Bath & North East Somerset Council

Climate Emergency Study: Synthesis of Evidence

In July 2019, the Council engaged consultants to provide high-level evidence to inform action in response to the Bath and North East Somerset Climate Emergency Resolution. The Centre for Sustainable Energy (CSE) delivered Section 4, Anthesis carried out the other Sections:

1. **The district-wide carbon footprint** and profile from activities within the district;
2. **Future emissions pathways** to 2030 and 2050 taking into account our 2030 target, the Intergovernmental Panel on Climate Change (IPCC) science based targets and what can be achieved based on known technology and present-day evidence;
3. **District-wide 'consumption' emissions** arising through the lifecycle of products and services purchased in the district;
4. **Household carbon footprints;**
5. **Emissions from large institutions;**
6. **The Council's emissions** from energy use and the goods and services we procure.

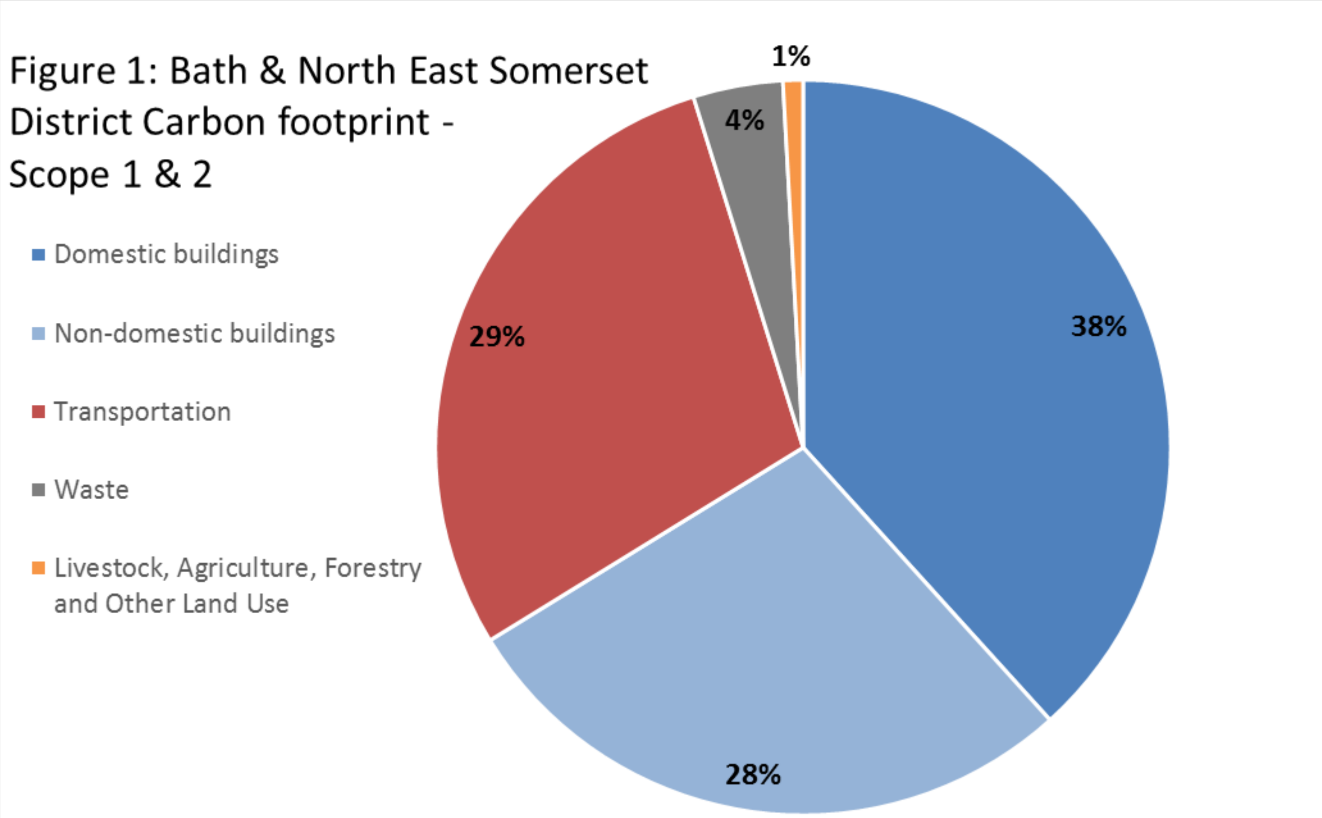
This report has been produced by the Council as a synthesis and explanation of the evidence that the consultants produced. For the full evidence, please refer to Anthesis slides for Sections 1,2,3,5,6 and the CSE report for Section 4. All sections are high-level and indicative only; a starting point for conversation. The results speak to the many actions that could be taken in the district, and an indication of the carbon savings that could result.

Three clear priorities for action emerge for cutting emissions from the biggest segments of the B&NES carbon footprint:

1. **Energy efficiency improvement** of existing building stock on a large scale is required and zero carbon new build, since energy use in buildings constitutes 66% of the area's in-district carbon footprint, and the largest single portion of the household footprint. Domestic retrofitting is aligned with the Council's priorities for delivering for residents and focussing on prevention[i] since retrofitting can support public health and low income and vulnerable people, a higher portion of whom live in the energy inefficient houses. It is also an area in which in-district action can have significant impact.
2. **Transport:** This is a further 29% of the district's footprint, and depending on income and other factors is a large component of the household footprint. Again, action on transport can be strongly influenced by local action and can help deliver on other council priorities.
3. **Local renewable energy generation**: This research sets out a pathway for decarbonisation that includes measures to electrify heat and transport. The carbon saving from these measures depends on an ample supply of renewable energy, the deployment of which can be facilitated by in-district action and will bring social and economic co-benefits.

1. The district-wide carbon footprint

Figure 1 is a snapshot of district-level greenhouse gas (GHG) emissions, using the SCATTER[ii] Inventory, originally funded by Government for use by local authorities.



SCATTER uses the Global Protocol for Community-Scale GHG Emission Inventories[iii] (GPC). The GPC covers carbon dioxide (CO_2) and other greenhouse gases such as Nitrous Oxide (N_2O) and Methane (CH_4). To express this mix of gases as a "carbon footprint" a CO_2 equivalent (CO_2e) is used taking into account the different warming potential of these gases.

The district footprint includes two GPC emissions categories: "Scope 1" (direct) emissions from sources within the district boundary, e.g. from burning petrol, diesel or natural gas and Scope 2 (indirect) emissions from the use of grid-supplied electricity[iv] that may be generated outside the district. Scope 1 and 2 emissions are around **766,876** tonnes of CO_2e per year ($t/CO_2e/yr$). The main sources are:

- Energy use in buildings: **66%** and **507,808**$t/CO_2e/yr$, consisting of emissions from
  - Homes: 38% of the total and **293,585t/**CO_2e/yr
  - Non-domestic buildings: 28% of the total and **214,223**$t/CO_2e/yr$.

- Transport: **29%** and **216,110**$t/CO_2e/yr$.

