Public Document Pack

Overview and Scrutiny Management Committee

Thursday 26 November 2020 at 10.00 am

To be held as an online video conference

The Press and Public are Welcome to Attend

Membership

Councillors Mick Rooney (Chair), Ian Auckland, Steve Ayris, Ben Curran, Denise Fox, Julie Grocutt, Tim Huggan, Douglas Johnson, Mike Levery, Cate McDonald, Sioned-Mair Richards and Jim Steinke

Substitute Members
In accordance with the Constitution, Substitute Members may be provided for the above Committee Members as and when required.

Sheffield City Council

PUBLIC ACCESS TO THE MEETING

The Overview and Scrutiny Management Committee comprises the Chairs and Deputy Chairs of the four Scrutiny Committees. Councillor Cate McDonald Chairs this Committee.

Remit of the Committee

- Effective use of internal and external resources
- Performance against Corporate Plan Priorities
- Risk management
- Budget monitoring
- Strategic management and development of the scrutiny programme and process
- Identifying and co-ordinating cross scrutiny issues

A copy of the agenda and reports is available on the Council's website at www.sheffield.gov.uk. You can also see the reports to be discussed at the meeting if you call at the First Point Reception, Town Hall, Pinstone Street entrance. The Reception is open between 9.00 am and 5.00 pm, Monday to Thursday and between 9.00 am and 4.45 pm. on Friday. You may not be allowed to see some reports because they contain confidential information. These items are usually marked * on the agenda.

Members of the public have the right to ask questions or submit petitions to Scrutiny Committee meetings and recording is allowed under the direction of the Chair. Please see the website or contact Democratic Services for further information regarding public questions and petitions and details of the Council's protocol on audio/visual recording and photography at council meetings.

Scrutiny Committee meetings are normally open to the public but sometimes the Committee may have to discuss an item in private. If this happens, you will be asked to leave. Any private items are normally left until last. If you would like to attend the meeting please report to the First Point Reception desk where you will be directed to the meeting room.

If you require any further information about this Scrutiny Committee, please contact Alice Nicholson, Policy and Improvement Officer, on 0114 27 35065 or email alice.nicholson@sheffield.gov.uk

FACILITIES

There are public toilets available, with wheelchair access, on the ground floor of the Town Hall. Induction loop facilities are available in meeting rooms.

Access for people with mobility difficulties can be obtained through the ramp on the side to the main Town Hall entrance.

OVERVIEW AND SCRUTINY MANAGEMENT COMMITTEE AGENDA
26 NOVEMBER 2020

Order of Business

1. Welcome and Housekeeping Arrangements

2. Apologies for Absence

3. Exclusion of Public and Press
To identify items where resolutions may be moved to exclude the press and public

4. Declarations of Interest
Members to declare any interests they have in the business to be considered at the meeting

5. Minutes of Previous Meeting
To approve the minutes of the meeting of the Committee held on 3rd September, 2020

6. Public Questions and Petitions
To receive any questions or petitions from members of the public

7. Addressing the Climate Emergency - An Update on Progress
Report of the Executive Director, Place

8. Draft Work Programme 2020/21
Report of the Policy and Improvement Officer

9. Issues to Report from the Scrutiny Committees
The Chairs of the Scrutiny Committees to report

10. Date of Next Meeting
The next meeting of the Committee will be held on Thursday, 17th December, 2020, at 10.00 am

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ADVICE TO MEMBERS ON DECLARING INTERESTS AT MEETINGS

If you are present at a meeting of the Council, of its executive or any committee of the executive, or of any committee, sub-committee, joint committee, or joint sub-committee of the authority, and you have a **Disclosable Pecuniary Interest** (DPI) relating to any business that will be considered at the meeting, you must not:

- participate in any discussion of the business at the meeting, or if you become aware of your Disclosable Pecuniary Interest during the meeting, participate further in any discussion of the business, or
- participate in any vote or further vote taken on the matter at the meeting.

These prohibitions apply to any form of participation, including speaking as a member of the public.

You **must**:

- leave the room (in accordance with the Members' Code of Conduct)
- make a verbal declaration of the existence and nature of any DPI at any meeting at which you are present at which an item of business which affects or relates to the subject matter of that interest is under consideration, at or before the consideration of the item of business or as soon as the interest becomes apparent.
- declare it to the meeting and notify the Council's Monitoring Officer within 28 days, if the DPI is not already registered.

If you have any of the following pecuniary interests, they are your **disclosable pecuniary interests** under the new national rules. You have a pecuniary interest if you, or your spouse or civil partner, have a pecuniary interest.

- Any employment, office, trade, profession or vocation carried on for profit or gain, which you, or your spouse or civil partner undertakes.

- Any payment or provision of any other financial benefit (other than from your council or authority) made or provided within the relevant period* in respect of any expenses incurred by you in carrying out duties as a member, or towards your election expenses. This includes any payment or financial benefit from a trade union within the meaning of the Trade Union and Labour Relations (Consolidation) Act 1992.

  *The relevant period is the 12 months ending on the day when you tell the Monitoring Officer about your disclosable pecuniary interests.

- Any contract which is made between you, or your spouse or your civil partner (or a body in which you, or your spouse or your civil partner, has a beneficial interest) and your council or authority –

  - under which goods or services are to be provided or works are to be executed; and
  - which has not been fully discharged.

- Any beneficial interest in land which you, or your spouse or your civil partner, have and which is within the area of your council or authority.

- Any licence (alone or jointly with others) which you, or your spouse or your civil partner, holds to occupy land in the area of your council or authority for a month or longer.

- Any tenancy where (to your knowledge) –
  - the landlord is your council or authority; and
  - the tenant is a body in which you, or your spouse or your civil partner, has a beneficial interest.

- Any beneficial interest which you, or your spouse or your civil partner has in securities of a body where -

  (a) that body (to your knowledge) has a place of business or land in the area of your council or authority; and

  (b) either -
    - the total nominal value of the securities exceeds £25,000 or one hundredth of the total issued share capital of that body; or
    - if the share capital of that body is of more than one class, the total nominal value of the shares of any one class in which you, or your spouse or your civil partner, has a beneficial interest exceeds one hundredth of the total issued share capital of that class.

If you attend a meeting at which any item of business is to be considered and you are aware that you have a **personal interest** in the matter which does not amount to a DPI, you must make verbal declaration of the existence and nature of that interest at or before the consideration of the item of business or as soon as the interest becomes apparent. You should leave the room if your continued presence is incompatible with the 7 Principles of Public Life (selflessness; integrity; objectivity; accountability; openness; honesty; and leadership).

You have a personal interest where –

- a decision in relation to that business might reasonably be regarded as affecting the well-being or financial standing (including interests in land and easements over land) of you or a member of your family or a person or an organisation with whom you have a close association to a greater extent than it would affect the majority of the Council Tax payers, ratepayers or inhabitants of the ward or electoral area for which you have been elected or otherwise of the Authority's administrative area, or

- it relates to or is likely to affect any of the interests that are defined as DPIs but are in respect of a member of your family (other than a partner) or a person with whom you have a close association.

Guidance on declarations of interest, incorporating regulations published by the Government in relation to Disclosable Pecuniary Interests, has been circulated to you previously.

You should identify any potential interest you may have relating to business to be considered at the meeting. This will help you and anyone that you ask for advice to fully consider all the circumstances before deciding what action you should take.

In certain circumstances the Council may grant a **dispensation** to permit a Member to take part in the business of the Authority even if the member has a Disclosable Pecuniary Interest relating to that business.

To obtain a dispensation, you must write to the Monitoring Officer at least 48 hours before the meeting in question, explaining why a dispensation is sought and desirable, and specifying the period of time for which it is sought. The Monitoring Officer may consult with the Independent Person or the Council's Audit and Standards Committee in relation to a request for dispensation.

Further advice can be obtained from Gillian Duckworth, Director of Legal and Governance on 0114 2734018 or email gillian.duckworth@sheffield.gov.uk.

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SHEFFIELD CITY COUNCIL

Overview and Scrutiny Management Committee

Meeting held 3 September 2020

(NOTE: This meeting was held as a remote meeting in accordance with the provisions of The Local Authorities and Police and Crime Panels (Coronovirus) (Flexibility of Local Authority and Police and Crime Panel Meetings) (England and Wales) Regulations 2020.)

