the summer will present a challenge to energy consumption and carbon emissions.
- **Risk to construction:** resistance to extreme conditions, detailing, and the behaviour of materials.
- **Risk to water management:** management of water during both flooding and drought events, and changes in soil composition.

5.5.2 Combined, these categories can be considered climate change threats that could result in increased energy demands, economic losses and loss of life.

5.5.3 There are plans for 1.5 million new homes across the UK by 2022. But a recent report by the CCC published in 2019 found that UK homes are still not fit for the future. Emission reductions from UK housing have stalled, and efforts to adapt the housing stock for higher temperatures, flooding and water scarcity are falling far behind the increase in risk from the rapidly changing climate[94].

5.5.4 Climate change may result in variations in approach to general building design and construction in order to offer a higher degree of protection against the identified risks. Many of these improvements will be brought about using existing off-the-shelf components that are in common use in other places around the world, but which may not previously have been considered necessary in parts of the UK. There is a growing need for the Government to provide support to train designers, builders and installers in low-carbon heating, energy and water efficiency, ventilation and thermal comfort, and property-level flood resilience.

[93] Gething, Bill (2010) 'Design for Future Climate: Opportunities for Adaption in the Built Environment.' Technology Strategy Board, Swindon.
[94] Committee on Climate Change (2019) 'UK housing: Fit for the future?' Committee on Climate Change.

5.5.5 As well as seeking improvements in the construction techniques, new developments will also need to improve various aspects of the operational performance to provide more resilience against climate change. At localised levels, the effects can manifest in different ways and, therefore, the most appropriate strategies should be selected on a site-specific basis. Adaptation involves developing a resilience and a preparedness to deal with the likely consequences of climate change and this should also be considered for new retrofit or conversion projects.

5.5.6 The impacts that could arise from climatic effects, reproduced from data in reports by the National House Building Council (NHBC)[95], European Commission (EC)[96], and the UK Climate Change Risk Assessment Reports (CCRA)[97], are presented in Table 5.2. The level of reduction in global emissions will alter the likelihood of these effects as the climatic conditions will vary, this is shown within the range of temperatures and precipitation levels seen across the RCPs in Figure 5.12. The climatic projections shown in the above figures are seasonal averages and, therefore, there is potential for even higher temperatures within that season.

5.5.7 The Independent Assessment of UK Climate Risk (2021)[98] identifies flooding and high temperature as posing the greatest risks to the built environment. Other potential effects of climate change on the built environment are summarised in Table 5.2. In the interest of completeness, and to account for potential irregular, adverse extreme weather, this section will also cover reducing risk to snow and ice. However, projections suggest that, overall, snow and ice will become a decreasing risk with climate change.

[95] National House Building Council Foundation (NHBC) (2007). 'Climate change and innovation in house building: designing out risk (NF3).' NHBC, London.
[96] European Commission (2021). 'Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change.' COM/2021/82 final, EU EC, Brussels.
[97] HM Government (2017). 'UK Climate Change Risk Assessment 2017.' HMSO, London.
[98] Climate Change Committee (June 2021). 'Independent Assessment of UK Climate Risk, Advice to Government, For the UK's third Climate Change Risk Assessment (CCRA3).' Climate Change Committee, London.

Table 5.2: Potential Impacts on Proposed Development

Climatic Factor	General Impact	Impact on Component / Receptor
Soil Drying	Increase will affect water tables and could affect foundations.	Increased risk of basement heave or subsidence, water ingress, consequential damage to finishes and stored items; Ground shrinkage can lead to failure of electrical, gas and water pipes, foundations and sub-structures.
Temperature Increase	Maximum and minimum changes will affect heating and cooling; Frequency of cycling through freezing point will affect durability; Daily maximum and minimum temperature will affect thermal air movement; Increased temperatures may cause an increase in leachate gases.	Overheating of mechanical and electrical equipment effecting lifespan, reliability and potential health and safety issues; Plastic materials will have a reduced lifespan; Structure/cladding/roofing membranes, sealants, pavements and roads have increased risk of cracking; Reduced capacity of overheated power lines; Building overheating (due to increased fabric efficiency and incorrect implementation); Solar PV modules work slightly less efficiently at high temperatures and some studies[99] have shown that high temperatures can age at a faster rate; Decreased labour productivity.
Relative Humidity	Increase will affect condensation and associated damage or mould growth.	Increase in respiratory diseases amongst site workers during construction, and occupants when buildings are operational.

[99] Patt, A., Pfenninger, S. and Lilliestam, J., (2013). Vulnerability of solar energy infrastructure and output to climate change. Climate Change 121 pp93-102 IPCC SPECIAL REPORT: GLOBAL WARMING OF 1.5 ºC[99]

Climatic Factor	General Impact	Impact on Component / Receptor
Precipitation & Water Availability	Increase and decrease will affect water tables; Cleaning costs will be increased in winter, with associated redecoration requirements; Durability and risk of water ingress will be affected by combination of precipitation increase and gales. Changes to precipitation patterns may lead to the risk of water shortages.	Increased damage to buildings and higher risk of failures, increased chances of flooding; Structure/cladding/roofing membranes and sealants have increased risk of cracking due to different moisture movements; Damage to foundations and basements; Delays in construction and increased costs; Increased risk of subsistence; Risk to adequate water supplies causing water stress for humans, species and ecosystems.
Snow and Ice	Increase will affect need for weather tightness, risk of water ingress, effectiveness of air conditioning, energy use, risk of roof failures.	Increased damage to roofing and higher risk of failure.
Gales, Storms and Extreme Weather	Increase may affect need for solar glare control.	Window specification and glare control requirement.
Solar Radiation	Increase/decrease in seasonal lighting needs.	Changes in lighting systems and glare control requirement.

5.5.8 The CCC advise that, to be resilient to future climate impacts, buildings should use low-carbon sources of heating such as heat pumps and heat networks, with no new buildings connected to the natural gas network by 2025 (at the very latest). All buildings (new, upgrades or repairs) should include increasing the uptake of:

- passive cooling measures (shading and ventilation);
- measures to reduce indoor moisture in homes;
- improved air quality;
- improved water efficiency;
- improved energy efficiency through improvements to building fabric; and,
- the installation of property-level flood protection in homes at risk of flooding.

Development and Biodiversity

5.5.9 The latest NHBC Foundation report published in May 2021[100] describes how much of the focus on sustainable housing has been related to reducing carbon emissions, however, appropriately designed green infrastructure also plays an important role in mitigating and adapting to the future impacts of climate change. The construction industry is well-placed in having an opportunity to create not just buildings, but sustainable communities, where people thrive alongside wildlife.

5.5.10 As part of the UK's transition to a sustainable future, local planning policy can help to ensure that new housing developments are sustainably built, have a positive impact on wildlife, and adopt measures and nature-based solutions that will help local communities to withstand the impacts of climate change.

5.5.11 There are now many options available that are designed to enhance biodiversity in the built environment. Specialist features can be incorporated within the building fabric that provide suitable alternative spaces for species dependant on buildings for nesting and roosting, such as birds, bats and solitary bees. Location and position in relation to the species foraging habitats are key to the success of these options for maintaining and enhancing species populations in the local area.

5.5.12 Other adaptations to the design of buildings will provide climate resilience. These include green roofs which insulate buildings, attenuate run-off, and provide habitat for wildlife. Heating of the building can be reduced simply by applying pale renders to the outside of properties, as lighter colours reflect rather than absorb heat.

5.5.13 The NHBC Foundation report (2021) provides a guide that sets out approaches to design and development that work with nature to deliver multiple benefits for both people and wildlife. Figure 5.13, reproduced from the NHBC guide, provides a summary of the type of features that can be built in or connected to buildings that benefit wildlife and deliver other benefits for resilience to climate change, such as reducing energy use and reducing surface water run-off.

[100] NHBC Foundation and RSPB (April 2021). NF89. 'Biodiversity in new housing developments: creating wildlife-friendly communities.' NHBC Foundation, Milton Keynes.