The GPC method used above shows in-district land use as a very small source of emissions. This includes emissions from livestock in the district and emissions released or absorbed by different land uses and management practices (e.g. fertiliser). However, this is a complex area. Further work would be needed to produce a more accurate picture and to consider in tandem how to respond to the Ecological Emergency that is part of the Climate Emergency. This includes species extinction, loss of habitat and habitat connectivity, the decline in pollinators and the loss of and decline in the health of the soil itself.

As has been recognised by the IPCC and the UK's Climate Change Committee, alongside a reduction in emissions there is a need to increase carbon absorption, also known as sequestration, by the natural environment. This can be through tree planning and restoration of peatland, for example, or through different methods of land management and agriculture that enable carbon to be drawn down into the soil.

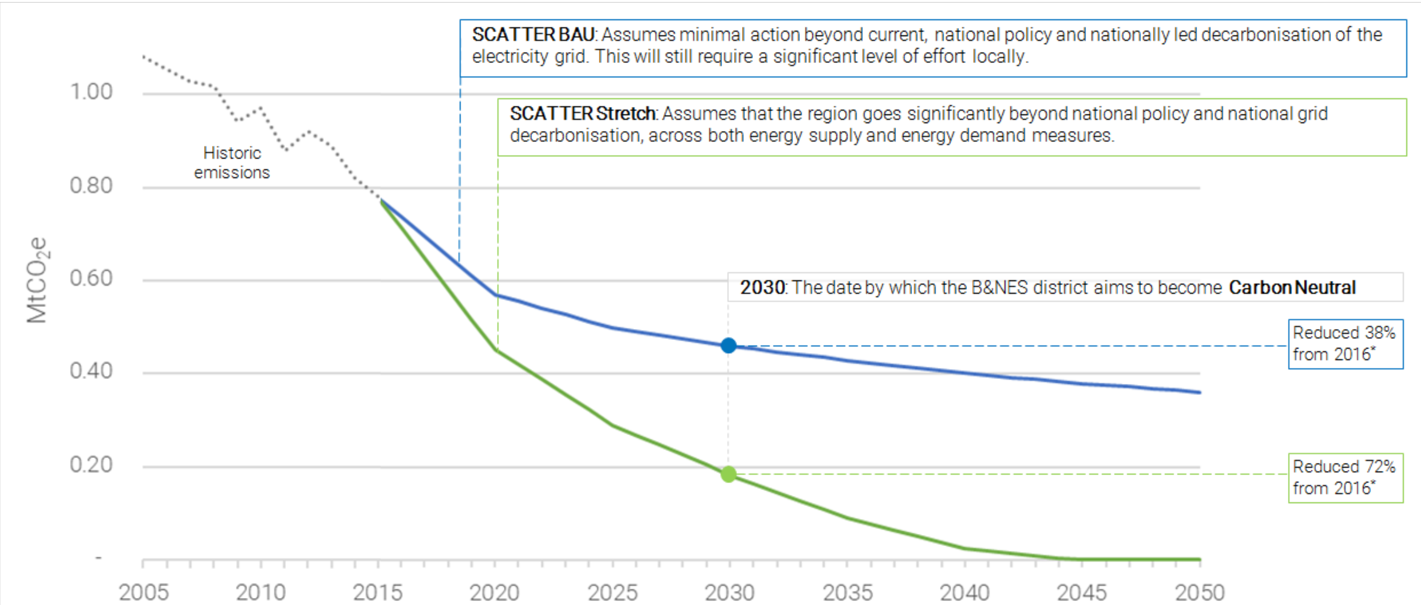
B&NES has an opportunity, given its large rural areas to increase the sequestration of carbon from the atmosphere by trees, grassland and soil. There is a long history of work to protect and enhance bio-diversity, landscape and ecology that could inform an approach. Future work would benefit from the involvement of key stakeholders including farmers and land-owners and a wide range of expertise in order to balance the following issues:

- Increasing carbon sequestration including consideration of the government's Climate Change Committee target of doubling tree cover in the UK by 2050 to help increase carbon sequestration.
- Increasing bio-diversity and the protection of habitats and species, including key pollinators and other insects that are vital to maintaining food supply
- Increasing soil health, reducing chemical fertilisers and pesticides and preventing soil erosion – all of which increases the soil's ability to absorb carbon
- Increasing local food production, utilising local productive capacity, through less intensive agricultural methods, as a number of local farmers already do and increasing access to fresh, seasonal local produce
- Increasing natural flood defence and mitigation, soil stabilisation and natural shading to improve resilience to the changing climate
- Protecting the beauty of our natural landscape, and enhancing the natural capital and ecosystem services it provides, whilst enabling sensitive renewable energy development, for example, and enabling more people to benefit from time spent in nature.

2. *Future emissions pathways*

Using national data scaled to the district, the SCATTER tool enables local authorities to sketch pathways (Figure 2) for reducing the emissions produced by the energy system. It presents a range of measures, e.g. home insulation, and allows users to select from four levels of ambition for each, with Level 1 being "Business as Usual" and Level 4, the "Stretch" pathway, deemed the maximum achievable based on present day technology and evidence.

Figure 2: B&NES Carbon Budget and Pathways for the Energy System: Million tCO_2e



The "**Business As Usual (BAU)"** pathway broadly equates to reductions in line with Government policy introduced to meet the original Climate Change Act target of an 80% reduction CO2 by 2050, prior to the adoption of the national net zero carbon (carbon neutral) 2050 target in June 2019[v]. The BAU pathway would achieve a 38% reduction in emissions by 2030 and would require more district action than currently planned. It would not achieve the national target of net zero carbon by 2050.

The **"Stretch"** pathway is Level 4 of the SCATTER tool; the highest level of ambition. It achieves a reduction of 72% by 2030 and zero carbon by 2050. There is still a gap between this and the Bath and North East Somerset aim of net zero carbon by 2030. This is because the Stretch pathway is based on present day evidence and judgment. The gap is expected to narrow as, for example, technologies develop and cost tipping points are reached, or if national policy or regulation causes a rapid market shift in either demand management or zero carbon energy supply. The figures on the Stretch pathway are indicative but need further refinement and **are not intended to be targets.**

In addition to the SCATTER pathways, the Tyndall Centre for Climate Change Research has produced an indicative carbon budget for all local authority areas by scaling down to a local authority level the global carbon budget that must be met in order to 'likely' keep temperature change "well below 2°C and pursuing 1.5°C" in line with the international Paris Agreement. This budget is shown in the Anthesis slides.

Table 1 shows the deployment scale for the main measures to reduce energy demand ("demand side measures") on the Stretch pathway. The numbers serve only to indicate the scale of action needed and are likely to change as local information is gathered.