PRESENT: Councillors Mick Rooney (Chair), Ian Auckland, Steve Ayris, Ben Curran, Denise Fox, Julie Grocutt, Tim Huggan, Douglas Johnson, Mike Levery, Cate McDonald and Jim Steinke

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1. APOLOGIES FOR ABSENCE

1.1 An apology for absence was received from Councillor Sioned-Mair Richards.

2. EXCLUSION OF PUBLIC AND PRESS

2.1 No items were identified where resolutions may be moved to exclude the public and press.

3. DECLARATIONS OF INTEREST

3.1 There were no declarations of interest.

4. MINUTES OF PREVIOUS MEETING

4.1 The minutes of the meeting of the Committee held on 4th June 2020, were approved as a correct record, subject to the amendment of Item 6 – Call-in of the Leader's Decision on Month 11 Capital Approvals 2019/20 – Heart of the City II – Block A (Palatine Chambers), by the deletion of the words 'unless dealing with a major city or tourist hotspot' in the seventh bullet point of paragraph 6.13.

4.2 Arising from the consideration of the minutes, and in relation to the issue regarding the establishment of a Citizens' Assembly to look at climate change, the Chair reported that he had discussed the issue with Councillor Mark Jones (Cabinet Member for Environment, Streetscene and Climate Change), and arrangements had been made for Councillor Jones to attend the next meeting of this Committee to report on progress.

5. PUBLIC QUESTIONS AND PETITIONS

5.1 The Chair reported that two questions had been received from members of the public, both after the designated time limit, but which he agreed should be considered.

5.2 The first question was from James Biggin (Managing Director, Steel City), and related to the closure of Ponds Forge Sports Centre.

5.2.1 The Policy and Improvement Officer (Alice Nicholson) reported that this issue was to be considered by the Economic and Environmental Wellbeing Scrutiny and Policy Development Committee, at its meeting to be held on 8th September 2020, and it was suggested that Mr Biggins attend that meeting to raise his question, and receive a detailed response.

5.3 Alice Nicholson read out the following question submitted on behalf of the GMB Union:-

5.3.1 Paragraph 3 of the report of the Head of Strategic Finance on the Council's Revenue Budget, which is to be considered later at the meeting, notes that there has been slippage in the budget which is partly as a result of further millions being handed over to Sheffield City Trust on top of substantial subsidies being paid out in consecutive, previous years.

(1) Does this Committee feel the most recent handing over of public money in the sum of £15 million to Sheffield City Trust, who are now in the process of cutting hundreds of low paid jobs, as well as keeping venues such as Ponds Forge closed, with no date for re-opening, is fair when the SCT Senior Management Team suffer no detriment, even when the organisation's business model has clearly failed?

(2) Does this Committee believe the time has now come to bring the sport, leisure and cultural services Sheffield City Trust is responsible for, back in-house?

(3) Will this Committee recommend to the Leader and relevant Cabinet Members the urgent need to consider bringing these services in-house to ensure the security of hundreds of jobs and the long-term stability of the services that mean so much to the people of Sheffield?

(4) Would the Council be eligible to secure a grant from the Government's £1.5 billion rescue pack for arts and leisure services if the facilities currently outsourced to Sheffield City Trust were to be brought back in-house?

5.3.2 It was suggested that the questions be forwarded to Councillor Terry Fox (Cabinet Member for Finance, Resources and Governance), Dave Phillips (Head of Strategic Finance) and Ryan Keyworth (Director of Finance and Commercial Services), and arrangements be made for (a) a detailed response to be provided to the GMB and (b) the questions to be read out at the meeting of the Economic and Environmental Wellbeing and Scrutiny and Policy Development Committee on 8th September, 2020.

6. UPDATE ON THE COUNCIL'S 2020-21 REVENUE BUDGET

6.1 The Committee received a report of the Head of Strategic Finance containing an update on the Council's 2020/21 Revenue Budget. Appended to the report, as supplementary documents, were reports on the Revenue and Capital Budget Monitoring 2020/21, as at 31st May 2020, and a report on the

Capital Approvals for Month 02 2020/21.

6.2 David Phillips (Head of Strategic Finance) introduced the report, indicating that, since the 2020/21 Revenue Budget had been agreed at full Council on 4th March 2020, the City and the Council had been hit by the Covid-19 pandemic, which had had a very significant effect on the Council's finances and the delivery of its budget, and that the report provided an update on these effects.

6.3 Also in attendance for this item were Councillor Terry Fox (Cabinet Member for Finance, Resources and Governance) and Ryan Keyworth (Director of Finance and Commercial Services).

6.4 Members of the Committee raised questions, and the following responses were provided:-

- There was a considerable amount of planning work being undertaken, including working with the Sheffield City Region and other core cities, in terms of looking at future budget planning. The Council was also working with the Outbreak Control Board, the Clinical Commissioning Group and other partners in this regard. Specific work was being undertaken to look at how statutory services could be underpinned and, in the light of an expected second wave of Coronavirus, the Council was taking things very seriously. The Council was able to use some of its reserves, and currently had sufficient stocks of Personal Protective Equipment (PPE).

- The Outbreak Control Board was currently looking at the external risks caused by the Covid-19 pandemic, and the challenge for the Board was to try and predict the impact of a second wave of the pandemic. The City had no experience of anything like this to work from, and it was very difficult to try and estimate and/or predict the consequences of a second wave, both on the Council and the City as a whole. The Council was looking initially at controlling the things it was able to and, as part of this work, was monitoring the data on a regular basis. There was now a significant stock of Personal Protective Equipment (PPE) in the City, and across South Yorkshire, with enough supply to keep all the Council services, including the care service, supplied for around three months. This would mean that the Council would not be subject to the challenges faced early on in the pandemic. In terms of internal risks caused by the pandemic, the Council had undertaken considerable work over the last five months, which had included allowing meetings such as this to take place remotely. In March 2020, there had only been capacity for around 100 members of staff to work from home but now, everyone who wanted to work remotely from home was able to. The aim was about making the Council as resilient as possible, and to allow staff to continue working from home, whilst planning for a second wave at the same time.

- When decisions were taken by the Incident Management Group, all financial implications had been considered, albeit at some speed. The

figures in the report included estimates regarding the implications of such decisions. The financial position at the end of July 2020 was not, in fact, materially different to the current position. At the height of the pandemic, the Council had been forced to take significant action to support the organisations that provided care to the most vulnerable in the City, both with regard to care homes and homecare, and it had been agreed to increase the funding to such organisations to ensure they remained financially solvent. Care home occupancy had actually dropped by around 10%. The Council had now got to work closely with the various services and partner organisations to understand how it would move back to a more 'business as usual' footing, and understand the extent to which this was possible, including the understanding of timescales. The Council had built in estimates to this year's financial figures, and was now working with the various services and providers in connection with the 2021/22 budget process, in order to understand the implications of this. There were concerns with regard to the medium term going forward, and managers had been asked to look at all potential risks, including capital costs. There was an acceptance that the Council could not continue working on the budget process as it had done in the past.

- The Council was looking at every possible way of making savings, and all managers had been requested to look into this. Regular meetings were held with the Directors in the Place and People Portfolios, together with the respective Cabinet Members, with the Directors being constantly challenged in terms of savings. Communications had been sent to Government Ministers regarding the Council's concerns relating to its finances, and was awaiting a reply. The Council was looking at a co-ordinated approach in terms of lobbying the Government with other core cities, who were in a similar position.

- The Council was monitoring the effects of lost revenue in terms of business rates and Council tax very closely, and updating estimates moving forward. The Council had also been in contact with the Government regarding this issue, who had allowed the Council to spread the impact of the lost income over a period of a few years. Work was also being undertaken to assist businesses in connection with their recovery after the pandemic. Some sectors had been granted exemptions in respect of business rates, such as the retail sector, and the Council always worked with companies regarding the payment of business rates, with enforcement action regarding non-payment always a last resort.

- Overspends for 2020/21 not relating to the Covid-19 pandemic were currently forecast to be £5.9 million mainly due to non-Covid additional pressures in physical and learning disabilities (£2 million), unfunded Air Quality scheme costs (£1 million) and staffing pressures within Customer Services and Human Resources (£1 million). There was more detail regarding this breakdown of the figures in the Month 2 report submitted to the Cabinet in July 2020. The Council's agreement with

Sheffield City Trust (formerly Sheffield International Venues) was due to end in 2024, and discussions had commenced with regard to where the Council wanted its leisure facilities to be going forward. The Covid pandemic had brought this timeline forward.