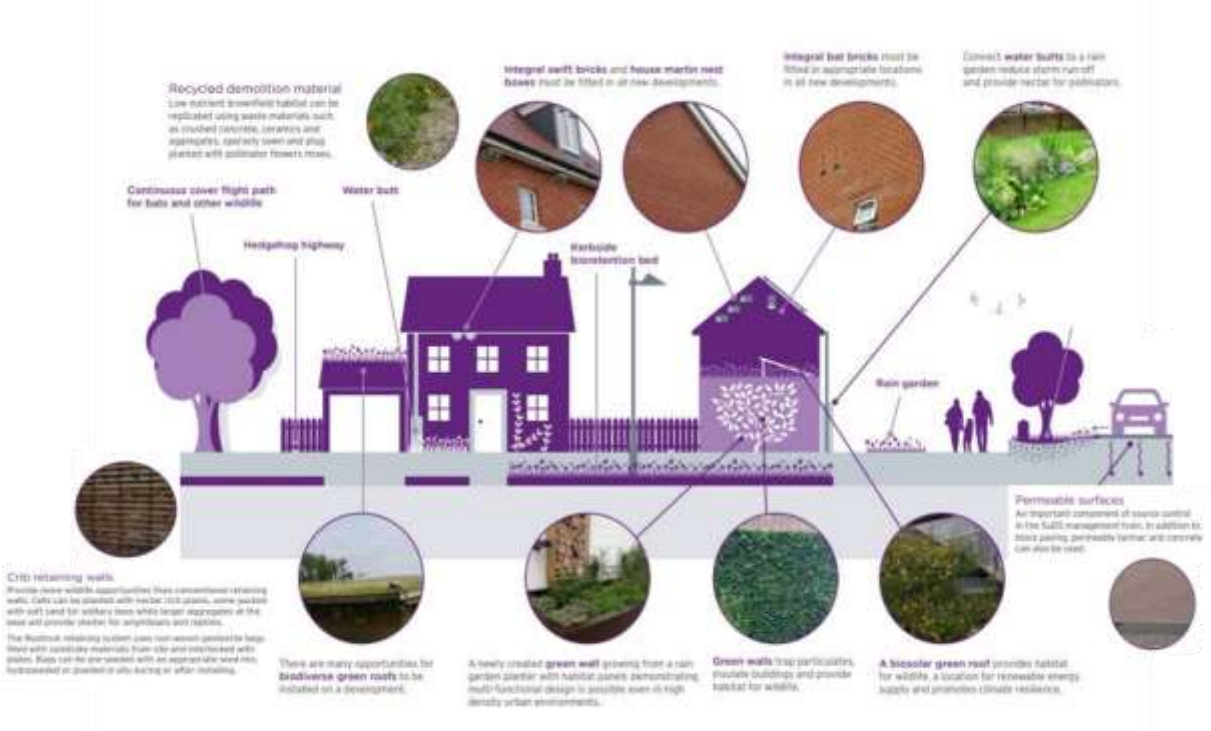

Figure 5.13: A summary of features in the built environment that can deliver multiple benefits for both people and wildlife (Source: NHBC Foundation, 2021).

6 CLIMATE RISKS AND OPPORTUNITIES

6.1.1 The Task Force on Climate-Related Financial Disclosures (TCFD)[101] describes how climate change presents a financial risk to the global economy. The risk climate change poses to businesses and financial markets is real and already present, including in Stoke-on-Trent and the surrounding areas. As the Earth's temperature rises, natural disasters are becoming increasingly common. These events disrupt ecosystems and human health, cause unanticipated business losses, and threaten assets and infrastructure. In response, governments and private sector entities are considering a range of options for reducing global emissions.

6.1.2 The TCFD believes that better information will allow companies to incorporate climate-related risks and opportunities into their risk management and strategic planning processes. As this occurs, companies' and investors' understanding of the financial implications associated with climate change will grow, empowering the markets to channel investment to sustainable and resilient solutions, opportunities, and business models. Better information will also help investors engage with companies on the resilience of their strategies and capital spending, which should help promote a smooth (rather than an abrupt) transition to a lower-carbon economy.

6.1.3 Transitioning to low emissions brings about risks and opportunities for Stoke-on-Trent and the surrounding areas. Environmental benefits are the intended purpose of reduced emissions, but achieving this can have positive and negative impacts, including on wildlife, infrastructure, human health, and financial costs.

6.2 Climate Risks

6.2.1 The TCFD framework divides climate-related risks into two major categories:

- Physical risks related to the physical impacts of climate change; and,
- Transitional risks related to the transition to a lower-carbon economy.

Physical Risks

[101] Task Force on Climate-related Financial Disclosures (2017). 'Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures.' Financial Stability Board, Switzerland.

6.2.2 The physical location of the city of Stoke-on-Trent presents a physical risk for adapting to and mitigating against climate change. The urban city is heavily confined and already considerably developed.

Transitional Risks

6.2.3 Transitioning to electric power from gas and fuel risks a strain on the national grid, especially as it progresses with decarbonisation, and fuel prices will rise.

6.2.4 In 2019, natural gas was responsible for an estimated 135 MWh of energy consumption in Stoke-on-Trent, while electricity was around 48 MWh. In light of the UK Governments Net Zero Strategy published in October 2021, it is expected that most heating-related gas consumption will transition to low carbon heating sources powered by electricity. This will significantly increase demand on the national grid. However, in theory, if this was provided by air source heat pumps alone then only 45 MWh of electricity would be needed to provide the same amount of heat. There will be some purposes of gas combustion that electricity cannot substitute, for example ceramics gas firing and laboratory processes, however, these are expected to be a very small proportion of total gas combustion in the city.

6.3 Climate Opportunities

6.3.1 Efforts to mitigate and adapt to climate change also produces opportunities for organisations. Climate resilience involves organisations developing adaptive capacity to respond to climate change to better manage the associated risks and seize opportunities. This includes the ability to respond to transition risks and physical risks. Climate-related opportunities will vary depending on the region, market, and industry in which an organisation operates. The TCFD identified several areas of opportunity and these are summarised in Figure 6.1.

Figure 6.1: Summary of Climate-Related Opportunities, based on the framework by the Task Force for Climate-related Financial Disclosures (TCFD, 2017).

Physical Opportunities for Stoke-on-Trent

6.3.2 New development in the Stoke-on-Trent region will need to demonstrate innovation to overcome space restrictions and increase resilience to future climate change.

Transitional Opportunities for Stoke-on-Trent

6.3.3 Transitioning to low carbon emissions will provide opportunities that have economic and health benefits as well as environmental benefits.

6.3.4 Pure electric vehicles will reduce emissions, improve air quality, and will likely lower costs for both the public and businesses. Pure electric vehicles have no direct operational carbon emissions, and indirect emissions will reduce in line with the decarbonisation of the national grid. The emissions from cars and commercial goods vehicles in Stoke-on-Trent during the year of 2020 were estimated as 280 kt CO_2e.

6.3.5 Installing solar PV panels on all suitable rooftops will reduce emissions and energy costs for both the public and businesses as they can generate renewable energy to cover consumption needs and sell excess back to the grid to contribute to national decarbonisation. The carbon footprint of solar is many times lower than gas with carbon capture and storage (CCS), even after accounting for the embodied emissions created during manufacture, construction and fuel supply. The average embodied

emissions from Solar PV is around 6 g CO_2e per kWh, whereas the emission factor of grid electricity is 233 g CO_2e per kWh[102]. With a housing stock estimated at over 100,000 properties, if around 20 % of them each had PV arrays with an average output of 4 kWp installed, around 127 kt CO_2e could be avoided each year in Stoke-on-Trent. This equates to a 10 % reduction in city emissions compared to a 2019 baseline.

[102] Pehl, M., Arvesen, A., Humpenöder, F. et al. Understanding future emissions from low-carbon power systems by integration of life-cycle assessment and integrated energy modelling. Nat Energy 2, 939–945 (2017). https://doi.org/10.1038/s41560-017-0032-9.

7 SUMMARY OF BASELINE EMISSIONS FOR STOKE-ON-TRENT

Overall Greenhouse Gas Emissions

7.1.1 Total GHG emissions in Stoke-on-Trent across all sectors is estimated to be 1,265.4 kt CO_2e in 2019. This equates to approximately 13.5 kt CO_2e per km^2 and 4.9 tCO_2e per person. Overall emissions in Stoke-on-Trent for 2019 have fallen by 29 % compared to 2005 emission levels, but there is not a clear reason for this reduction as levels fluctuate each year. Sustained economic growth in Stoke-on-Trent is likely to impact the level of carbon emissions per capita in the region in coming years.

7.1.2 Engagement with landowners and developers via the planning process is key to achieving suitable climate change mitigation, biodiversity enhancement measures, and opportunities for natural carbon sequestration on all future development sites in the city.

Transport Emissions and Air Quality

7.1.3 Annual transport emissions for Stoke-on-Trent in 2019 were 323 kt CO_2e, which is 13.8 % of transport emissions for the whole of Staffordshire, and 0.3 % of the total UK transport emissions. Road haulage emissions from HGVs and LGVs equates to approximately 213 kt CO_2e, which is around 66% of the total transport emissions for the city.

7.1.4 Petrol cars currently make up a high proportion of the transport mix in Stoke-on-Trent, and there are currently very few Ultra Low Emissions Vehicles (ULEV) registered in the local area. The Government intends to bring forward the phase-out of diesel and petrol cars and vans, with a ban on the sale of new vehicles of this type by 2030. Facilitating the use of ULEVs, public transport, public cycle share schemes, and other sustainable modes of transport will lower emissions in the longer term.

7.1.5 The relationship between air quality and climate change is highly complex but is an important consideration due to the direct risk to human health. Taking actions to improve air quality across the city will not only support a healthier population but will also mitigate against the impacts of climate change. Cross boundary initiatives to improve the effectiveness of climate change policies should be considered, to develop the policy approach where it would lead to the reduction of emissions across Stoke-on-Trent and surrounding areas.

Industry Emissions

7.1.6 Emissions from the industrial, agricultural and commercial sectors were 454.7 kt CO_2e in 2019, which contributed 36 % of total emissions. Schools only account for a small proportion of these emissions. In addressing the issues of climate change though planning policies, the City Council should work closely with local industries in planning and implementing the journey to net zero, especially in terms of utilising available new technologies and linking training skills with new technology to reduce overall emissions from industry in Stoke-on-Trent.

Housing and Domestic Emissions

7.1.7 Stoke-on-Trent has an aging housing stock with the majority of buildings built before 1964. Domestic emissions represent approximately one third of all emissions in the city. It is estimated that around 45 % of dwellings in Stoke-on-Trent are not adequately insulated and 26 % have EPC ratings of E or below. Only around 5 % are considered highly energy efficient with EPC ratings of B or A. 21.8 % of households in Stoke-on-Trent are estimated to be living in fuel poverty. The primary causes of fuel poverty are low incomes, high energy bills, and energy inefficient homes.