Table 1: Contribution of Demand Side Measures to SCATTER Stretch pathway

Demand-Side measures	Cumulative savings to 2030 ($ktCO_2e$)	Scale of action (NOT targets). Headline measures only, other measures detailed in full report
Domestic lighting, appliances & cooking	781	• 23% reduction in energy used by lighting and appliances • 76% electric cooking (moving away from gas)
Domestic insulation, temperature controls and heating replacement	755	• Existing homes retrofitted (Table 2) • All new homes built to Passivhaus standard equivalent • 40% of heating systems electric, mostly renewable e.g. heat pumps
On-road transport	1098	• 25% reduction in car use km per person per year • Modal shift creates 7% reduction in car travel • Electric cars: 76% pure battery EV, 14% Petrol Hybrid EV • 76% electric buses, 24% hybrid buses
Freight	263	• 37% of freight rail is electric • Road freight remains diesel
Passenger Rail transport	120	• 100% passenger rail electrification
Industrial processes	373	• 16.5% reduction in industrial energy demand • 44% of industrial processes are electric
Commercial insulation and heating replacement	252	• 24% reduction in heating and cooling demand • 54% electric heating, mostly renewable • *Work underway on new build standards for non-domestic*
Commercial lighting, appliances & cooking	99	• 11% reduction in lighting and appliance consumption
Waste treatment	92	• 8% decrease in household waste • 9% increase in household recycling rate

Table 2: Retrofit measures for existing homes: Cumulative	2025	2030	2050	% of available homes (at 2050)
Solid wall insulation	11,535	14,739	21,215	24%
Cavity wall insulation	24,175	24,175	24,175	28%
Floor insulation	13,161	16,817	31,441	36%
Super-glazing (triple glazed standard)	26,168	33,436	62,511	72%
Loft insulation	35,411	43,339	59,195	68%
Draught proofing	66,438	66,473	66,615	76%
Average heat loss/home (Watts/°C)	183	158	58	

The measures in Table 1 either reduce the amount of energy used, or switch from using a fossil fuel (e.g. gas or petrol) to electricity. The latter relies on the assumption that the electricity grid continues to become less carbon intensive as renewable electricity increases. For example, to deliver the Stretch savings for electric cars, they must run on increasingly green electricity.

To ensure the decarbonisation of electricity supply, the Stretch pathway calculates the district's contribution to the maximum national deployment of renewable electricity technologies or "supply side measures". The figures in Table 3 were produced by scaling down national estimates of renewable energy resource and maximum deployment to a district level. It does not take into account local factors. For comparison, Table 2 also references the Council's previous work to assess the district's renewable resources, namely a 2010 study[vi] which was updated in 2018[vii]. This work produced "technical potentials" for renewable energy measures based on physical and technological constraints and also "practical potentials" incorporating assumptions about the social constraints at the time, e.g. market conditions and public acceptance. The practical potentials are the basis for the renewable energy target in the Council's Placemaking Plan[viii]. To provide a sense of the challenge, Table 3 also shows the current (2018) installed capacity:

Table 3: Supply-side measures on the SCATTER Stretch pathway

Supply Side Measure	Scale of action (NOT targets) for headline activities	SCATTER Stretch Installed Capacity	Current installed capacity 2018	District resources, from B&NES studies
Solar PV	PV on 50% of homes 116 football pitches of PV on commercial roofs or fields	210MW	18.2MW	Technical potential: 278MW Practical potential: 142.2MW
Onshore wind	28 large scale turbines.	70MW	0.1MW	Technical potential: 62 large turbines, 155MW Practical potential: 17 large turbines and 45MW
Biomass for electricity	From anaerobic digestion or sewage gas (burning certain types of biomass may present risks to air quality, food growing, biodiversity and soil health).	28MW electricity	0MW electricity 6.3MW heat	Technical potential: 0.002MW electricity and 26.8MW heat (from 2010 study, technology has advanced) Practical potential: 1.6MW electricity and 3 MW heat
Hydro power		7MW	0.1MW	Technical potential: 5MW Practical potential: 0.3MW

The Stretch figures above illustrate a national level of ambition that could be needed to reach net zero by 2050, and a proxy for what the district's portion of that may look like. These figures exceed the local technical potential as assessed in previous studies for hydro and biomass and the practical potential assessed for all technologies. Also, SCATTER does not compare supply with local demand to consider how much supply is needed to make the district "self-sufficient" in energy. This would require further assumptions about the future local energy mix, technology and localised demand. Such an exercise, whilst still inherently imprecise, could refine our understanding of the level of deployment needed to ensure that the demand-side measures have enough renewable electricity supply to deliver their necessary savings.

3. District-wide 'consumption' emissions

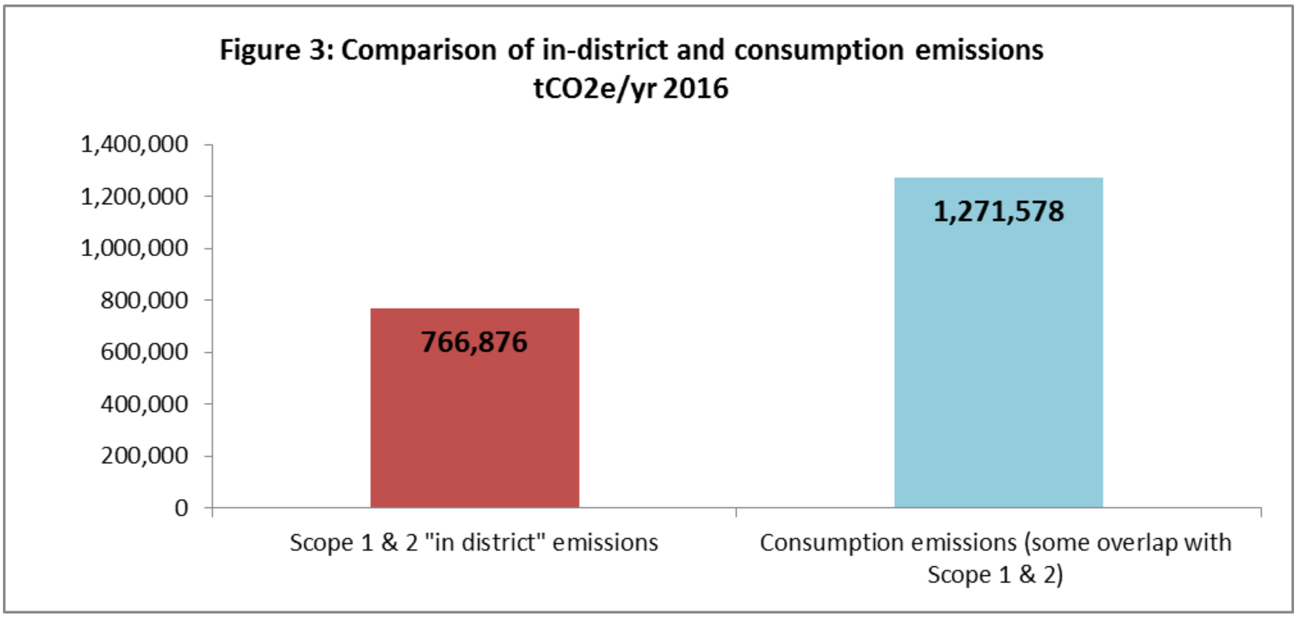
Consumption-based emissions are the emissions from products produced in an area, plus emissions imported (embodied in good or services produced outside the district but consumed within the district), minus emissions exported out of an area. Traditional carbon accounting often does not consider the impact of imported emissions, however research suggests that these imports could represent 45% of GHG emissions associated with UK consumption[1]. As such, when used alongside traditional accounting methods, consumption-based emissions assessments can provide a more complete picture of the environmental impact of a country or region albeit for emissions that may be harder to control through in-district activity.