- The overspend for 2020/21 was slightly higher, but not markedly out of line with past overspends, therefore the Council was not proposing anything significantly different in terms of dealing with this. The Council normally expected a somewhat lower overspend than £17 million at this stage of the year, and whilst the non-Covid-related overspend of £5.9 million was not considered too high, the Covid-related overspend pushed the figure up to a higher level. There was a need to sort things out in the medium term and as part of this work, the Council would continue to lobby the Government in terms of its funding allocation.

- Approximately £15 million of savings had been approved in this year's budget, and the ability to deliver them had been severely affected by the Covid-19 pandemic. The challenge now for the Council was to enable 'business as usual' activities to restart again. The Council was challenging the delivery of savings, hence the regular monthly meetings arranged to monitor the position. The capacity and resources issues faced by the Council had been major, and thanks should be conveyed to those members of staff who had been deployed or who had, and were currently, working very long hours. It had been a major achievement to go from a few hundred members of staff being able to work from home to around 6,000 staff.

- The Business Recovery Group, which was separate to the Incident Management Group, was currently looking at the longer-term recovery of the City.

- There had been a huge drop in income from car parking charges, although this figure was slowly increasing. The Director of City Growth was monitoring this issue.

- The Council was looking at areas where there were underspends, although such underspends were relatively minor. Work was being undertaken to look at the detail of the budget and identify those areas having underspends. Work would then take place to ensure that managers were very clear that they did not see this as an opportunity to take advantage of such underspends when the pandemic was over, and work was taking place with Members on this.

- It was accepted that the Council needed to take the opportunity to change the organisation for the better, following the pandemic, and the Business Recovery Group was already looking at this. It had been accepted that there would be a big culture change within the organisation following the pandemic, particularly with regard to staff working from home. It was not likely that, in some areas of the Council, staff would return to working in the office five days a week. There was

also a need to look at the Council's buildings, and what they could be used for, with any resultant savings needing to be reprioritised.

- The Cabinet Member for Finance, Resources and Governance was meeting monthly with the Directors in the People and Place Portfolios and relevant Cabinet colleagues in connection with monitoring the budget position. The issues highlighted within the People Portfolio included the increase in staff workloads, children's services and SEN transport costs, and those in the Place Portfolio included issues regarding Council housing, track and trace facilities and the Change Programme. All Cabinet Members and Directors were being challenged in terms of the budget position. The Council was looking at a long-term vision, accepting that there would be major changes to working practices after the pandemic.

6.5 RESOLVED: That the Committee:-

(a) notes the contents of the report, together with the supporting documentation - Revenue Budget and Capital Programme Monitoring 2020/21 and Capital Approvals for Month 2 2020/21 - now submitted, together with the responses to the questions raised, in particular (i) the additional pressures caused by the Covid-19 pandemic and (ii) that the Council's current level of reserves provides time for action to be taken strategically in response to the Covid-19 pandemic, and the more general financial position, but that actions will be needed, on current projections, to maintain financial stability in the medium-term, with such actions including further co-operation with other key stakeholders, in particular, the NHS; and

(b) requests:-

(i) that the Council continues lobbying the Government in connection with making a case for further funding towards the costs created as a result of the Covid-19 pandemic, with particular emphasis on pressures regarding Adult Social Care; and

(ii) arrangements be made for a standard item on Budget Monitoring on all agendas for future meetings of this and the four Scrutiny and Policy Development Committees, with the individual Committees deciding on how they wished to deal with this issue.

7. WORK PROGRAMME 2020/21

7.1 The Committee considered a report submitted by the Policy and Improvement Officer (Alice Nicholson) setting out a draft Work Programme for 2020/21 for this Committee and the four Scrutiny and Policy Development Committees.

7.2 Ms Nicholson stated that she was aware that some Committees had not met

during the Covid-19 period, and that it was proposed that all the Committees would meet by early October 2020.

7.3 RESOLVED: That the Committee:-

(a) notes the contents of the report now submitted, together with the comments now made;

(b) approves, in principle, the schedule as set out in the report; and

(c) requests that arrangements be made for the Chairs and Deputy Chairs of all the Committees to meet, via Zoom, to discuss the number of meetings to be held, with the items considered to be determined by the respective Chairs and Deputy Chairs, and the Chairs of the Scrutiny and Policy Development Committees be requested to forward suggested items for consideration by this Committee to the Scrutiny Team.

(NOTE: in accordance with Council Procedure Rule 26 of the Council's Constitution, and the provisions of Section 100B(4)(b) of the Local Government (Access to Information) Act 1985, the Chair decided that Item 7 above be considered as a matter of urgency in order for the item to be considered at the earliest opportunity, although it had not been possible to give five clear days' notice that the item was to be considered.)

8. DATE OF NEXT MEETING

8.1 It was noted that the next meeting of the Committee would be held on a date to be arranged.

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Report to Overview and Scrutiny Management Committee 26th November 2020

Report of: Laraine Manley, Executive Director, Place

Subject: Addressing the Climate Emergency – An Update on Progress

Author of Report: Mark Whitworth, Sustainability and Climate Change Service Manager, City Growth Service

Summary:

This report outlines the progress the Council and its partners have made in addressing the climate emergency and our stated ambition of becoming net-zero carbon by 2030.

Over the past nine months the Council, working with the support of the Green City Partnership Board and along with other stakeholders in the city has been developing a comprehensive evidence base to underpin our city's approach to achieving net-zero carbon.

The report provides a summary of this work including some of the initial findings as well as setting out proposed next steps. The report makes series of recommendations of where it is anticipated OSMC can support this critical programme of work, and welcomes the opportunity for further proposals to come forward as part of this discussion.

The report has been requested to by the Overview and Management Scrutiny Committee and outlines the work that has been progressed over the past 18 months.

Type of item: The report author should tick the appropriate box

Reviewing of existing policy	**x**
Informing the development of new policy	**x**
Statutory consultation	
Performance / budget monitoring report	
Cabinet request for scrutiny	
Full Council request for scrutiny	
Community Assembly request for scrutiny	
Call-in of Cabinet decision	
Briefing paper for the Scrutiny Committee	**x**

Other – Requesting specific support from OSMC	**x**

The Scrutiny Committee is being asked to:

In recognition of the need to address the climate emergency across all our activities (as well as across the city, with other organisations and individuals), there is a valuable role for Scrutiny to play in helping to embed our ambitions across the organisation. We would like to make three recommendations that would help to support the city to progress this:

1. Scrutiny Committee chairs to support and challenge other committees on climate action

2. Support the roll-out of carbon and climate awareness programmes for Members and Officers and attend awareness sessions.

3. Support the establishment of a cross-party climate change and sustainability Committee

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Background Papers:

1. Sheffield Greenhouse gas emissions baseline and inventory - Infographic
2. Sheffield Greenhouse gas emissions baseline and inventory Report
3. Sheffield Net-zero Carbon Gap Analysis infographic
4. Sheffield Net-zero Carbon Gap Analysis Report
5. Setting Climate Commitments for the City of Sheffield: Quantifying the implications of the United Nations Paris Agreement for Sheffield – The Tyndall Centre for Climate Change Research
6. Green City Partnership Board Membership –November 2020
7. Related projects and programmes – A summary

Category of Report: OPEN (please specify)
Most reports to Scrutiny Committees should be openly available to the public. If a report is deemed to be 'closed', please add: **'Not for publication because it contains exempt information under Paragraph xx of Schedule 12A of the Local Government Act 1972 (as amended).'**

Report to Overview and Scrutiny Management Committee
26th November 2020

Addressing the climate emergency – an update on progress

1. Introduction

Sheffield has had a strong record of accomplishment on sustainability. It was one of the first UK cities to develop an energy recovery facility and to create an energy network that provides heat and hot water to businesses and residents in the city. More recently, private-sector led renewable power plants have been developed in the Lower Don Valley (E.ON) and at Holbrook in the east of the city (UYE).

Sheffield was the first UK city to initiate a city-wide switch to low energy LED street lighting and following installation has also trialled dimming to further reduce carbon emissions. We are also one of the first cities in the UK to trial electric refuse collection vehicles and we are now rolling out an EV cargo bike scheme as well as EV van and taxi trial schemes.