7.1.8 Improving fabric efficiency of existing houses can vastly reduce winter heating demand and could reduce domestic gas consumption significantly. Summer overheating and cooling requirements must also be considered as temperatures rise due to global warming. A policy that is helping to reduce fuel bills and fuel poverty is in some instances likely to lead to increased energy consumption and carbon emissions. Climate Change Policies should be prioritised which both reduce carbon emissions and alleviate fuel poverty, and which avoid impeding progress in the other.

Energy Emissions

7.1.9 Energy emissions for Stoke-on-Trent relating to both electricity and gas consumption across all sectors totalled 866.8 kt CO_2e in 2019, which accounted for 69 % of all emissions in Stoke-on-Trent. Electricity accounted for 16 % of total emissions and gas 52 %, with the remaining 1 % from 'other' fuels.

7.1.10 Transitioning from gas combustion to electricity where possible will result in lower emissions with the decarbonising national grid and will be aligned to the aims of the UK Government's Net Zero Strategy. Furthermore, an estimated 45 GWh of geothermal heat is expected to be supplied annually to 110 properties across the city

via the completion of the District Heating Network which is currently under construction, and this scheme will generate no onsite emissions following drilling.

Renewable Energy Generation

7.1.11 Stoke-on-Trent currently has installed capacity from solar photovoltaics (PV), wind power, and micro combined heat and power (mCHP). These renewable technologies had a combined total installed capacity in 2020 of 6,964 kilowatts (kW): installed capacity from solar PV is 6,947 kW, 15 kW for wind, and 1.99 kW for mCHP. The existing Energy from Waste (EfW) plant in Stoke-on-Trent also has an installed capacity of 14.2 to 15 MW, however, there is currently some debate in the UK about the low carbon credentials of this type of technology.

7.1.12 High-level constraints mapping for renewable energy technologies in the local area indicates that hydropower and large-scale wind developments are unlikely to be feasible in the city. However, there may be opportunities to further utilise solar PV in both commercial and domestic settings. Small-scale commercial wind developments may also be feasible subject to the planning process. District heating networks can be expanded across the city, and there are opportunities for renewable heat from mine water. This resource could potentially be used to provide heat elsewhere in the city as an alternative low carbon heating source.

8 POLICY RECOMMENDATIONS

8.1 Stakeholder Engagement

8.1.1 Engagement with stakeholders is important to Stoke-on-Trent City Council as they undertake a review of local planning policy in relation to climate change and shape future policies on climate change up to 2040. Several key stakeholders were identified and contacted to provide their views on what is important to them and what they would like to see covered in the climate change polices in the emerging local plan.

8.1.2 Stakeholders contacted included Resident's Associations, Taxi Firms, Social Housing Providers, Businesses, Property Developers, Transport Providers, Bus Operators, Government Agencies, Infrastructure Providers, Climate Liaison Groups, City Council Departments, and Adjoining Councils. Stakeholder responses have helped to inform the policy recommendations along with the baseline evidence for the city.

8.1.3 All respondents either had no views on existing planning policies in the currently adopted Core Spatial Strategy, or did not consider these to be effective and enable new development to address climate change.

8.1.4 13 % of respondents considered that all aspects of existing policies could be strengthened to be more effective in addressing climate change in the city, and 13 % highlighted the following aspects/ issues in particular:

- Creation of more woodland and habitat systems in Stoke-on-Trent;
- Fuel Poverty because of its alignment with carbon reduction and it is of particular concern for Stoke-on-Trent;
- Thermal efficiency of buildings, especially dwellings;
- Establishment of a Cabinet Position within the City Council responsible for climate change and carbon reduction; and
- Monitoring to demonstrate effectiveness of any Policies.

8.1.5 The Local Authority’s journey to Net Zero was considered by respondents as being patchy and fragmented and therefore this should be addressed through the local plan. All policy areas were considered important to over half of respondents, with Housing and Transport in particular being mentioned as being of most importance.

8.1.6 All respondents set out that they have already completed works or introduced policies which will address climate change within their own remits, and view the Local Authority as being in a key position to influence positive changes to address climate change for all developments in the area through the planning process.

8.1.7 The critical partnerships needed to achieve the goal of Net Zero, as identified by respondents, include:

- Infrastructure and Utility Providers;
- Local Businesses and Industry;
- Developers;
- Partnerships with the public of Stoke-on-Trent;
- Local Landowners;
- Neighbouring Authorities;
- Local Enterprise Partnerships; and
- National Agencies and Other Bodies.

8.1.8 A whole systems solution to policies relating to climate change in the emerging Local Plan was considered an important aspect, with 25 % of respondents supporting this approach within the Local Plan. Figure 8.1 lists the policy aspects which 75 % of respondents would like to see included in the Local Plan for Stoke-on-Trent, according to their level of significance to stakeholders.

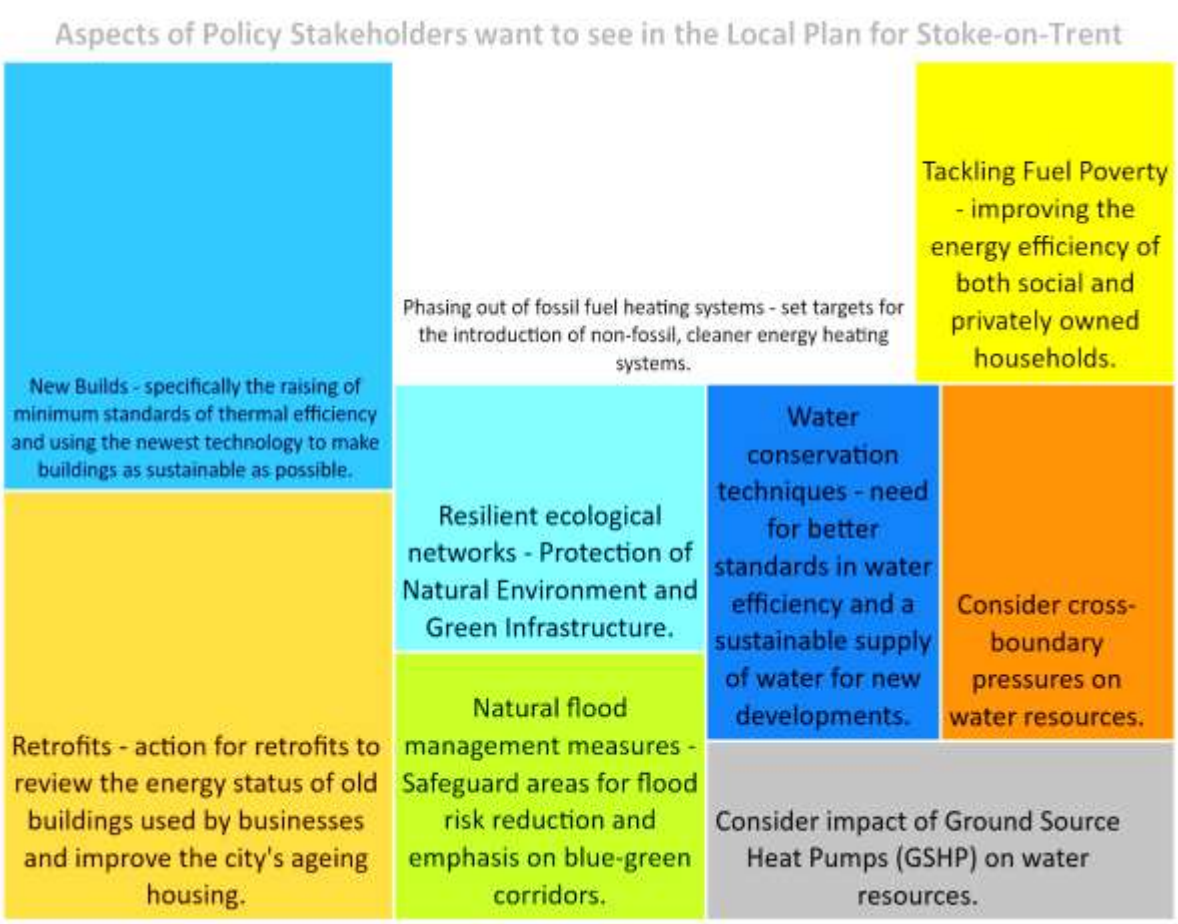

Figure 8.1: Aspects of Policy Stakeholders said want to see in the Local Plan for Stoke-on-Trent.

8.2 Holistic Interventions for Climate Change Mitigation and Adaptation

8.2.1 This section of the baseline report considers the potential approach to policies in terms of scope and content in line with the overall approach to climate change. All potential holistic interventions that can help to reduce energy use and greenhouse gas emissions, along with the potential impacts of new technologies are identified, focusing on the strategies for climate change mitigation and adaptation that the emerging policies for Stoke-on-Trent will need to address.

8.2.2 The difference between climate change mitigation and adaptation is explained simply by the World Wildlife Fund as:

“Climate change mitigation means avoiding and reducing emissions of heat-trapping greenhouse gases into the atmosphere to prevent the planet from warming to more extreme temperatures.