A detailed assessment of consumption emissions in the district was beyond the scope of this study. However, a high-level calculation was performed to provide an estimate of the magnitude, as well as the sectors responsible for consumption-based emissions in the district.

The methodology drew on national datasets for UK consumption emissions over time as researched by Department for Environment, Food and Rural Affairs (DEFRA) and University of Leeds. This data was split out by 17 Standard Industrial Classification (SIC) categories, which in turn are comprised of 106 activity types. Economic data for Gross Value Added (GVA), researched by the Office for National Statistics has been utilised in the methodology. This is defined as the value of goods or services produced in an area and is split into the same SIC categories. This GVA data is available both at a national and a local authority level.

The methodology makes an assumption that economic activity and carbon consumption are closely related, enabling the national (UK) consumption-based emissions to be scaled down to a local authority by allocating emissions in the same ratio as the B&NES local authority GVA (for each SIC sector) to UK GVA. The ratio of local to national emissions resulting from this method was found broadly consistent when cross-checked against the ratio of B&NES population to the UK population.

The results indicate that in 2016 consumption-based emissions for the B&NES area totalled **1,271,578 tCO_2e.** This is 1.7 times more than the in-district emissions, albeit there is some overlap since it includes the consumption of goods and services produced in the district whose production emissions would also have been counted in Scope 1 and 2.



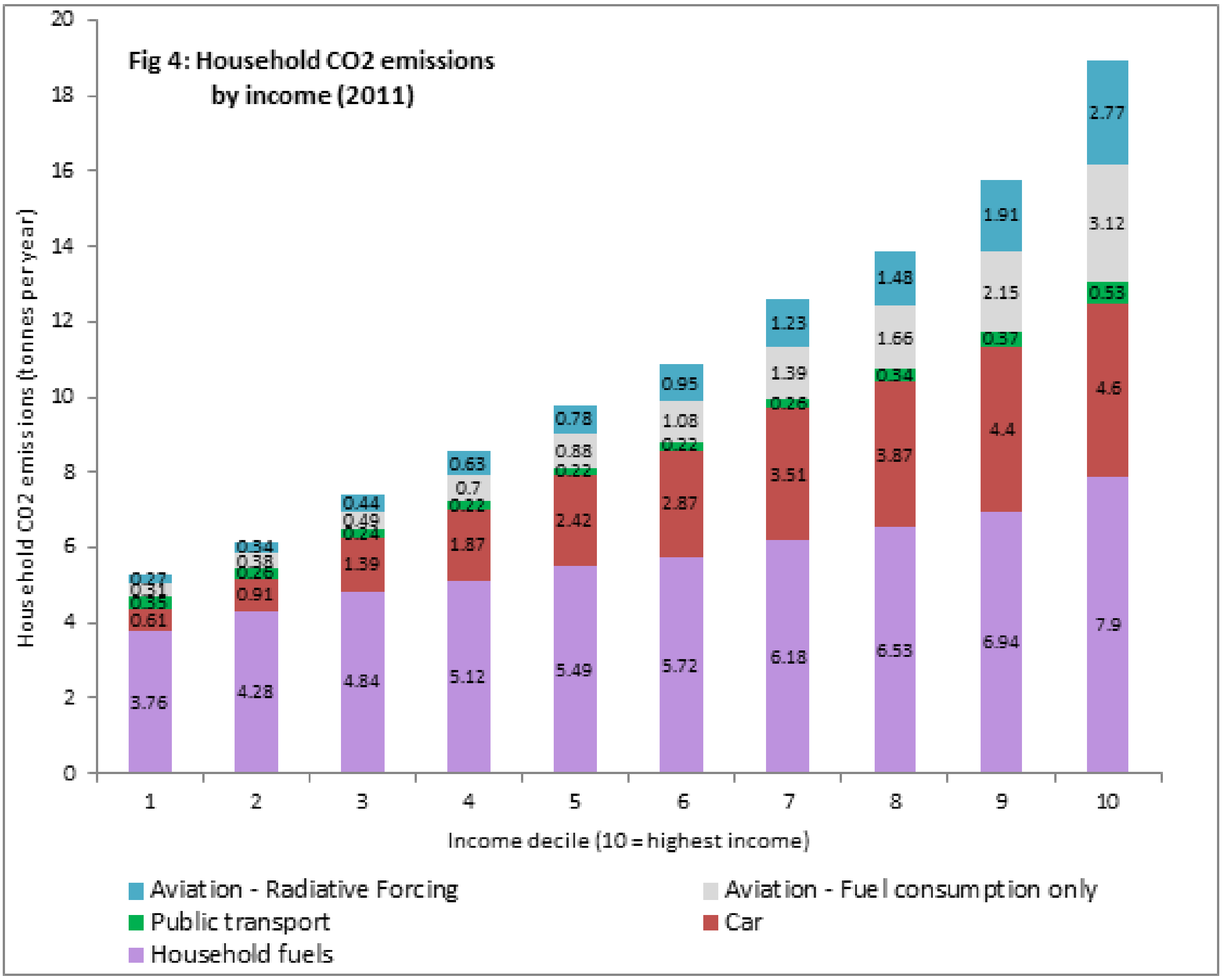
Between 2007 and 2016 consumption-based emissions decreased from around 2 million tCO_2e. This is likely due to both efficiency improvements within processes and supply chains as well as the economic recession impacting the volumes of goods and services consumed. The SIC categories with the largest emissions are manufacturing, utilities[ix] and mining, illustrating that these aspects of production contribute most to the emissions of products consumed. The most significant source of demand for products and services was identified as households. This indicates that both reducing household demand for carbon intensive products and continuing to increase production efficiency could help reduce consumption emissions. For example, purchasers could require suppliers to demonstrate how they are reducing the embodied emissions in their products.

4. Household carbon footprints based on income

The Council is committed to ensuring that the transition to a zero carbon future is a just one. The research we have undertaken can contribute to the debate that will be needed across the community about where responsibility for action lies and about how we can support the vulnerable and those on a low income, a higher proportion of whom live in the inefficient homes, for example.

The Centre for Sustainable Energy (CSE) looked at the significant relationship between household[x] carbon footprints and income deciles in three key areas: home energy use; ground transport and air travel. The headline findings presented here are based on national, not local data and derive from a study conducted from 2011-2013. However, the trends are likely to be similar today and in Bath and North East Somerset.

Figure 4 shows that on average across the UK, without counting radiative forcing (see description below) the carbon footprint of the wealthiest 10% of households is around **16.14 tCO_2e/yr** and more than three times the **5.03 t CO_2e/yr** of the least wealthy 10%. With radiative forcing, this is **18.92 t CO_2e/yr** against **5.3 t/CO_2eyr**.