The city already has a number of innovative companies and organisations whose activities, products and services contribute towards greater environmental sustainability as well as providing good jobs for Sheffield people, and are already demonstrating how we can move towards a net-zero future.

Sheffield Climate Alliance works to promote a zero-carbon approach across all sectors of our city as well as campaigning on related issues such as fracking and divestment in fossil fuels. Sheffield Renewables and Community Energy England are working to bring about change in how we view, use and generate our energy and both have a track record in delivering renewable energy projects that provide wider community benefits.

We have a large number of local businesses who are keen to rise to the challenge of net-zero, as demonstrated at Sheffield Sustainable Business Network's inaugural event earlier in the year.

Our universities also provide a huge advantage and opportunity for the city and its residents. The Advanced Manufacturing Research Centre is a collaborative partnership between the University of Sheffield, Boeing and Rolls Royce which applies world-leading research and development, environmental sustainable solutions and is a centre of Sheffield's advanced manufacturing expertise with an international reputation for excellence that creates and shapes industries.

Transitioning to a zero-carbon economy will require a massive change in many, if not all aspects of life. It will require the buy-in of everyone in the city – our residents, businesses, institution, organisation and communities across the city.

The challenge is undeniably very significant but as the change that is starting across the country and the world shows, change is inevitable. We should not see this change as a negative.

Whilst there is a lot to do, the wider benefits that this transition will bring are incredibly significant. This ranges from new jobs and services to support the growing demand for clean and green products, to improved local air quality from fewer vehicles, better health outcomes and quality of life from warmer homes, and increased 'active travel' improving our neighbourhoods. All this contributes towards greater resilience as a city.

This is particularly pertinent given the current Covid pandemic, which has seen air quality identified as a potential factor in outcomes of Covid patients, as well as clear popular demand that as a country we 'build back better' and ensure that our recovery from this pandemic is a fair, just and green one.

This approach is being mirrored by cities and towns across the UK, as well as cross the world. The C40 group, which represents the world megacities, has recently launched its campaign to achieve a green and just recovery.

C40 mayors have collectively identified key actions that are critical to achieving a vision for a green and just recovery – and a future that works for everyone. This includes leading in taking action for jobs and an inclusive economy and helping to creating '15 minute cities' where all residents of the city are able to meet most of their needs within a short walk or bicycle ride from their homes. It also includes building with nature to prioritise 'nature based solutions' such as parks, green roofs, green walls, blue infrastructure and permeable pavements, to help reduce the risks of extreme heat, drought, and flooding, and improve liveability and physical and mental health.

Whilst Sheffield may not be a megacity, we are learning from what others are doing on this agenda and looking to identify where we can implement similar approaches. Our Zero Carbon commission is actively undertaking this, identifying best practice and looking to see how Sheffield can take this forward.

We can also point to new and existing projects here in Sheffield: the award winning Grey to Green programme which has created to UK's largest retrofit sustainable urban drainage scheme, whilst the Connecting Sheffield programme aims to transform the transport infrastructure that people use to get around the city as part of their everyday lives by creating high-quality, safe and convenient routes into and around the city for cycling, walking and public transport. We have included a short summary of some of these programmes in appendix 7.

1.1 Our approach to net-zero carbon

Over the past nine months the Council, working with the support of the Green City Partnership Board and along with other stakeholders in the city, has been developing a comprehensive evidence base to underpin our city's approach to achieving net-zero carbon.

Independent consultants were co-commissioned by the Council and the Green City Partnership Board to complete this study. This report to Oversight and Management Scrutiny Panel outlines some of the key findings emerging from this commission and outlines the next steps we intend to take with our partners to drive forward decarbonisation across the city.

There will be a focus on the UK next year when the Glasgow hosts the 26th UN Climate Change Conference of the Parties (COP26). The COP26 summit will bring parties together to accelerate action towards the goals of the Paris Agreement and the UN Framework Convention on Climate Change. The Council is already exploring how it can support an international campaign to build momentum around the shift to a decarbonized economy ahead of COP26, where governments must strengthen their contributions to the Paris Agreement.

It is hoped that our work with partners across the city can help to contribute towards a global movement that 'will send governments a resounding signal that business, cities, regions and investors are united in meeting the Paris goals and creating a more inclusive and resilient economy.'

The UK is committed to working with all countries and joining forces with civil society, companies and people on the frontline of climate change to inspire climate action ahead of COP26.

2. Background

Over the past five years the Council has adopted two strategies; 'Growing Sustainably' (2017), which was a response to the 2015-16 Sheffield Green Commission, and the Sheffield Green City Strategy (2018) which is remains the adopted City Sustainability Strategy.

The Green City Strategy established an original goal of the city achieving net zero carbon emissions by 2050, which the city adopted in 2018 and which at the time reflected similar climate goals set by other UK Core Cities, Government as well as other international cities recognised as leaders in climate change action.

In October 2018, the Intergovernmental Panel on Climate Change issued its update report SR 1.5, which set out the global impact of failure to restrict global warming to less than 1.5 degrees Celsius (above pre-industrial levels) and was a clear message to the global community that urgent and significant decarbonisation was required, with immediate effect.

2.1 Declaration of a climate emergency

In early 2019, Sheffield City Council declared a climate emergency and in doing so became one of the first local authorities in the county to take such action. The motion was agreed unanimously at Full Council in February 2019 and responded to several petitions to the Council to declare a climate emergency.

The February Full Council motion noted that cities are one of four critical global systems that can accelerate and upscale climate action, but recognised that this will require major transitions in how both mitigation and adaptation are undertaken and tasked the Green City Partnership Board to explore how the city should respond to the IPPC report and review our existing commitment to become a zero carbon city by 2050 (Green City Strategy, adopted 2018).

A commitment was given to report back to Full Council within 6 months with a more ambitious date for the city to become zero carbon, accompanied by an action plan 'setting out the required work to deliver a new goal through all relevant strategies and plans, and would entirely and actively welcome the involvement of the cross-party scrutiny system in shaping and overseeing this vital work.'

The Green City Partnership Board subsequently engaged the Tyndall Centre for Climate Change Research to complete a carbon budget report for Sheffield. Further details are outlined below in section 2.2.

In June 2019, the Council announced that ***a new commitment will be made to bring forward the city's carbon neutral target from 2050 to a minimum of 2030, and that a Citizens' Assembly will be commissioned to consider the necessary action in the city to implement this change.*** At the same time, the Cabinet Member's title was amended to include Climate Change, as an indication that tackling the climate emergency was, and remains, a top priority for the city going forward.

2.2 Tyndall Centre for Climate Change Research - Carbon Budget for Sheffield

In July 2019 Full Council received a report (Appendix 5) and a presentation from the Tyndall Centre for Climate Change Research. The presentation set out how a carbon budget had been calculated for the City of Sheffield and provided a recommended budget or limit to carbon dioxide or equivalents, from the energy system from 2020 onwards.

The targets were derived from the 2015 International Paris Climate Agreement and were intended to enable Sheffield to play its part in delivering actions required to hold the increase in global average temperature to well below 2 degrees Celsius and to pursue efforts to limit the temperature increase to 1.5 degrees Celsius.

The key findings and recommendations from the Tyndall Centre report are:

- Sheffield has a total recommended carbon budget 16MtCO2e for period 2020 – 2100
- **Sheffield uses this entire budget in less than 6 years at 2017 levels**
- A rapid programme of decarbonisation is required, commencing 2020 and averaging **14% year-on-year reduction**
- The city should aim to become 'Zero Carbon' by **2038 at the latest**
- An even greater rate of reduction will be required for **zero carbon 2030**

2.3 Citizens' Assembly

Following the announcement in the summer of 2019, the Council explored how it could most effectively deliver a Citizens' Assembly. The matter was discussed at Full Council during the autumn and a report outlining next steps was presented to the Green City Partnership Board in February 2020, outlining options and next steps.

Prior to this, at November 2019 Full Council meeting, Members agreed that the following suggestions should be considered:

- Look into establishing a climate emergency committee to develop strategies, and implement actions to bring about the necessary changes to meet our zero-carbon emissions target by at least 2030.