Climate change adaptation means altering our behaviour, systems, and, in some cases, ways of life to protect our families, our economies, and the environment in which we live from the impacts of climate change. The more we reduce emissions right now, the easier it will be to adapt to the changes we can no longer avoid." [103]

Climate Change Mitigation in Stoke-on-Trent

8.2.3 Climate change mitigation presents a challenge in terms of addressing the existing situation including built form. In new development, this can be addressed in terms of energy efficiency and reduction of the need for reliance on non-renewable forms of energy generation and associated modes of transport. Policies in the emerging Local Plan need to address the need for mitigation and provide the framework for appropriate measures. This can include Policies addressing sustainable building design, sustainable transport and the approach to renewables of a range of scales.

Climate Change Adaptation in Stoke-on-Trent

8.2.4 Climate change adaptation is a more difficult construct in that it requires a shift in people's behaviours, facilitated by the environment around them. Therefore, if the infrastructure is not provided through changes to the built environment (e.g. construction of flood defences, more sustainable travel patterns and movement or sufficient appropriate electric charging points), then behaviours become more difficult to change. Adaptations need to take into account the range of challenges that people may face, particularly the most vulnerable members of society including those in fuel poverty. It is not necessarily for the planning system to address all measures, but it is a tool alongside other initiatives to guide Stoke-on-Trent forward in this regard. Adaptation also presents a range of opportunities in terms of embracing new technologies and innovation in a changing climate. New food production opportunities may be available either through formal agriculture or through local initiatives (some local community food initiatives already exist in Stoke-on-Trent). It is not necessarily for the Local Plan to promote these more micro measures, but these should equally not be precluded unintentionally by restrictive policies.

8.2.5 The Local Plan should evolve alongside the various UK Government pledges to tackle climate change including the Net Zero 2050 strategy. Intelligent design, preparation, and responsible construction can help to minimise future risks associated with

[103] www.worldwildlife.org/stories/what-s-the-difference-between-climate-change-mitigation-and-adaptation

climate change. A whole systems approach should be adopted for Stoke-on-Trent, with all new planning proposals to consider climate adaptation and mitigation throughout.

8.3 APPROACH TO DRAFT POLICY RECOMMENDATIONS

8.3.1 This report identifies the context for formulating climate change policies within the emerging Stoke-on-Trent Local Plan. We provide suggestions below for the approach to draft policies to be embedded in the Local Plan and the Council's overall planning regime. The Policies that go into the Plan are for the Council to ultimately formulate and consider as part of the overall Local Plan and strategic approach.

8.3.2 The Baseline Report considers current government targets relating to areas including: Sustainable Building Design and Construction, Carbon Sequestration and Natural Capital, Sustainable Transport, and Renewable Energy Generation and Storage, amongst other matters.

8.4 POLICY CONTEXT FOR THE PLANNING SYSTEM

National Planning Policy Framework (NPPF) (2021)

8.4.1 Part 3 of the NPPF provides the overarching guidance for plan making, stating at Paragraph 15 that 'The planning system should be genuinely plan-led. Succinct and up-to-date plans should provide a positive vision for the future of each area; a framework for addressing housing needs and other economic, social and environmental priorities; and a platform for local people to shape their surroundings.'

8.4.2 At Paragraph 16 it states:

"16. Plans should:

a) be prepared with the objective of contributing to the achievement of sustainable development;

b) be prepared positively, in a way that is aspirational but deliverable;

c) be shaped by early, proportionate and effective engagement between plan-makers and communities, local organisations, businesses, infrastructure providers and operators and statutory consultees;

d) contain policies that are clearly written and unambiguous, so it is evident how a decision maker should react to development proposals;

e) be accessible through the use of digital tools to assist public involvement and policy presentation; and

f) serve a clear purpose, avoiding unnecessary duplication of policies that apply to a particular area (including policies in this Framework, where relevant)."

8.4.3 The Local Plan will comprise of both strategic and non-strategic Policies (Para.19).

8.4.4 Strategic Policies should set out the overall strategy and include a range of Policy areas including, 'planning measures to address climate change mitigation and adaptation.'

8.4.5 With regards to non-strategic policies, the NPPF states:

"28. Non-strategic policies should be used by local planning authorities and communities to set out more detailed policies for specific areas, neighbourhoods or types of development. This can include allocating sites, the provision of infrastructure and community facilities at a local level, establishing design principles, conserving and enhancing the natural and historic environment and setting out other development management policies."

8.4.6 The Local Plan will be subject to Examination in Public and will be considered against the 'Tests of Soundness' which means that they are:

"a) Positively prepared – providing a strategy which, as a minimum, seeks to meet the area's objectively assessed needs; and is informed by agreements with other authorities, so that unmet need from neighbouring areas is accommodated where it is practical to do so and is consistent with achieving sustainable development;

b) Justified – an appropriate strategy, taking into account the reasonable alternatives, and based on proportionate evidence;

c) Effective – deliverable over the plan period, and based on effective joint working on cross-boundary strategic matters that have been dealt with rather than deferred, as evidenced by the statement of common ground; and

d) Consistent with national policy – enabling the delivery of sustainable development in accordance with the policies in this Framework and other statements of national planning policy, where relevant."

8.4.7 Soundness includes a consideration of consistency with the strategic polices.

8.4.8 Part 14 relates to meeting the challenge of climate change, flooding and coastal change. It identifies that the planning system should be supporting the transition to a low carbon future. The Policies should consider the wider impacts and

vulnerabilities arising from a changing climate including adaptability of space and appropriate sustainability measures for buildings and other developments.

8.4.9 Paragraph 155 also seeks to increase the use and supply of renewable and low carbon energy and heat. Local Plans should:

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

8.4.10 The NPPF is supported by the Planning practice guidance (PPG). Guidance on climate change identifies the importance for planning to consider it as an integral part of plan-making and thereafter decision-making. The PPG makes reference to the Planning and Compulsory Purchase Act 2004, Section 19(1A), which "requires local planning authorities to include in their Local Plans "policies designed to secure that the development and use of land in the local planning authority's area contribute to the mitigation of, and adaptation to, climate change" (PPG Paragraph: 002 Reference ID: 6-002-20140306), and to the Climate Change Act 2008 which places a requirement on the government to assess regularly the risks to the UK of the current and predicted impact of climate change, to set out its climate change adaptation objectives and to set out its proposals and policies for meeting these objectives.

8.4.11 As indicated in the methodology above, the PPG indicates that Local Plans can help to address the challenges of climate change through:

- Reducing the need to travel and providing for sustainable transport;
- Providing opportunities for renewable and low carbon energy technologies;
- Providing opportunities for decentralised energy and heating; and
- Promoting low carbon design approaches to reduce energy consumption in buildings, such as passive solar design.

8.4.12 There are a range of other legislation and evidence that are referred to in the main baseline report and are otherwise relevant including the TCPA 1990, the Planning

and Energy Act 2008 as well as a number of national and international declarations on climate change (e.g. IPCC). This includes the UK Government's 2019 Climate Emergency declaration. Alongside this, the City of Stoke-on-Trent Council declared a Climate Emergency on 4 July 2019. The declaration can be viewed on the Council website[104]. It should be noted that locally based timelines for achieving net zero are yet to be established beyond the UK Government's 2050 target.

8.5 CONTEXT AND PROPOSED APPROACH TO PLAN-MAKING FOR CLIMATE CHANGE

8.5.1 In considering Policies to address climate change (as with all Policies) there is a need to address the structure, general content, and ultimately a need to achieve a 'sound' Local Plan containing Policies that meet the tests of soundness.

Existing Context

8.5.2 To provide some context on the existing local planning policy position, the adopted Newcastle-under-Lyme and Stoke-on-Trent Core Spatial Strategy (2009) Policy CSP3 states:

[104] https://moderngov.stoke.gov.uk/mgConvert2PDF.aspx?ID=8431&T=10

Policy CSP3 – Sustainability and Climate Change

Development which positively addresses the impacts of climate change and delivers a sustainable approach will be encouraged. The highest standards of energy and natural resource efficiency will be achieved by: -

1. Requiring that all new development, as a minimum, complies with on-site or near-site renewable or low carbon energy targets set out in current or future national guidance and the Regional Spatial Strategy and takes positive measures to reduce carbon emissions to the levels set out in the Regional Spatial Strategy.
2. Ensuring the use of construction methods which minimise the use of non-renewable resources and which maximise the use of recycled and locally sourced materials.
3. Requiring all new developments to incorporate the use of Sustainable Urban Drainage Schemes (SUDS).
4. Developing habitat systems which are resilient to climate change in accordance with latest best practice.
5. Supporting local initiatives to address climate change such as the North Staffordshire Warm Zone and other initiatives that may emerge.
6. Requiring best practice standards where supported by future local or regional evidence.
7. All new development shall be located in locations at lowest possible flood risk as identified in the SFRA and all suitable flood mitigation measures shall be investigated and where possible incorporated into the development. Opportunities will be sought to open up culverted watercourses to

General Principles

8.5.3 In formulating Policies, there is a need to ensure that they are clearly and positively written to ultimately allow the development management teams to carefully consider proposals and applications for development. They will also provide the framework from which more strategic decisions may be made in the Authority area.

8.5.4 Consideration should also be given to the Duty to Co-operate in terms of the potential for cross-boundary approaches to meeting renewable energy targets and climate change objectives.

8.5.5 Policies should be sufficiently justified through an appropriate strategy based on the evidence but should also be effective in terms of being deliverable over the Plan

period, which in this case is up to 2040. They should otherwise be consistent with national policy requirements.