Household fuels are the single largest source of carbon emissions overall, and emissions from the wealthiest 10%, at 7.9t CO_2e/yr are around double those of the least wealthy 10% at 3.76 tCO_2e/yr. To refine the picture on domestic emissions, CSE used a further methodology, the National Household Model (NHM). Rather than looking at assumed household fuel consumption as per Figure 4, the NHM considers housing stock types and energy behaviour across income brackets, e.g. that lower income people tend to under-heat their homes. Figure 5 shows that the results largely correlate with those in Figure 4, with domestic emissions increasing with income. However, this trend was bucked by the least wealthy decile:

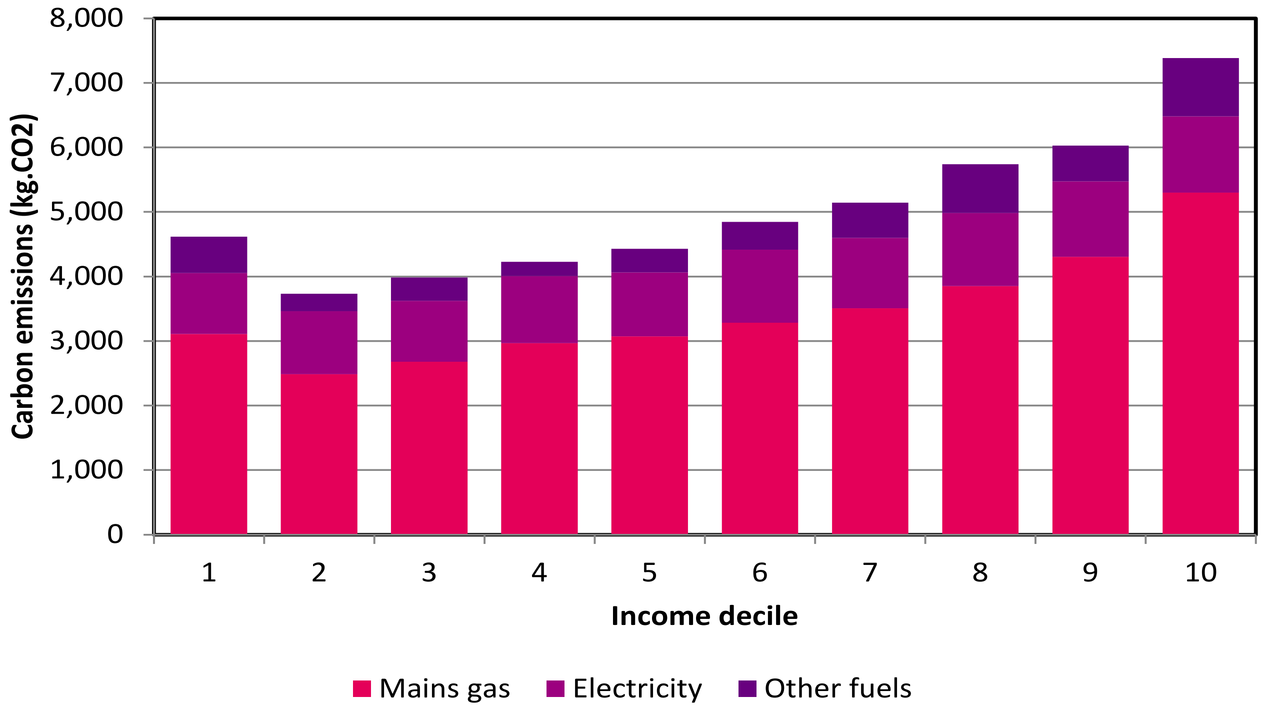


Figure 5: Household Emissions by income decile (tonnes of CO_2/ yr) using NHM (2011)

CSE suggests that this may in part be due to the disproportionately higher number of households in the lowest decile living in the least energy efficient homes, as shown in Figure 7. For most income deciles, between 7% and 8% of households live in homes rated in Energy Performance Certificate (EPC) bands F and G - the least efficient dwellings. However, for the lowest earning 10% this proportion increases to almost 14%. There is a large difference between the emissions of the highest and lowest EPC band (Figure 6).

Fig 6 Average Emissions by EPC band (tCO2/yr)

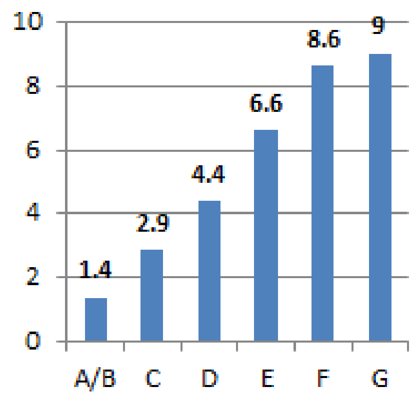
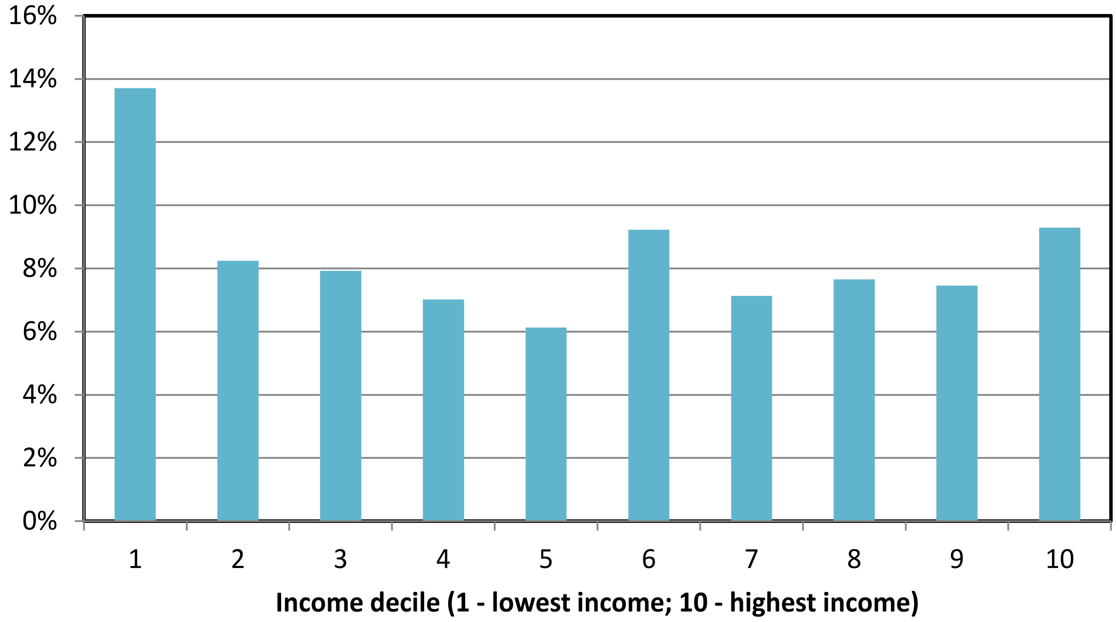


Figure 7: Income decile and % of households in EPC bands F & G.