  Note: This OSMC report recommends that this should be established early in the New Year (recommendation 3)

- Considering the introduction of climate change impact assessments for appropriate Council decisions. -

  Note: We have been developing such a tool as part of our Zero Carbon Commission*, and this OSMC report recommends that the emerging tool is shared with Scrutiny Panel chairs and that it is applied across all their activities (recommendation 2).*

- Investigating the feasibility and desirability of establishing a properly resourced team of sustainability officers to work on real progress towards making Sheffield carbon-neutral and help develop the world leading technologies needed to supply good quality jobs.

Note: Work has been on-going during 2020 to progress this action. Details are included in section 2.6 on resources.

The emerging Covid-19 pandemic and the subsequent first lockdown in March 2020 meant that a decision was taken to cancel the Citizens' Assembly, as it was not felt that it is possible to hold a meaningful and equitable citizens' assembly during Covid-19, due to restrictions on mass gatherings or meeting face to face. Cllr Mark Jones wrote to all the members of the Green City Partnership Board to explain this decision, along with the decision not to commence plans to reconvene in the autumn due to the risk of a second wave, and to outline an alternative approach.

As we conclude the development of the evidence base (see Section 3 - Zero carbon commission) the Council is developing an alternative approach to holding a face-to-face Citizens' Assembly, that takes account of both the need to engage with a wide range of people from all communities, but also recognises the constraints the current Covid pandemic place upon us.

This proposed approach will enable the Council and its partners to hold wider conversations and engage with people from across the city. The conversations will initially focus on sharing the truth about climate change and findings of the emerging Zero Carbon Commission, as well as providing opportunities for communities to be involved with planning for a zero carbon future. These wider conversations will aim to test out approaches and, as well as exploring our local evidence base, will also look at the findings of the national Climate Assembly.

The UK Climate Assembly started prior to Covid, on a face-to-face basis but held its final session remotely. Its recent report outlines the actions that the assembly believes need to be taken. The six themes that run through the report are the need for:

- education and information;
- fairness;
- freedom and choice;
- co-benefits and
- nature.

There was also a call for strong leadership from government, and the recognition that everyone needs to play their part. The recommendations seek to provide individuals, communities and organisations with the information, incentives and conditions to make change possible.

These themes will be explored in our public engagement which is proposed to take place after the completion of the commission.

2.4 Covid-19

The Covid pandemic is having a devastating, and often inequitable, impact on our communities and residents. We recognise that, in these very challenging times, climate change and decarbonisation may not be at the forefront of peoples' minds as we deal with the immediate and often very difficult impacts of the current pandemic.

However, there are some opportunities. Some of the changes in behaviour such as increased working from home, using technology more and travelling less – where people can of course - are changes that would could have a positive effect on the climate. In some instances, the situation has push us to re-evaluate how we live and work; valuing our communities and green spaces more, and noting and appreciating better air quality and less traffic during lockdown.

Covid has meant that some attention is taken from the climate agenda, but there is strong public sentiment that, in recovering from what is clearly a human and economic disaster, change is required. Research has found that just 6% of people want to return to the status quo, and a majority of the population believe that the climate should be prioritised as much or more than the economy. 81 per cent of the population is concerned about climate change according to research carried out by the Department for Business, Energy and Industrial Strategy, an increase of 3% since March.

A report by HSCB earlier this year noted that the 'C-19 crisis is accelerating the change in consumption behaviour and broadening the public support for a cleaner economy and for environmental responsibility.'

But we should not be complacent. Although there have been some temporary reductions in emissions during lockdown, levels of greenhouse gases in the environment have reached a record high this year.

Previous economic crises suggest that emissions may potentially increase as the economy seeks to recover and following this unique health induced human and economic crisis. People are expected to increase car use as a result of concern about the safety of travelling on public transport: recent research by the University of Cambridge and Yougov found that 26% of people in the UK expected to use their car more since Covid, compared with 9% who said they would use it less. The need to act has not gone away.

2.5 Green City Partnership Board

The Green City Partnership Board (GCPB) was established in July 2018. A full list of the current membership is provided in Appendix 6. Following changes made at the end of last year by the current Chair, Cllr. Mark Jones the board now has cross-party representation.

The Green City Partnership Board provides the critical function of bringing together key partners and stakeholders from across the city to work together on solutions to address our climate emergency. Over the course of this year, and despite the current pandemic the board have helped to oversee and steer our Zero Carbon Commission.

The Green City Partnership Board has recognised the key role that it plays in helping us all to achieve this shared goal. At its February Board meeting earlier this year its members confirmed that the board's focus should be on working towards achieving net zero carbon. It recognised that it has a clear role in enabling, engaging and communicating with the city and its communities, as achieving this ambition will require everyone in the city to play their part.

At our last Board meeting in September, we had a presentation from Board Member Liz Ballard (CEO Sheffield and Rotherham Wildlife Trust) on the ecological crisis faced by the planet. Following a discussion, the chair asked for a show of hands on whether members wanted to see the Council explore the possibility of declaring an ecological emergency. There was unanimous support for the proposal, and it was agreed to progress this outside of the meeting. A few other core cities, and a number of other local authorities, have declared similar ecological emergencies and are now developing their plans to take this forward, e.g. Bristol City Council.

Looking forward, the Green City Partnership Board has a key role in continuing to support the development of our net zero plan, to collaborate with others to facilitate this approach across the city, as well as developing our wider approach on climate change adaptation and ecological crisis we face as a city.

2.6 Resources

The Council have undertaken the first phase Achieving Change (restructure). This has created a Sustainability and Climate Change Team within the Strategic Transport, Sustainability and Infrastructure Service and has brought together the Climate Emergency, Air Quality and wider sustainability functions.

A further Achieving Change was approved in February 2020 that would establish the core structure for the Climate Change and Sustainability Team, and create two new posts (plus an additional 'existing' post) to support the work developing our approach on decarbonisation, as well as develop our work on city resilience and climate change adaptation. The Covid-19 pandemic has significantly delayed progressing this, and we are awaiting corporate processes recommencing following a postponement earlier in the year.

There is still a requirement to confirm the funding in advance of recruitment to these new posts.

3. Zero Carbon Commission

The Council and its partners already had a strategic evidence base, including the Tyndall Report outlined in section 2.2. This set a proposed carbon budget for the city however it wasn't intended to establish the detail on how the city can achieve its net zero ambition.

The Council and the GCPB therefore agreed to commission a series of reports that together will inform a zero carbon plan City and provide an initial evidence base for sharing through the proposed wider engagement that is planned in-lieu of a Citizens Assembly.

The commission was resourced by Sheffield City Council as one-off spend in order to sustain momentum and the initial findings of each report have been presented to the Green City Partnership Board for discussion, consideration and feedback.

The work is split into three elements;

1. Greenhouse gas emissions baseline inventory
2. Gap Analysis – Business as usual projections
3. City-level mitigation pathways for Sheffield / Pathways for Sheffield City Council

3.1 The Baseline inventory

(Please refer to the summary infographic (Appendix 1) and baseline report (Appendix 2) for full details.)

The first work package has provided us with a comprehensive greenhouse gas and energy baseline inventory and provides an in-depth analysis of this. The baseline inventory was developed covering the three key Greenhouse Gases (GHG): CO2, Methane (CH4) and nitrous oxide (N2O).

In line with the Tyndall Centre Carbon Budget report, this analysis only considered Scope One and Scope Two emissions; that is emissions directly generated in the city from combustion (e.g. vehicles) or processes and those associated to emissions from electricity use (i.e. generated outside of Sheffield but consumed here, e.g. for heating or cooking)

The sectoral split of where our greenhouse gas emissions arise (2017) shows that the largest sector is industrial and commercial emissions (35%) closely followed by domestic (33%), with 26% arising from Transport and around 6% arising from agricultural, waste and land use emissions.

The majority (over 90%) of our city's greenhouse gas emissions are from carbon dioxide, and therefore this became the focus of subsequent work.

The report looked at trends in carbon emissions and energy consumption from 2005 to 2017. Over this period, total emissions have fallen by 42%. Industrial and commercial emissions have dropped by 55%, domestic emissions by 37% and transport emissions by only 13% over this period. The report explores these trends in more detail; some headline points are outlined below:

Industrial and commercial energy consumption has decreased by ~ 33% since 2005; the largest drop being in solid fuels and then gas. Overall energy intensity has fallen by between 40% and 65%, dependent on fuel which will reflect a range of factors from structural change, with an growing service sector, to efficiency improvements and some fuel switching.

The vast majority of industrial carbon emissions are related to commercial and light industrial activity, with only about 4% related to large industrial sources.