8.5.6 Policies should have a careful balance of not being overly subjective whereby its interpretation may be broader, and the effectiveness of the strategic approach reduced. Prospective Applicants and Developers, as well as the Council require a level of clarity and certainty in promoting development of all scales and impacts. Policies should therefore have clear direction and objectives, but as appropriate, should have a degree of flexibility to ensure that that the Local Plan objectives are deliverable.

8.5.7 The current National Policy framework (July 2021) and emphasis placed on the various Climate Emergency Declarations and related initiatives, should provide a level of support in formulating policies to address climate change. The policy wording should not be so onerous as to make it difficult to meet the requirements, or to otherwise impact on the overall soundness of the Local Plan in delaying or preventing delivery of development, particularly on key/ strategic sites.

8.5.8 Policies should be consistent with National Policy which allows for a consideration of local needs and circumstances. This is particularly relevant to the approach to climate change in terms of the opportunities and constraints presented in any particular Authority Area.

8.5.9 Stoke-on-Trent is an authority area that is based inland (i.e. no direct coastal opportunities). It also has limited areas of higher ground alongside significant urbanicity which may preclude reliance on larger scale wind energy to meet identified renewable targets. This does not prevent consideration of a range of smaller and more appropriate measures for energy generation or energy efficiency or indeed allow for consideration of new technologies that may emerge through the Local Plan period.

8.5.10 The Local Plan therefore needs sufficient flexibility and coverage to consider a range of measures and eventualities that may arise. There will clearly be opportunities to consider and revise Policy through future plan reviews or provide further clarity and detail through the production of Supplementary Planning Documents.

8.5.11 Policies can be amalgamated where appropriate, but singular policies addressing all aspects of climate change should in our view be avoided as the policy thrust/ focus can be lost.

8.5.12 Policies elsewhere in the Plan should also be cross-referenced, but this should be a simple reference rather than repetition of text in that other Policy. For example, any site specific or strategic site Policies should not repeat text from one of the climate change related Policies, but should make reference to any site specific measures such as, '…energy efficiency measures such as [INSERT MEASURE] should be considered in line with Policy [INSERT POLICY REFERENCE]'. This will allow for efficiency within the plan making process, but also reduce the length of the Plan document itself at each stage of drafting and Examination.

8.5.13 Policies can be criteria-based, but again care is needed to balance between providing sufficient clarity whilst avoiding unnecessary repetition elsewhere in the Plan.

8.5.14 The Policy recommendations set out in this document are made in line with findings of the baseline assessment to ensure that the approaches are consistent with the requirements for Stoke-on-Trent. In considering possible policy approaches, there has been consideration of recently approved Local Plans and of Plans currently at an advanced stage of process (i.e. Submitted or at Examination). The following section looks at each of the relevant Policy areas and provides examples and recommendations to be considered in the emerging Stoke-on-Trent Local Plan when linked to the baseline information. They are considered individually, but the report will then consider whether any or all of the Policy areas can be drawn together into one or more Policies as appropriate.

8.6 CLIMATE CHANGE POLICY CONSIDERATIONS

8.6.1 In considering Policies for climate change, there are a range of both direct and indirect Policy reference points. These include Policies addressing climate change in its broadest terms, including sustainable building and design Policies, energy efficiency, renewable energy generation, sustainable transport and flood risk. There is a need to recognise the importance of climate adaptation and mitigation as detailed above in section 8.2, which will need local strategies to ensure that Stoke-on-Trent and its surrounding areas have an understanding of changes in temperature and more extreme weather conditions, which can lead to increased flooding, but also drought. Both urban and rural parts of Stoke-on-Trent will be affected, and the remedies may differ. It is not for the Policies in the Local Plan to identify solutions, but there needs to be sufficient flexibility to allow for changes.

8.6.2 In considering Policies relating to energy efficiency and building design, care should be taken not to unnecessarily replicate Building Regulations. There also need to be sufficient flexibility to both provide certainty to developers and decision makers alike.

8.6.3 The Policy/ies can focus specifically on buildings and built form or may also cover various other Policy areas such as landscape character, heritage and renewable technologies. Our recommendation would be to ensure that there is care taken not to unduly overlap Policies in terms of repetition of text.

8.6.4 We consider the above elements in terms of Policy formulation under four areas, some of which are interrelated and/or will be captured in a single Policy on climate change. The areas are **sustainable design** to consider built form and sustainable modes of development, **carbon sequestration and natural capital** to consider the potential for considering carbon reduction and utilisation of the natural environment, **sustainable transport** as this is key to linking place and space in a Net Zero carbon world and **renewable energy, low carbon and storage** as a key driver of carbon reduction, but recognising the importance of energy generation for economic, social and environmental sustainability.

Sustainable Design

8.6.5 There are numerous examples across the country of sustainable design and construction policies. Policy length can vary considerably depending on which Policy areas are included. The Policy can encompass a range of matters such as building

design and layout, energy efficiency, landscaping, utilities and access consideration. The Policy can also focus on building design alone with other elements addressed by separate Policies.

8.6.6 Figure 8.2 is a Policy example recently adopted in the Durham Local Plan 2020 and relates to Sustainable Design. The Policy covers a broad array of aspects including energy efficiency and sustainability, consideration of how this applies to places and spaces, landscaping, buildings (including extensions and alterations) and signage and public art. The Policy both addresses general building form and approach to design as well as identifying measures for energy efficiency and sustainable design.

Policy 29 Sustainable Design
All development proposals will be required to achieve well designed buildings and places having regard to supplementary planning documents and other local guidance documents where relevant, and:
a. contribute positively to an area's character, identity, heritage significance, townscape and landscape features, helping to create and reinforce locally distinctive and sustainable communities;
b. create buildings and spaces that are adaptable to changing social, technological, economic and environmental conditions and include appropriate and proportionate measures to reduce vulnerability, increase resilience and ensure public safety and security;
c. minimise greenhouse gas emissions, by seeking to achieve zero carbon buildings and providing renewable and low carbon energy generation, and include connections to an existing or approved district energy scheme where viable opportunities exist. Where connection to the gas network is not viable, development should utilise renewable and low carbon technologies as the main heating source;
d. minimise the use of non-renewable and unsustainable resources, including energy, water and materials, during both construction and use by encouraging waste reduction and appropriate reuse and recycling of materials, including appropriate storage space and segregation facilities for recyclable and non-recyclable waste and prioritising the use of local materials;
e. provide high standards of amenity and privacy, and minimise the impact of development upon the occupants of existing adjacent and nearby properties; and
f. contribute towards healthy neighbourhoods and consider the health impacts of development and the needs of existing and future users, including those with dementia and other sensory or mobility impairments.
Landscape proposals should:
g. respond creatively to topography and to existing features of landscape or heritage interest and wildlife habitats;
h. respect and where appropriate take opportunities to create attractive views of and from the site;

i. reflect in the detailed design any features characteristic of the locality such as boundaries, paving materials and plant species;
j. create opportunities for wildlife including though the use of locally native species;
k. make appropriate provision for maintenance and long term management; and
l. in the case of edge of settlement development, provide for an appropriate level of structural landscaping to screen or assimilate the development into its surroundings and provide an attractive new settlement boundary.
Places and Spaces
Major development proposals and those which affect, or add to, the public realm should:
m. create a well-defined, easily navigable and accessible network of streets and spaces which respond appropriately to local context, to ensure that:
1. the public realm, including new roads, paths and other rights of way, open spaces, hard and soft landscaping, boundary features and other structures, are designed to be functional, well-managed safe and durable, taking into account the lifetime needs of its users;
2. convenient access is provided for all users whilst prioritising the needs of pedestrians, cyclists, public transport users, people with a range of disabilities, and, emergency and service vehicles;
3. connections are made to existing cycle and pedestrian networks;
4. the public realm benefits, where possible, from natural surveillance;
5. amenity open space is designed with regard to the local micro-climate including sunlight, shade and shelter; and
6. private and communal amenity space is well-defined, defensible and appropriate in its design, size and location to the needs of its users.
Buildings
All new residential development will be required to comply with the Nationally Described Space Standards (NDSS). In order to allow for an appropriate transition period, the NDSS will only be applied to outline or full applications approved one year after the Plan is adopted. In addition all major new residential development will be required to:
n. when assessed against the Building for Life Supplementary Planning Document secure as many greens as possible, whilst minimising the number of ambers. Schemes with one or more red will not be acceptable and will be refused planning permission unless there are significant overriding reasons;
o. achieve reductions in CO2 emissions of 10% below the Dwelling Emission Rate (DER) against the Target Emission Rate (TER) based on current Building Regulations. The policy would not apply in the event that the relevant Building Regulations were enhanced; and
p. be built to at least 30 dwellings per hectare (dph) net in and around town centres and locations where there is good access to facilities and frequent public transport services. Lower densities may be acceptable in other locations or where it is necessary to:
1. ensure good design and development that is compatible with its surroundings and character;

2. secure particular house types to meet local needs; and,
3. meet infrastructure requirements.
All major new non-residential development will be required to achieve Building Research Establishment Environmental Assessment Method (BREEAM) minimum rating of 'very good' (or any future national equivalent). Extensions and Alterations Proposals for alterations and extensions to residential property, and development associated with the incidental enjoyment of a dwelling, should ensure the development is sympathetic to the existing building(s) and the character and appearance of the area in terms of design, scale, layout, roof design and materials.
Signage, Adverts, Street Furniture and Public Art
Proposals should ensure:
q. street furniture, public art, adverts and signage are appropriate and sympathetic to all users and the local setting in terms of scale, design, lighting and materials, and
r. adverts are not detrimental to visual amenity or public highway safety.