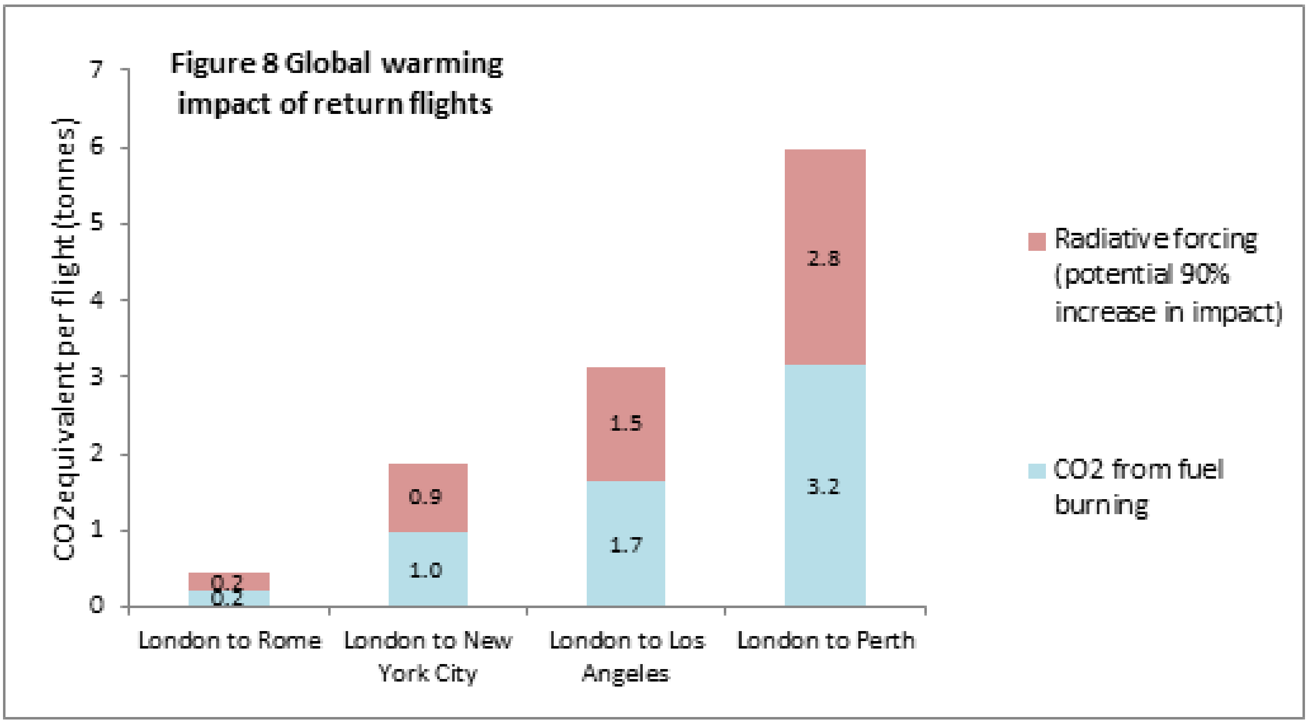


District analysis showed the geographic distribution of energy inefficient homes; in parts of the district dwellings rated in bands F and G comprise **31%- 50% of all dwellings**.

Car emissions: The wealthiest decile produced more than 7 times more emissions from car emissions than the least wealthy decile. Whilst it was not the intention of this work to produce a major travel study, and it should be read in conjunction with existing research[xi], CSE's report illustrates the geographic dimension to car use. Some areas have a high dependency on cars for commuting and there are areas where the average distance travelled to work is less than 10km providing possible scope for shift to lower carbon transport.

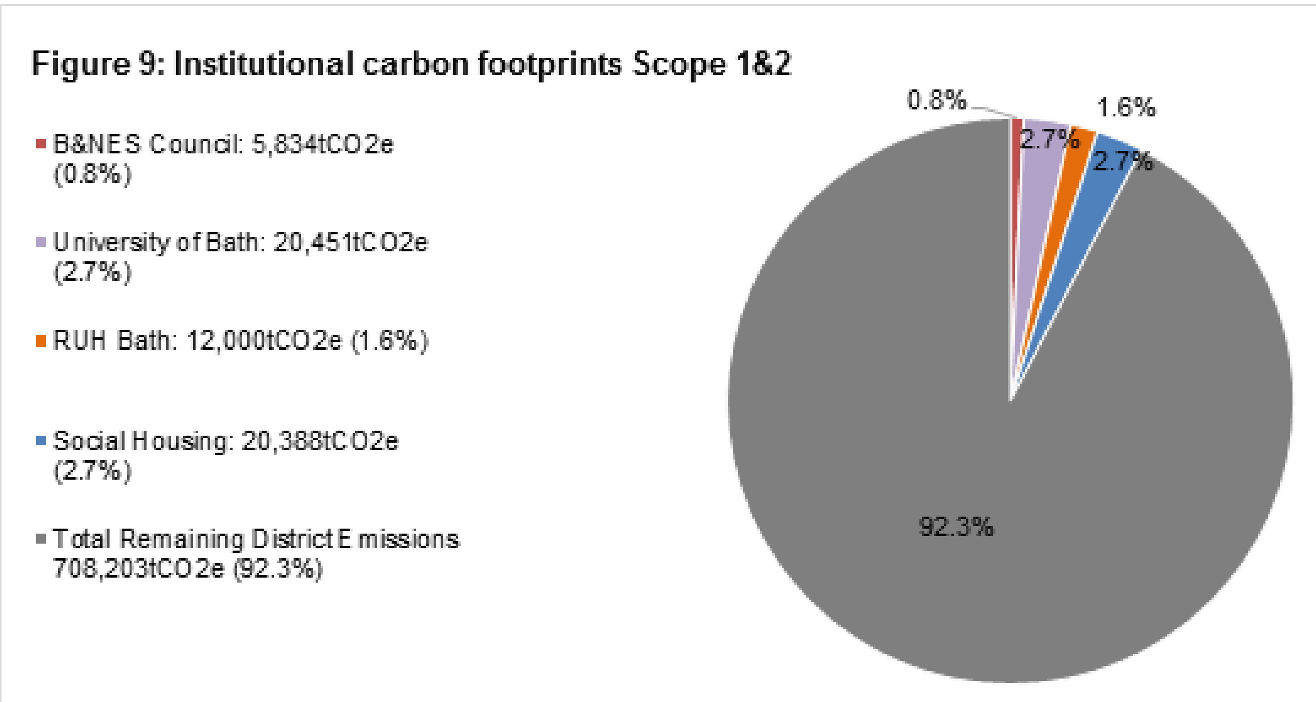
The aviation emissions of the wealthiest decile were 10 times those of the least wealthy. In addition to the impact of CO2 from burning aeroplane fuel, CSE considered radiative forcing, whereby water vapour from aeroplane engines acts as a temporary greenhouse gas and may add a further 90% to the impact of CO_2 emissions from aviation, although there is significant scientific uncertainty about the magnitude of the effect.

The aviation data presented here is illustrative only. For example, those on higher incomes are more likely to be taking multiple overseas trips and travelling further afield on longer-haul flights, whereas less wealthy households are more likely to be taking fewer trips per year on shorter-haul flights. Therefore this illustration may underestimate the disparity between people on different incomes. Figure 8 has been added to indicate the climate impact of flights[xii] to enable comparison with the carbon footprints in Figure 4.



5. *Emissions from large public institutions*

Large public institutions within the district can lead by example through their operations and supply chain. Data on Scope 1 & 2 emissions is included for the Council and the University of Bath. Time constraints for this work have precluded requesting data from other large institutions, so estimates have been produced for illustrative purposes. Figure 9 shows that the footprint from four large institutions could constitute around 8% of the district's emissions. This does not consider procurement or Scope 3 emissions which at least for the Council are far greater than the Scope 1 & 2 emissions.