Domestic energy use dropped by 25% overall with a 30% reduction for gas, indicating both boiler and fabric efficiency improvements, and a 15% reduction for electricity, largely indicating improvements in appliance efficiency.

Transport energy use has only dropped by 17%. Car mode share remains fairly constant but bus share has dropped and along with bus energy use.

Overall we can see how the decarbonisation of domestic heat, where gas is the primary fuel for over 80% of dwellings, and the decarbonisation of transport present some of the greatest challenges for the city.

3.2 The gap analysis

(Please refer to the summary infographic (Appendix 3) and Gap Analysis report (Appendix 4) for full details.)

This report explored how a decarbonisation trajectory based on current 'business as usual', incorporating existing policies and programmes, including National Government programmes compares against a goal of achieving net-zero carbon emissions by 2030.

Overall, Sheffield has already made some good progress in reducing emissions between 2005 and 2017, with the rate of emissions reductions being higher than the national average so far.

The report made clear that the current policy landscape is not sufficient to meet net zero by 2030, or even to continue this level of emissions reductions into the future.

This position reflects the picture at the national level, where the current policy landscape is not sufficient to meet the fourth and fifth carbon budgets nor to reach net zero by 2050. It should also be noted that this scenario would be similar for other UK cities, and is consistent with other projections such as the SCATTER tool, used by other core cities.

The report noted that much of the progress in reducing carbon emissions in recent years has been from grid decarbonisation, which has progressed at a rapid pace. Going forward, more focus will need to be turned to tricky areas such as decarbonisation of heat and transport. The third report will outline the decarbonisation pathways for the city.

3.3 Pathways to decarbonisation

This report is split into two parts. The first will explore the actions required at the city-level in order to achieve net zero carbon emissions by 2030. The second will explore what action the Council will need to consider across its own activities, operations and wider estate in order to be net zero carbon by 2030.

As part of the work to develop the pathways to decarbonisation report, the consultants engaged with a large number of key stakeholders. These were representatives of organisations from sectors who it is envisaged will be critical in the initiation and delivery of the actions required to address climate change.

4. Next steps and recommendations

Concluding work is now being undertaken on the reports, prior to them being presented to Green City Partnership Board for receiving, consideration and feedback.

Once this has been confirmed the Council will be making the reports public and will also be commencing a programme of wider engagement across the city, as a way of sharing the findings as well as seeking support and buy-in to the approaches.

This climate conversation, held over a period of months is intended to enable the council and its partners to develop a clear action plan with a strong evidence base and which the citizens of Sheffield have informed.

It is hoped this plan can be contributed to, adopted and signed-up to by a considerable number of organisations, as well as individuals, across the city.

4.1. Acting with agility

Whilst it is important to have a clear evidence base, to understand the scale of the challenge (and opportunity) facing us and to develop a pathway to net zero, it is also important that we don't allow this to delay our action or to miss opportunities. There are clear areas where we will need to act and we are already taking action at the same time that we are gathering the evidence. This includes:

- submitting bids for the government funding which is being made available
- developing a climate emergency assessment that can be used to inform the decision-making process
- considering how procurement can contribute and build on our Sustainable Procurement Policy
- working to ensure that climate change is central to the emerging Sheffield Plan
- exploring options for increasing understanding of the climate emergency amongst elected members and officers across the organisation to enable them to make good decisions and to act as climate leaders.

Appendix 7 sets out some examples of where we are already making progress on climate-related projects and programmes.

4.2 Scrutiny Committee as climate leaders

We greatly appreciate the opportunity to update OSMC on progress to address the climate emergency. We anticipate that the final reports on our pathways to decarbonisation will suggest that responsibility for addressing the climate emergency will need to lie across the council (and, indeed, across the city) and there is a valuable role for Scrutiny to play in helping to embed our ambitions across the organisation. We would like to make three recommendations that would help to support the city to progress:

1. **Scrutiny Committee chairs to support and challenge other committees on climate action**

Achieving net zero carbon will require action to be taken across all our activities, as both a Council and a city. We would greatly appreciate the support of Scrutiny chairs to challenge their wider committees to take action on the climate emergency and to encourage wider agenda items to consider how they can embed climate action into their work.

We are developing a 'climate impact assessment' tool as part of the net-zero carbon commission and would like the opportunity to roll this out for use by Scrutiny committees, alongside other parts of the Council, in order to embed positive climate action into all our activities and programmes, plans and strategies.

2. **Support the roll-out of carbon and climate awareness programmes for Members and Officers and attend awareness sessions.**

This will help to provide a wider understanding of how we can support our climate agenda through wider activity – including our strategies and policies as well as through the delivery of our services. It will help provide the background for Members to support recommendation 1 above, to improve decision-making and to have the conversations that they will need to have as community leaders.

3. **Support the establishment of a cross-party climate change and sustainability Committee**

Establishing a climate emergency committee to develop strategies, and implement actions to bring about the necessary changes to meet our zero-carbon emissions target by at least 2030, alongside exploring wider programmes relating to the circular economy, city resilience and adaptation and the ecological emergency.

Mark Whitworth – Sustainability and Climate Change Service Manager

Victoria Penman – Economic Policy Officer

18th November 2020

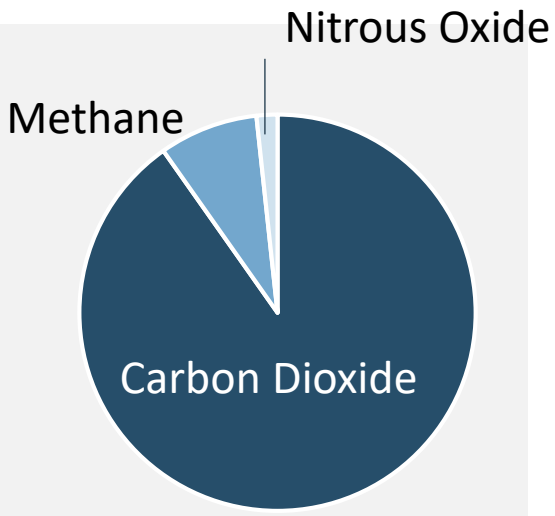
Addressing the climate emergency – Appendices

1. Sheffield Greenhouse gas emissions baseline and inventory - Infographic
2. Sheffield Greenhouse gas emissions baseline and inventory Report
3. Sheffield Net-zero Carbon Gap Analysis infographic
4. Sheffield Net-zero Carbon Gap Analysis Report
5. Setting Climate Commitments for the City of Sheffield: Quantifying the implications of the United Nations Paris Agreement for Sheffield – The Tyndall Centre for Climate Change Research
6. Green City Partnership Board Membership –November 2020
7. Related projects and programmes – A summary

2030 Net Zero Carbon Sheffield

Baseline inventory – where are we now?

There are many greenhouse gases – most of Sheffield's climate change impact is mainly from carbon dioxide (which will be the focus of the work going forwards



Our emissions have been gradually reducing over the last decade but we need to improve drastically and quickly.

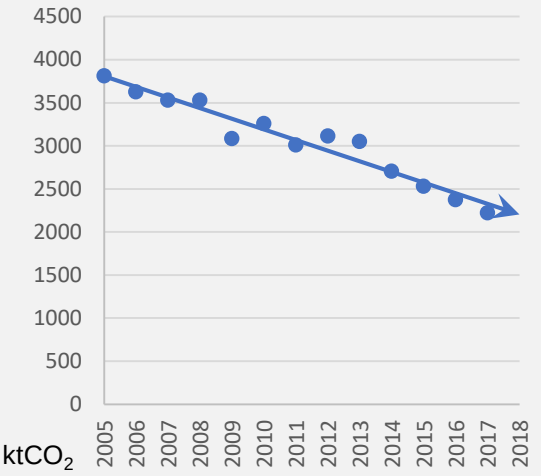
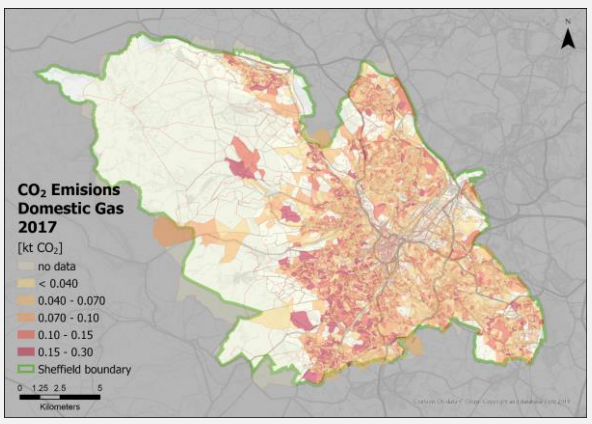