Figure 8.2: Full text of Policy 29 Sustainable Design of the Durham Local Plan (2020).

8.6.7 The Policy in Figure 8.2 shows a level of flexibility in identifying a Policy aiming to achieve net zero carbon development, but is balanced against the need for viability. Reference is made to National Housing Standards such as Nationally Described Space Standards (NDSS) and Building for Life as well as BREEAM for non-residential space. Durham, for instance, has specified achieving BREEAM 'very good' as a minimum standard. These measures may or may not be achievable in Stoke-on-Trent depending on any specific development proposal, but there should be an aspiration to meet a higher standard, subject to full viability testing.

8.6.8 Stoke-on-Trent as a whole is one of the most fuel deprived areas in the UK and old stock / poor energy efficient buildings is a key reason behind this. As such, the challenge of improving energy standards is a key area to reduce energy usage. The need for energy efficiency will be balanced against other obligations such as Biodiversity Net Gain, affordable housing requirements, and education contributions. Some sites in Stoke-on-Trent, such as brownfield land, may already have viability issues and therefore, the balance will be between achieving delivery and addressing these higher development standards.

8.6.9 It should be noted that certain authorities have sought to apply a higher standard of energy efficiency to that required by Building Regulations, including aspiring to zero carbon development. This would be challenging for Stoke-on-Trent to apply,

however, achieving net zero carbon by 2050 should be considered further as the local plan progresses. It may be that commercial demands of occupiers will also guide development standards and the onus should be put on the applicant to indicate what standard they can achieve but with sufficient flexibility to allow a demonstration of why a 'lower' standard may be sought in any specific proposal.

8.6.10 These measures/ requirements will need to be tested through the Local Plan Sustainability Assessment and whole plan viability assessment to ensure that any identified measures are relevant and achievable in terms of lifespan of the Plan, have some inherent flexibility, and importantly be of local relevance to Stoke-on-Trent. They should have reference to working towards zero carbon development by 2050 including measures identified by the most recent Government strategy, although as noted above, there is still a need for greater detail on how this can be achieved at the local level and so remains aspirational at the current time subject to more detailed guidance and assessment.

8.6.11 The Policy in respect of Climate Change should certainly relate to energy efficiency and good design, but should not in itself be a design Policy. It is recommended that the general design aspects are included in a separate Policy elsewhere in the Plan (possibly under Development Management Policies) and that the Climate Change Policy makes reference to this insofar as it is relevant to Climate Change.

8.7 CARBON SEQUESTRATION & NATURAL CAPITAL

Carbon Sequestration

8.7.1 The process of carbon sequestration involves capturing and storing atmospheric carbon dioxide (CO_2). It is being promoted as a method of reducing the amount of atmospheric CO_2 as part of reducing climate change.

8.7.2 It can be promoted by natural means through retention and enhancement of planted areas (e.g. seeking additional tree/ vegetation planting) or through protection of existing carbon rich areas such as peatlands/ lowland bog. Stoke-on-Trent City Council is currently working with the Woodland Trust to plant over 11,000 trees around the city as part of the 'Big Climate Fightback'.

8.7.3 With regards to peatland, it is known to exist in Staffordshire areas such as at Black Firs and Cranberry Bog at Balterley c.10 km due west of Tunstall, but is not identified in Stoke-on-Trent. Where appropriate opportunities for habitat creation are presented as part of any development there may be opportunities for carbon sequestration in Stoke-on-Trent, but otherwise may need joint initiatives with neighbouring Authorities to address any forthcoming targets. This is reliant on a Duty to Cooperate and therefore needs further discussion and negotiation before commitments in this regard. The baseline report identifies current projects including tree planting as part of a collaboration between the Woodland Trust, Stoke-on-Trent City Council and the Forestry Commission and the more recent SUNRISE project. Protection can also be given to existing landscape assets including parklands and soils in general.

Natural Capital

8.7.4 According to the UK Government, a definition for natural capital is set out in the HM Treasury Green Book: Appraisal and Evaluation in Central Government. On Page 63 it states:

> **"Natural capital includes certain stocks of the elements of nature that have value to society, such as forests, fisheries, rivers, biodiversity, land and minerals. Natural capital includes both the living and non-living aspects of ecosystems. Stocks of natural capital provide flows of environmental or 'ecosystem' services over time. These services, often in combination with other forms of capital (human, produced and social) produce a wide range of benefits. These include use values that involve interaction with the resource and which can have a market value (minerals,**

timber, freshwater) or non-market value (such as outdoor recreation, landscape amenity). They also include non-use values, such as the value people place on the existence of particular habitats or species."

8.7.5 Natural England have produced a series of indicators alongside a Natural Capital Atlas which considers approaches in specific areas of England. The Staffordshire atlas (No.35) includes Stoke-on-Trent. It considers a wide range of land use types and habitats including farmland, freshwater, grassland, mountains, moors and heaths, woodlands and urban areas. The atlas attributes values (low to high) in broad terms and places these on 5km2 (500 Ha) areas of land. This provides some indication of the Natural Capital value when considered across the County, but is more difficult to assess in terms of Stoke-on-Trent alone given the scale of indicator areas (i.e. within any 5km2 area of Stoke, there may be a diverse range of land uses including urban areas which may then have a woodland or freshwater asset). Clearly much of the Authority Area is urban, but there are wooded and grassed areas (e.g. Grange Park and Central Forest Park) as well as freshwater assets including the River Trent and its tributaries.

8.7.6 With regards to drafting Policies, it is considered that a broad approach may be taken to allow for more detailed consideration of indicators at the Local Authority level.

8.7.7 Natural Capital is also considered closely alongside Biodiversity Net Gain (BNG). BNG is an assessment of ecological value of biodiversity and habitats of existing sites and then as a result of any proposed development. The development should demonstrate a net gain in biodiversity either on-site, or if applicable, off-site through for example, habitat creation, additional landscaping and watercourse enhancement. It is assumed that BNG Policy considerations will be in a separate Planning Policy, but it is recommended that clear cross reference is made between the Policy areas.

8.7.8 With regards to Policy examples, the full understanding of Carbon Sequestration is still in its relative infancy in terms of how to include this in Planning Policies and ensure that it is effective, justified and ultimately sound. The UK Climate Change Committee have produced a report titled Land use: Policies for a Net Zero UK (January 2020)[105]. This considers a range of approaches to land use including food production, climate change adaptation and biodiversity.

[105] https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk/

8.7.9 The emerging Salford Local Plan Publication draft 2020 is a useful example of policy wording relating to carbon sequestration. This is yet to be tested at Examination, but it is considered that the general thrust is in accordance with national policy and guidance. Within the draft Policy, Carbon Sequestration is first identified in principle at draft Policy F4 Fairness Between Generations where the first criterion seeks, "Minimising carbon emissions and maximising carbon sequestration". The supporting text simply refers to other areas of the plan where the measure will have relevance. It is then referenced in Salford Publication Draft Policy CC1 Climate

> ***"B) Maximising carbon storage and sequestration, including by:***
> ***9) Protecting, and where appropriate supporting the provision or restoration of, habitats that provide a carbon storage function, such as lowland raised bog in Chat Moss (in accordance with policies GI1, GI2 and BG2)***
> ***10) Incorporating green infrastructure, such as trees and woodland that helps to sequester carbon from the atmosphere (in accordance with policies GI1 and GI6)***
> ***11) Minimising degradation and erosion of soil (in accordance with policy GB2)"***

Change:

8.7.10 Again, the draft Policy is in a position to identify a specific spatial area whilst keeping the Policy intention broader but succinct. With regards to Stoke-on-Trent, it is therefore considered that reference can either be made to the broader aims and potential approaches, or, if appropriate, that specific initiatives such as SUNRISE are directly referenced. The key is that the Policies remain relevant through the life of the Plan and that where new initiatives and approaches come forward that these may be considered (again justified in their own right).

8.7.11 With regards to Natural Capital, Policies are starting to emerge that make direct reference to this, whilst others provide the framework for considering natural capital without explicitly stating this. Chapter 5 of the South Downs Local Plan (2019) titled 'A Thriving Living Landscape', refers to Natural Capital within one of four Objectives:

> **"Objective 4: To achieve a sustainable use of ecosystem services thus enhancing natural capital across the landscapes of the National Park and contributing to wealth and human health and wellbeing"**

8.7.12 Natural Capital is not then referred to specifically within any of the Policies or supporting text, but provision is made for the protection and enhancement of assets. It is therefore a broad concept, but one that should be captured by all Local Plans

including in Stoke-on-Trent. This can be at both strategic and detailed policy level with a simple explanation of what Natural Capital is as a concept. For Stoke-on-Trent, it can be identified as part of a strategic objective and also identified within relevant policy text certainly on climate change, but if appropriate within other relevant policies such as on Biodiversity and geodiversity/ trees/ heritage/ flood risk. Natural Capital may then be referenced in those Policies (or their supporting text) and again as with carbon sequestration any local initiatives including those referenced above to promote Natural Capital in Stoke-on-Trent or the wider Staffordshire area could either be directly referenced, or a broader reference may be given that allows for any emerging initiatives to tie into the Policy Framework.