6. The Council's emissions

The study presents the emissions generated by the Council's own estate and operations in accordance with the World Resource Institute's Greenhouse Gas Protocol (2004). Scope 1 emissions are from natural gas for heating plus fuel for owned and controlled fleet vehicles. Scope 2 is from purchased electricity. Together, Scope 1 and 2 emissions comprise **5,834 tCO_2e /yr**, as illustrated in Figure 10. Building electricity (which also includes non-building uses such as streetlights, parking meters etc.) is the largest portion of this, followed by fleet vehicles. Scope 1 and 2 emissions are **0.7%** of the district's Scope 1 and 2 emissions (rounded up to 1% in Fig 11).

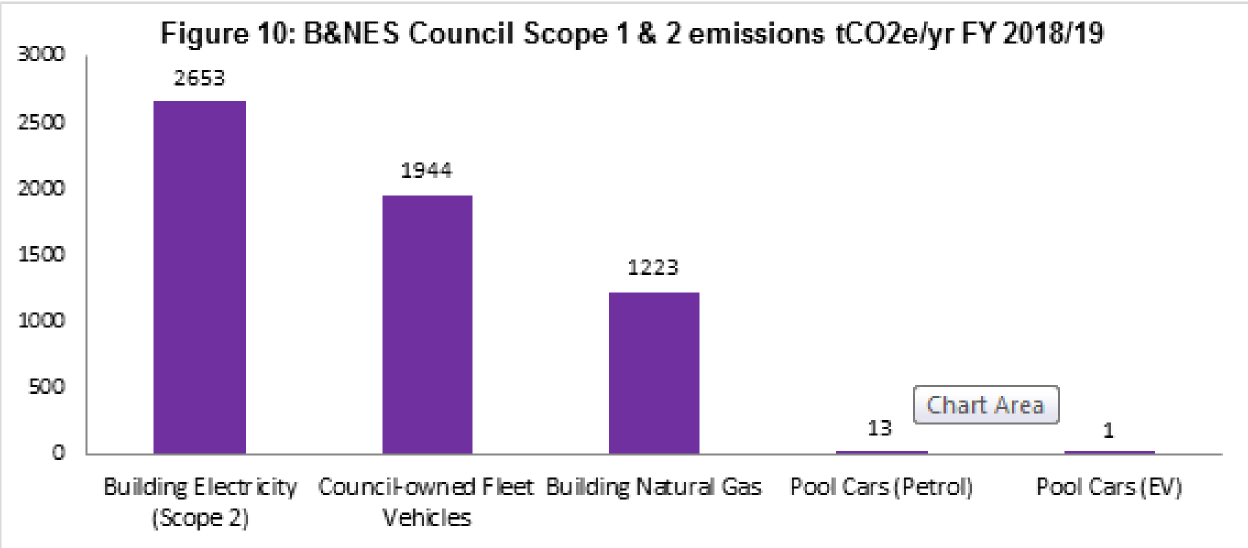
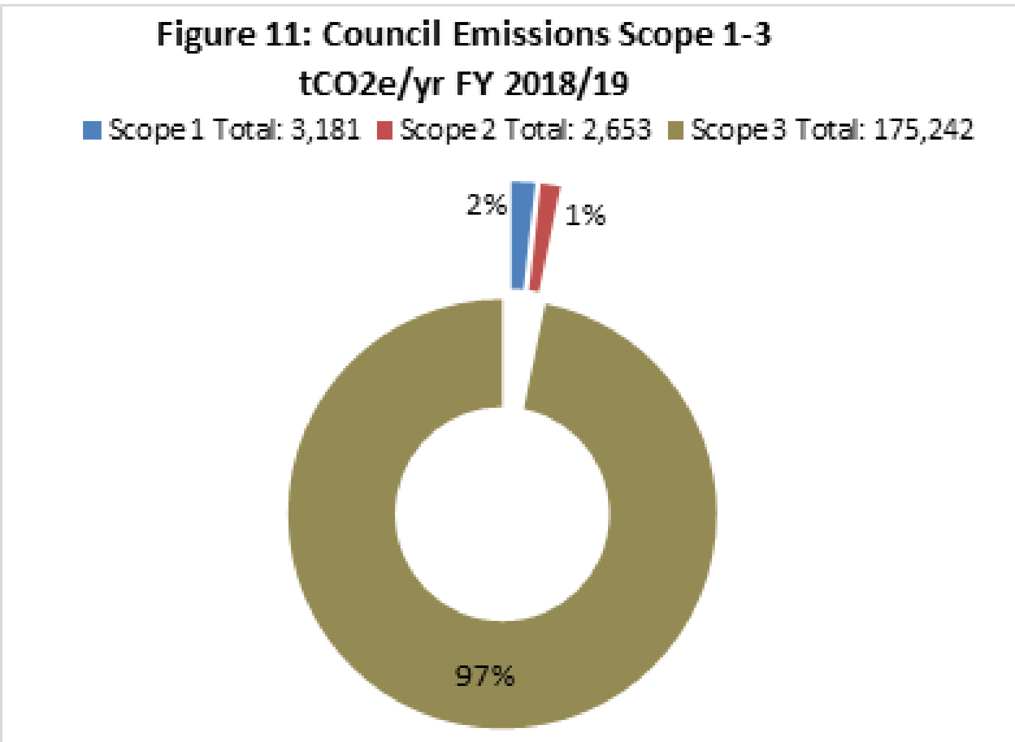
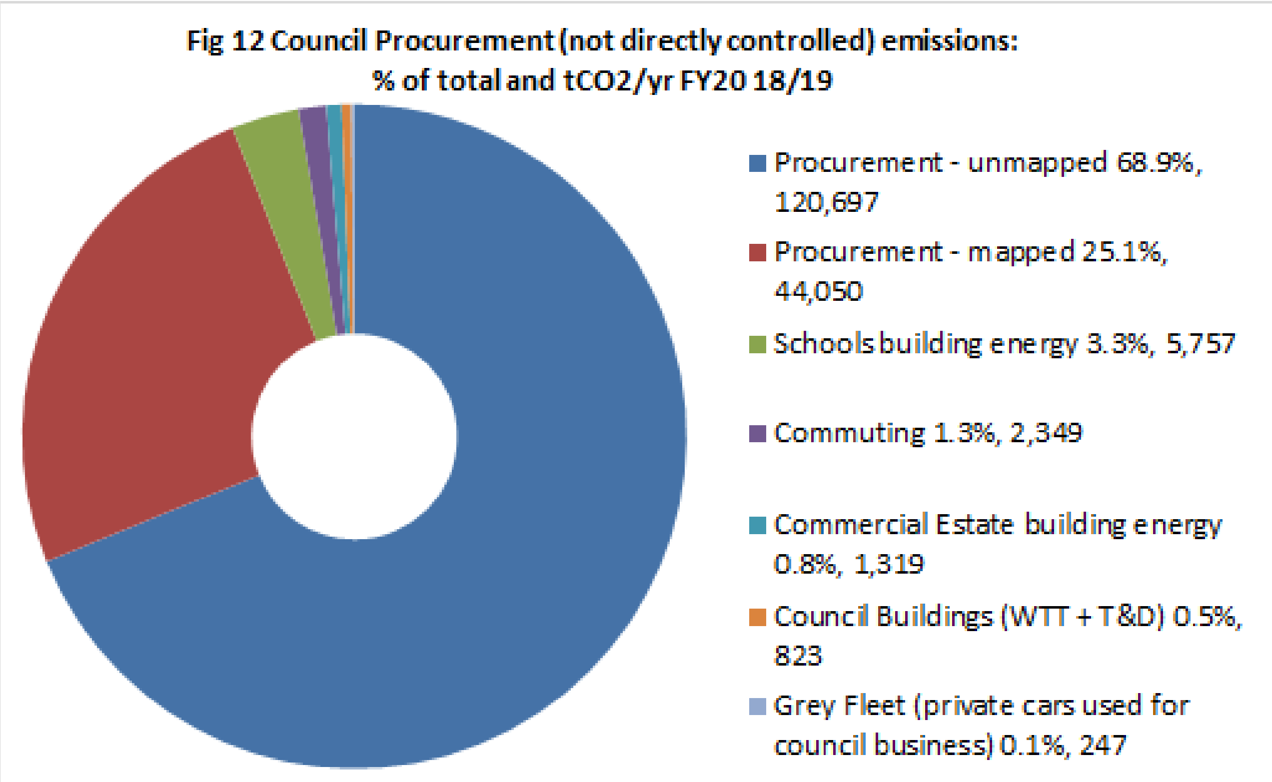