Chart shows $ktCO_2$

DOMESTIC

33%

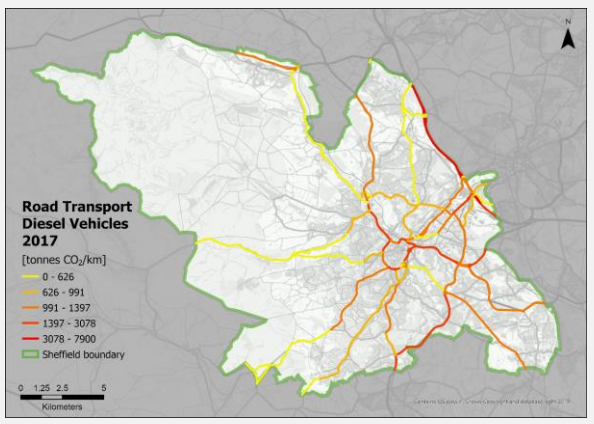
- Emission are higher in the South West of the city.
- Gas emissions four times those from electricity

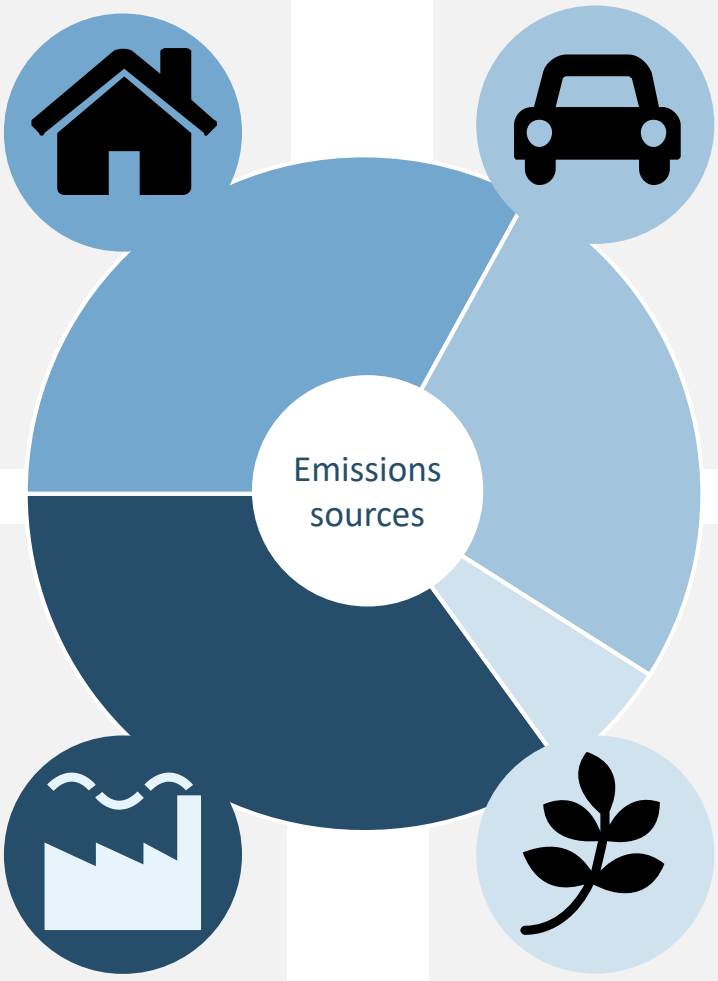


ROAD TRANSPORT USE

26%

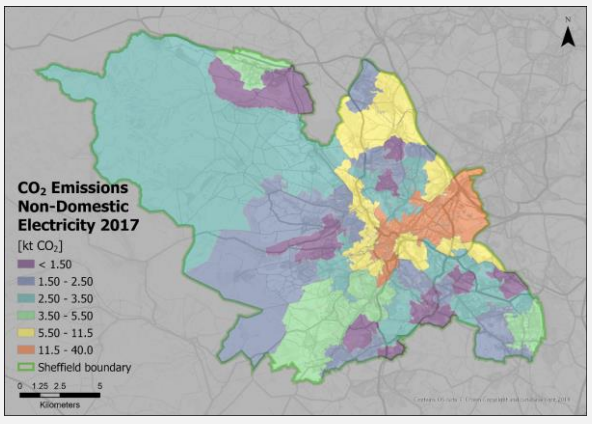
- 98% of transport emissions are from road transport
- Sector has shown least decline in recent years





INDUSTRY AND COMMERCIAL USE

- Retail and offices make up over half of business in Sheffield
- Large industrial installations are only ~5% of total emissions

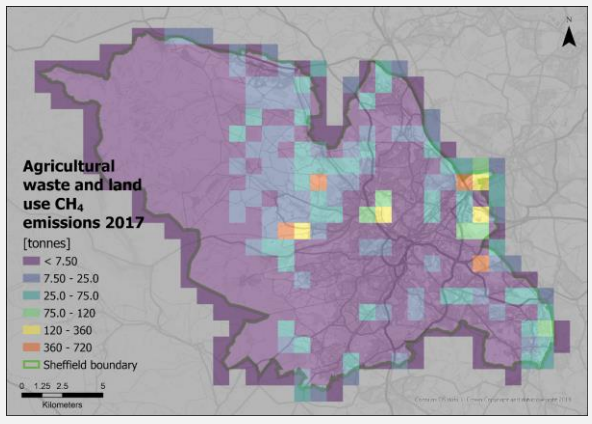


35%

AGRICULTURE, WASTE AND LAND USE

6%

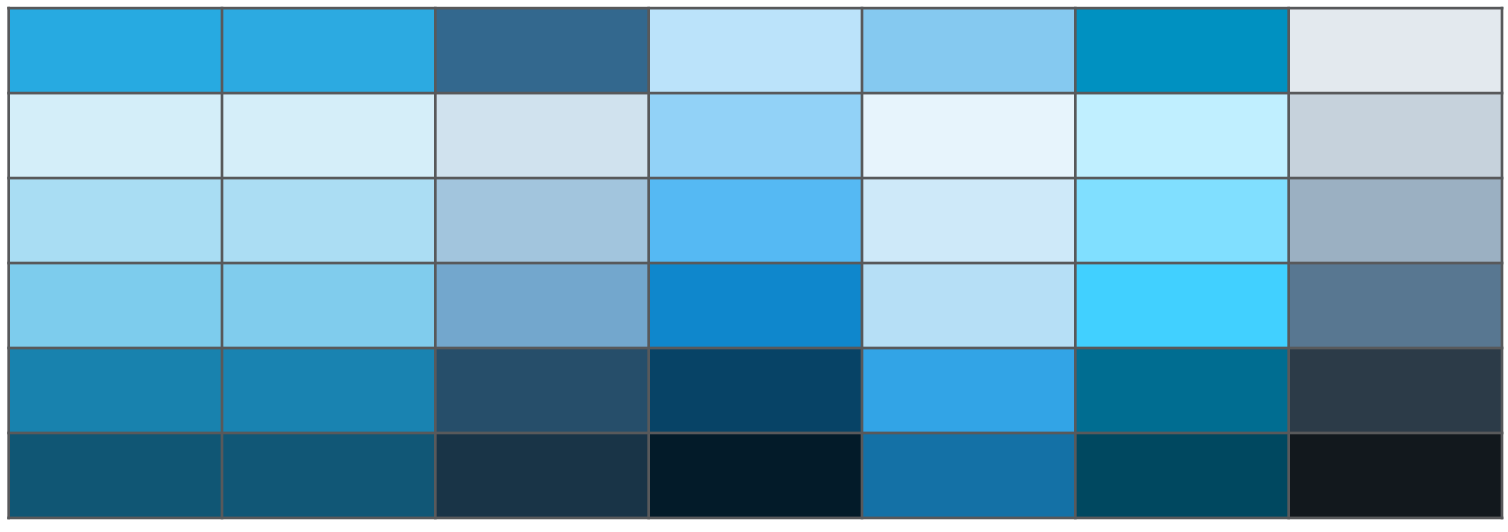
- Sector dominated by methane emissions (82%)
- Carbon dioxide emissions negative due to Land Use and Forestry