8.7.13 In the context of Stoke-on-Trent sequestration and natural capital they could help reduce the impacts, adapt and increase the resilience of the city in a changing climate due to carbon emissions. As a consequence, increased rainfall and flooding, increased heat and other major weather events make adaption and mitigation a key area of consideration for the city and future developments. Indirectly natural capital and sequestration can also have a positive effect in regards to air quality/pollution levels and sustainable transport routes alongside footpaths and bike routes.

8.7.14 This will need to consider the tests of soundness and allow for some level of certainty for developers, stakeholders and decision makers.

8.7.15 The Local Plan can set out carbon targets for new development, and policy on the use of carbon offsetting to meet shortfalls in on-site delivery as a last resort only after all other emission reduction measures have been explored. Stoke-on-Trent City Council could create a carbon offsetting fund, with carbon offset prices based on a nationally recognised carbon pricing mechanism, similar to that implemented by other LAs. Where developments do not achieve the carbon reduction targets on-site, this policy requires a developer to make up the residual emissions (shortfall) off-site or to make a cash-in-lieu contribution to the carbon offsetting fund.

8.8 SUSTAINABLE TRANSPORT

8.8.1 A further key area in respect of influences and impact on climate change relates to a sustainable approach to transport and movement. The Sustainable Transport approach in Local Plans can be embedded in a Policy or be a Policy in its own right. The Policy may then be placed in a Transportation Chapter, or within an Environmental/ Climate Change Chapter.

8.8.2 The Policy can identify specific measures alongside broader strategic objectives. It can cross-refer to other Policy areas such as housing and employment as well as identifying any strategic sites or sites of note. As previously indicated, care must be taken not to repeat too much of the text of either Policy.

8.8.3 In terms of Policy recommendation, it will depend on whether the emerging Stoke-on-Trent Local Plan will have a separate Transport Chapter and a broader Policy can be located there. Alternatively, this can be embedded within a Climate Change Policy, but there is the danger that that Policy may become very elongated. Our recommendation would be for a Sustainable Transport Policy in its own right and a more simplified cross reference within the Climate Change Policy.

8.8.4 An example of a recently adopted Policy is in the South Oxfordshire Local Plan 2020 which identifies strategic transport objectives, local initiatives, areas specific matters alongside wider Policy coverage of accessibility and mobility by a choice of transport modes including sustainable transport:

"Policy TRANS2: Promoting Sustainable Transport and Accessibility
The Council will work with Oxfordshire County Council and others to:
i) ensure that where new development is located close to, or along, existing strategic public transport corridors, bus and/or rail services can be promoted and strengthened in response to increases in demand for travel and freight;
ii) plan positively for rail improvements within the area that support improved connectivity to areas of new development;
iii) ensure new development is designed to encourage walking and cycling, not only within the development, but also to nearby facilities, employment and public transport hubs;
iv) support provision of measures which improve public transport (including Park & Ride), cycling and walking networks within and between towns and villages in the district;
v) support, where relevant, sustainable transport improvements in the wider Didcot Garden Town area and in and around Oxford, particularly where they improve access to strategic development locations;

vi) promote and support improvements to the transport network which increase safety, improve air quality, encourage use of sustainable modes of transport and/or make our towns and villages more attractive;
vii) adopt an approach to the provision and management of car parking aimed at improving the attraction of our town and village centres; and
viii) ensure the needs of all users, including those with impaired mobility are planned for in development of transport improvements.
This policy contributes towards achieving objectives 1, 4, 6 & 8."

8.8.5 The Durham Local Plan 2020 includes two separate Policies entitled Delivering Sustainable Transport (Policy 21) and Durham City Sustainable Transport (Policy 22).

Policy 21 – Delivering Sustainable Transport
The transport implications of development must be addressed as part of any planning application, where relevant this could include through Transport Assessments, Transport Statements and Travel Plans. All development shall deliver sustainable transport by:
a. delivering accommodating and facilitating investment in safe sustainable modes of transport in the following order of priority: those with mobility issues or disabilities, walking, cycling, bus and rail transport, car sharing and alternative fuel vehicles;
b. providing appropriate, well designed, permeable and direct routes for walking, cycling and bus access, so that new developments clearly link to existing services and facilities together with existing routes for the convenience of all users;
c. ensuring that any vehicular traffic generated by new development, following the implementation of sustainable transport measures, can be safely accommodated on the local and strategic highway network and does not cause an unacceptable increase in congestion or air pollution and that severe congestion can be overcome by appropriate transport improvements;
d. ensuring the creation of new or improvements to existing routes and facilities do not cause unacceptable harm to the natural, built or historic environment; and
e. developments in the vicinity of level crossings (both vehicular and pedestrian) will be expected to assess the potential increase in risk at each crossing affected and indicate the appropriate mitigation required to reduce or remove such risks.

All development should have regard to the policies set out in the County Durham's Strategic Cycling and Walking Delivery Plan and, where possible, contribute to the development of a safe strategic cycling and walking network and in particular the routes set out in Local Cycling and Walking Infrastructure Plans.
The following principles will be used to determine cycle and parking provision in development:
- **cycle parking or secure cycle storage should be provided to facilitate increased cycle ownership and use;**

- **car parking at residential developments should ensure that a sufficient level is provided for both occupants and visitors, to minimise potential harm to amenity from footway parking. On street and footway parking should be avoided where it would have an unacceptable impact on highway safety, or a severe impact on the road network;**
- **car parking at destinations should be limited to encourage the use of sustainable modes of transport, having regard to the accessibility of the development by walking, cycling, and public transport; and**
- **appropriate provision for electric vehicle charging, including charge points and laying of cables, should be made on both residential and non-residential development where parking is provided.**

The council is preparing a Parking and Accessibility Supplementary Planning Document that reflects the principles set out above. Developments should have regard to the Parking and Accessibility Supplementary Planning Document following adoption by the council.

Policy 22

Durham City Sustainable Transport

In order to reduce the dominance of car traffic, address air quality and improve the historic environment, the council proposes to deliver the following transport interventions in Durham City:

Demand Management

Encourage modal shift to more sustainable modes of transport by promoting and influencing changes in travel behaviour including:

- **marketing and promotion programmes;**
- **employer travel plans;**
- **school travel plans; and**
- **residential travel plans.**

Sustainable Transport Improvements

To help reduce through-traffic from Durham city centre, sustainable transport modes will be encouraged, including through:

a. **improvements to existing city centre transport infrastructure;**
b. **walking and cycling improvements linking the University to the city centre;**
c. **walking, cycling and public transport improvements linking Aykley Heads, Sniperley, Framwellgate Moor, Newton Hall and the city centre; and**
d. **walking, cycling and public transport improvements linking Gilesgate, Dragonville, Carrville, Belmont and the city centre.**

8.8.6 The Policies address broad sustainable transport requirements and approaches in the wider Country area with strategic aims and set principles. The second Policy addresses the specific Sustainable Transport Policy requirements for the City of Durham. The general themes are for more choice of means of transport, accessibility, particularly for mobility impaired/ disabled users.

8.8.7 This report focuses on the Climate Change aspects of Sustainable Transport in Stoke-on-Trent. As set out in the report the city has a polycentric layout, congestion, current low numbers of EV charging units installed and the limited use of sustainable / low carbon private and public transport methods. These factors are affecting air quality /pollution issue for the city and is one of the major contributors to emissions of the city. In line with the Durham example, it is considered that the broader area of Transport should be addressed in its own right, and sustainable transport including EV charging, improvement of current and new cycle lanes, pedestrian routes/pathways and public transport should be set out in detail in that chapter whether in a stand-alone policy or as part of a wider transport Policy. This includes the approach to private and public transport and cycling in the city in the context of the Local Transport Plan. However, as it is a key factor in addressing climate change, reference should therefore be made within the climate change policy. This should then cross-refer to the transport policies.

8.9 RENEWABLE ENERGY, LOW CARBON ENERGY & STORAGE

8.9.1 As has been indicated within this report, there are a range of renewable energy generation methods that are achievable with some being limited within the Stoke-on-Trent Authority area. The constraints and opportunities are set out in greater detail in section 4.7. There are various smaller scale projects (e.g. wind turbines) that have been subject to recent planning applications in Stoke-on-Trent, which indicates that there is a Policy need to inform decision making.

8.9.2 There is often a tension between any Policy that seeks to consider both large scale and small-scale generation opportunities in the same text as the issues and related policy criteria can differ significantly. However, it is not considered that this is an issue in Stoke-on-Trent due to the lack of opportunities for large scale wind in Stoke-on-Trent, which should make soundness easier to achieve.

8.9.3 The Policy needs to consider the potential for a range of renewable energy generation alongside opportunities for storage. There have been various smaller scale applications for wind energy development, but there may be further opportunities for other renewable technologies such as solar. Existing energy networks such as the Stoke-on-Trent Heat District Network should be referred to in terms of potential for connection to be new development. This is a key way to generate renewable/low carbon sustainable heat and maximise the renewable heat potential given the limited alternatives within Stoke-on-Trent. It is considered that a standalone policy would be advised to emphasise the importance of it to meet targets within the city. Alongside this, there is the potential for heat pumps to utilise mine waters/geothermal, which is relevant to Stoke-on-Trent given its historic mining legacy. This could be identified directly in the renewable energy Policy or in the accompanying supporting text. It could also be considered in terms of its potential across the City area as a separate initiative that sits outside of the Policies within the emerging Local Plan.