Figure 11 illustrates that Scope 1 and 2 emissions are dwarfed by Scope 3, the emissions arising from Council activity and expenditure which may be influenced but are not directly controlled by the Council.



It was

beyond the brief of this study to do a full Scope 3 assessment for the Council, but for an indication Anthesis updated a 2010 study of procurement emissions using FY2018/19 expenditure figures (Fig 12). The 2010 study had looked at the carbon intensity of categories of Council expenditure to calculate a footprint (using a similar approach to Section 3: Consumption emissions). For example, for expenditure on furniture, an emissions/pound spent figure could be used to calculate total emissions from that category of expense.



At an estimated **175,242 tCO_2e/yr** the procurement emissions dwarf those in Scope 1 and 2 and the Council recognises the need for action even if these emissions are harder to influence. Procurement (unmapped) is expenditure that has not been classified into the categories used in the 2010 study. This includes the building-related and transport emissions from a range of health and social care services, such as care homes, which are run by contractors procured by the Council but not directly under the Council's control. An average of the carbon intensity of all categories of expenditure in the 2010 study was used as a proxy. Due to this lack of data it is very likely that this footprint has been exaggerated, rendering inaccurate any comparison between the procurement emissions of the Council and the district-wide consumption emissions. Work is underway by the Council to categorise this expenditure to better assess emissions.

Procurement (mapped) includes the expenditure that correlates to the categories used in the 2010 study which for Bath and North East Somerset Council included emissions from the Council's purchases of sewage and refuse services, construction and legal, consultancy and business services.

Schools comprise 3.3% of the procurement emissions. Schools are now separate to the Council since they became academies or are on their way to being academies. As such, schools' energy consumption is no longer counted as part of the Council's directly controlled operations (i.e. Scope 1 or Scope 2). Schools that are included within Scope 3 pay their own energy bills but are included in Scope 3 because they are part of the Council's energy contract to secure a good energy price.

The Council's commercial property estate is occupied by tenants who pay the bills and manage the buildings however the Council can influence the footprint through aspects of the building fabric and the tenancy arrangements. Commercial Estate emissions are likely to be higher than shown since the methodology made many assumptions e.g. it uses national building archetypes for different occupancy types. Within B&NES, many buildings will be older than the national average and in many cases listed buildings which are more likely to have a higher carbon footprint than assumed in this calculation.

A small portion of emissions arises from the production of energy used in the Council's buildings that is not captured in Scopes 1 & 2; the Well to Tank (WTT) emissions from extraction of energy resources and emissions from the Transmission and Distribution (T&D) of energy. Mobile emissions arise from employee commuting and the Council's "grey fleet" of personal vehicles used by employees on Council business.

References

[i] B&NES Council (2019) Council sets out its priorities and new financial plans https://www.bathnes.gov.uk/latestnews/council-sets-out-its-priorities-and-new-financial-plans

[ii] SCATTER tool: https://www.anthesisgroup.com/scatter-carbon-footprint-reduction-tool

[iii] https://ghgprotocol.org/sites/default/files/standards_supporting/GPC_Executive_Summary_1.pdf

[iv] Scope 3 emissions that occur outside the boundary from activities within the boundary are not fully assessed in this study however Section 3 "Consumption Emissions" hints at their scale.

[v] UK 2050 Net Zero Carbon target: Government "*PM Theresa May: we will end UK contribution to climate change by 2050*" 12th June 2019: https://www.gov.uk/government/news/pm-theresa-may-we-will-end-uk-contribution-to-climate-change-by-2050 "Net zero carbon" or "carbon neutral" means that any emissions that are not brought to zero must be offset by the same amount of carbon being by taking carbon out of the atmosphere or through measures outside of the target's area.

[vi] Camco (2010) "Renewable Energy and Planning Research Update" commissioned by B&NES Council: https://www.bathnes.gov.uk/sites/default/files/sitedocuments/Planning-and-Building-Control/Planning-Policy/Evidence-Base/Sustainability/renewable_energy_and_planning_research_-_november_2010.pdf

[vii] Regen SW (2018) "Renewable energy resource update report" commissioned by B&NES Council https://www.bathnes.gov.uk/sites/default/files/sitedocuments/Planning-and-Building-Control/Planning-Policy/LP20162036/bnes_renewable_energy_resource_update_report_2018_publication_version.pdf

[viii] Bath and North East Somerset Placemaking Plan: https://www.bathnes.gov.uk/services/planning-and-building-control/planning-policy/placemaking-plan

[1] DEFRA (2019) "UK's Carbon Footprint 1997 – 2016" https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794557/Consumption_emissions_April19.pdf For analysis, see Carbon Brief (2019) Guest post: The UK's carbon footprint is at its lowest level for 20 years https://www.carbonbrief.org/guest-post-the-uks-carbon-footprint-is-at-its-lowest-level-for-20-years

[ix] Utilities sector is defined as electricity, gas, steam and air conditioning

[x] The average household size in 2018 was 2.4 people https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/bulletins/familiesandhouseholds/2018

[xi] Further transport studies include the West of England Joint Transport Study https://www.jointplanningwofe.org.uk/gf2.ti/f/757442/31727173.1/PDF/-/JTS_Final_Report.pdf and the research underpinning the Getting Around Bath Transport Strategy https://www.bathnes.gov.uk/services/parking-and-travel/transport-plans-and-policies/bath-transport-package

[xii] The Guardian (July 2019) "How your flight emits as much as many people do in a year" https://www.theguardian.com/environment/ng-interactive/2019/jul/19/carbon-calculator-how-taking-one-flight-emits-as-much-as-many-people-do-in-a-year

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