8.9.4 The Policy approach needs to be sound and deliverable and given the identified constraints in Stoke-on-Trent should be broad enough to allow for a range of technologies both now and in the future.

8.9.5 The South Oxfordshire Local Plan 2035 (Adopted 2020) at Policy DES9: Renewable and Low Carbon Energy provides an example that has been found sound through Examination in Public:

"Policy DES9: Renewable and Low Carbon Energy
1. The Council encourages schemes for renewable and low carbon energy generation and associated infrastructure at all scales including domestic schemes. It also encourages the incorporation of renewable and low carbon energy applications within all development. Planning applications for renewable and low carbon energy generation will be supported, provided that they do not cause a significantly adverse effect to:
i) landscape, both designated AONB and locally valued, biodiversity, including protected habitats and species and Conservation Target Areas;
ii) the historic environment, both designated and non-designated assets, including development within their settings;
iii) openness of the Green Belt;
iv) the safe movement of traffic and pedestrians; or
vii) residential amenity.
This policy contributes towards achieving objectives 4, 5, 6, 7 & 8"

8.9.6 The Leeds Local Plan (Review) 2019 includes a Policy on Low Carbon Energy (EN3):

"POLICY EN3: LOW CARBON ENERGY
The Council supports appropriate opportunities to improve energy efficiency and increase the large scale (above 0.5 MW) commercial renewable energy capacity, as a basis to reduce greenhouse gas emissions. This includes wind energy, hydro power, biomass treatment, solar energy, landfill gas, and energy from waste. Protection of internationally designated nature conservation sites will be a key consideration, including relevant Policies contained as part of the Natural Resources and Waste Local Plan. Proposals for biomass power generation are required to supply an assessment of the potential biomass resource available (including location) and the transport implications of using that resource. Any development that may lead to an adverse effect on the integrity of a European site will not be supported."

8.9.7 Given the relatively limited opportunities for certain renewable energy generation technologies in Stoke-on-Trent, there is a need to ensure that future opportunities are considered to address the need for climate adaptation and mitigation. It is recommended that a Policy is formulated that does not preclude a broad range of renewable technologies (i.e. non-prescriptive), but that can refer to potential impacts through appropriate criteria possibly similar to the South Oxfordshire example.

8.9.8 The Policy should embrace existing and the potential for new technologies within the Local Plan period. The Policy can make reference to the Climate Change Policy and vice versa without replicating one another. As indicated, the opportunities for large scale wind are unlikely to materialise in Stoke-on-Trent due to the topography. However, there have been a number of smaller scale wind opportunities that have

been promoted and approved in the city. It is considered that there is a need to have a Policy that addresses this potential and provides sufficient criteria to allow for appropriate assessment of impact on amenity, biodiversity and landscape balanced against more positive environmental, economic and social benefits.

8.10 SUMMARY OF CLIMATE CHANGE POLICY CONSIDERATIONS

8.10.1 Addressing climate change through the Local Plan is an important part of the wider tool kit to climate adaptation and mitigation strategies. Climate Change can be addressed in both direct and non-direct Policies and runs as a thread through the Local Plan. As this assessment indicates, there are opportunities to address climate change in Stoke-on-Trent, but it must also be acknowledged that the nature of the City area is such that opportunities for certain approaches is somewhat limited.

8.10.2 The Local Plan therefore needs to have inherent flexibility. It should seek to ensure that opportunities for adaptation are realised (e.g. through retrofitting council properties and encouraging other land and property owners to do similar) and encouraging renewable energy generation where appropriate. Opportunities arising from the recent Government pledges should be considered in detail as the local plan emerges and identified in Policy if appropriate. It is recommended that a broader reference to national strategies is made in the local plan, as these may change during the plan period.

8.10.3 The opportunities for natural capital enhancement and preservation alongside carbon sequestration opportunities should be encouraged in Stoke-on-Trent referenced in the emerging Plan Policies.

8.10.4 Transport is a key factor, and the Plan should strongly encourage sustainable modes of travel linking to wider transport strategies. In Stoke-on-Trent, this includes facilitating the move to greater use of electric vehicles and the associated energy requirements for EV charging infrastructure. There is also use of the railway and considering opportunities for improving connections from the main station to the City Centre, for example.

8.10.5 Renewable energy schemes should be encouraged and can be subject to a separate criteria-based policy to ensure suitability for development. It is noted that in Stoke-on-Trent there has been a number of smaller scale wind generation schemes, and it would be appropriate to include a criteria-based policy separate to a broader renewables policy. A broader renewables policy would allow flexibility for emerging new technologies within the plan period.

8.10.6 A summary of our recommended approach to Policies to address climate change are as follows:

Climate Change Policy Area	Recommendations/ Areas to consider	Standalone or Combined Policy	Cross-Reference(s)	Monitoring indicators
Climate Change and the Climate Emergency	Reference to national and local policies and declarations. Address climate change indicators and broad areas within the Policy with cross-references to other parts of the Plan	Within Climate Change Policy	Renewable energy; small wind energy generation; sustainable building; transport; flood risk; trees; biodiversity & geodiversity; agricultural land/ soils	Sustainable measures included in development
Sustainable Building Design and Construction	Separate development management policy but should be identified/ linked to the Climate Change Policy; considerations of national energy efficiency and building standards should be identified; Policy needs to consider the Government move to Net Zero by 2050, but there will be a need to consider viability through the local plan. A higher level should be considered and the aspiration for net zero should be referenced. The requirements can differentiate between minor and major development (as defined by development management indicators). Building Regulation requirements will need to be met by the developer and care that there is no duplication but also that	Standalone and referenced within Climate Change Policy	Climate Change; general development management policies	Number of developments built at what level of standard

	there is a level of consistency (the policy can be aspirational above but care should be taken in 'requiring' measures that will affect deliverability).			
Energy Efficiency	Within Sustainable Building Policy and in the Climate Change Policy; Policy needs to be realistic and deliverable. This will be balanced against what is aspirational and what would significantly impact on delivery of development targets in Stoke-on-Trent.	Within Sustainable Building Policy and in the Climate Change Policy	Climate Change; general development management policies	To what standard a development has/proposed to be built to
Carbon Sequestration & Natural Capital	Include within Climate Change Policy. Refer to the need for development to consider potential environmental enhancements such as additional planting and protection of areas that provide opportunities for sequestration and have a natural capital value or potential.	Within Climate Change Policy	Trees; biodiversity & geodiversity; agricultural land/ soils	Amount of Biodiversity net gain per development
Sustainable Transport	Separate development management policy but should be identified within the Climate Change Policy. The policy should refer to sustainable transport measure in general such as reducing the need for travel and promotion of modes other than the private car. EV charging can also be considered here alongside other initiatives in line with any requirements on provision of charging points.	Standalone and referenced within Climate Change Policy	Climate Change	Sustainable transport indicators i.e. Number of EV Charging Points

Renewable Energy Generation and Storage	Policy addressing impacts of a range of renewable energy proposals appropriate to Stoke-on-Trent; Brownfield ahead of greenfield; loss of agricultural land, particularly best and most valuable (BMV) land as part of food security, although development can also provide enhancements to biodiversity; suitable and compatible within the proposed location; no significant adverse impact on local amenity by virtue of noise, overshadowing, emissions and odour, visual intrusion or on the surrounding landscape or townscape, ecology and wildlife, or heritage assets.	Standalone	Climate Change	Number of developments / capacity / generation
Renewable Heat	Policy specifically dealing with the opportunities in Stoke-on-Trent as this is a key policy area given the proportion of Stoke emissions that arise from space and water heating. The use of the policy may be directed depending on scale of development as smaller developments may not be able to be linked to any network by themselves.	Standalone	Climate Change; building; general development management policies	Number of developments which include renewable heat or ability to be incorporated to renewable heat

Small Wind Energy Generation	Criteria -based Policy specifically addressing single or small collections of smaller scale (e.g. monopole up to 10-15m to blade tip) wind turbines that are proposed to power single operations or developments. These may be ground or building mounted. This is in contrast to large single turbines or windfarms that will be considered if forthcoming by the Policy above on renewable energy generation and storage. Consideration against PD rights may be necessary to ensure no conflict. The policy needs to consider potential for impact on a range of factors to allow development management teams to properly assess any impacts and to give applicants some clarity on what will be required. This will include siting and design to address visual impacts; natural environment impacts such as any protected areas on site and potential wildlife impacts of blades; impact on the historic environment and assets either on site or in the setting of assets; impact on amenity (noise, visual intrusion and shadow flicker, including cumulative visual impact);	Standalone	Climate Change	Number of developments/ generation / capacity

	landscape impact; consideration of grid connections and site requirements; air traffic (including glint and glare and radar consideration where appropriate);; proposals to be considered in the light of potential community benefits and there will be a need to consider community engagement.			

Appendix A - Potential Development Areas for Large-Scale Solar

Appendix B - Historic Adverse Weather Events

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STOKE-ON-TRENT
Sir Henry Doulton House
Forge Lane
Etruria
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Two Devon Way
Longbridge Technology Park
Longbridge
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B31 2TS
Tel: +44 (0)121 580 0909

BOLTON
41-50 Futura Park
Aspinall Way
Middlebrook
Bolton
BL6 6SU
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BRISTOL
Desklodge
2 Redcliffe Way
Bristol
BS1 6NL

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6 Brunel Business Court
Eastern Way
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Suffolk
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