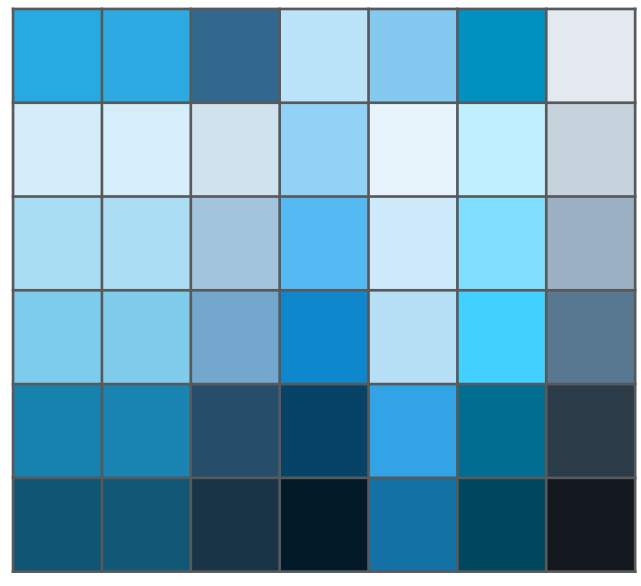


LOCAL ENERGY GENERATION AND STORAGE

- Sheffield generates 473GWh of electricity (right) and 253GWh of low carbon heat locally every year (registered sources)
- There are 5,451 photovoltaic installations but this represents only 2% of the 247,000 homes.

Information based on 2017 data (the latest year for which it is available)

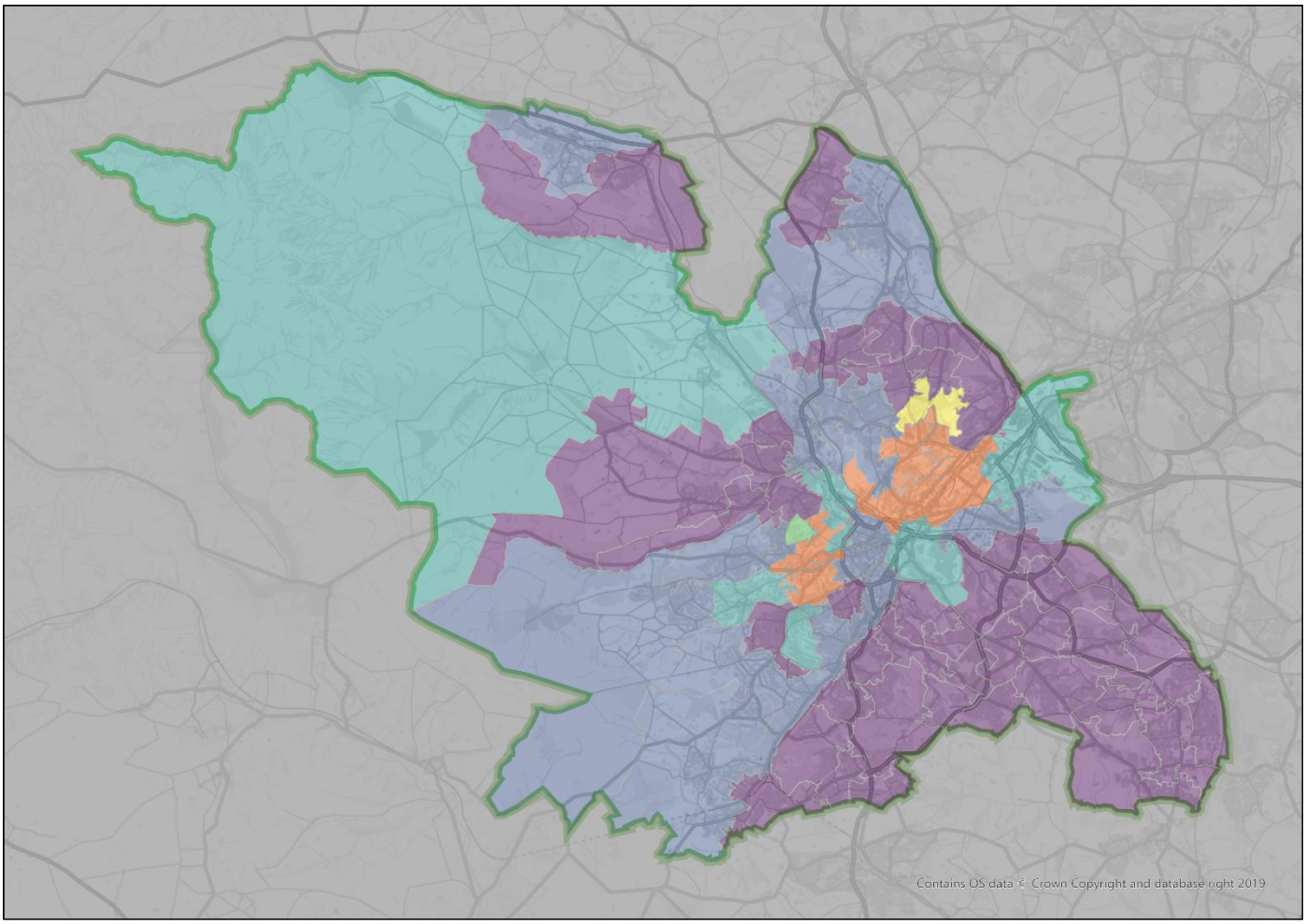




ARUP

Creating a world fit for the future

RICARDO



Baseline and Inventory Report – Work Package 1

Report for Sheffield City Council

Customer:

Sheffield City Council

Customer reference:

Zero Carbon Commission: DN461793

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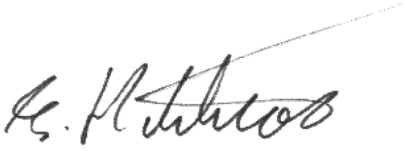

Date:

19th June 2020

Ref: ED13755

Ricardo is certified to ISO9001, ISO14001, ISO27001 and ISO45001

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Glossary

Abbreviation	Definition
GHGI	Greenhouse Gas Inventory
GVA	Gross Value Added
LA CO_2	Local Authority Carbon Dioxide
LULUCF	Land Use, Land-Use Change, and Forestry
MSOA	Middle Super Output Areas
NAEI	National Atmospheric Emissions Inventory
VKM	Vehicle Kilometres

1 Introduction and scope of analysis

Sheffield City Council has set a target for the city to be zero carbon by 2030. In addition, in their report of June 2019, the Tyndall Centre recommended that the city should stay within a cumulative CO_2 emissions budget of 16 Mt CO_2 for the period of 2020 to 2100, which would mean achieving near zero carbon emissions by no later than 2038. The City Council has commissioned ARUP and Ricardo to support them in developing a plan to achieve this net zero goal. The work being carried out falls into 4 work packages:

- WP1 Baseline inventory – developing a detailed understanding of current carbon and GHG emissions;
- WP2 Gap Analysis – projecting this baseline inventory forward under business as usual to assess the scale of the challenge required to meet net zero emissions;
- WP3.1 City level mitigation pathway – developing a set of mitigation options at the city level that can achieve the net zero goal;
- WP3.2 Council estate mitigation pathway – developing a set of detailed mitigation actions for the councils own buildings and fleet;
- WP4 Governance arrangements – will develop the governance approach to support delivery of the net zero pathway.

This report sets out the results of WP1 on the baseline inventory. The work covers an assessment of the current energy use and GHG emissions within Sheffield, along underlying activity.

1.1 Scope of analysis

The baseline inventory has been developed covering the three key Green House Gases (GHG) – CO_2, Methane (CH_4) and nitrous oxide (N_2O). The analysis only considered scope 1 and scope 2 emissions, that is emissions directly generated in the city from combustion or processes and those associated to emissions from electricity use.

The main source of data used is the local and regional carbon dioxide (CO_2) emissions estimates for the UK (LA CO_2) produced by by Ricardo for the Department of Business, Energy & Industrial Strategy (BEIS) in order to provide a nationally consistent evidence base for use in tracking carbon reduction policy. The dataset provides a spatial disaggregation of the CO_2 emissions from the UK Greenhouse Gas Inventory (GHGI), part of the National Atmospheric Emissions Inventory (NAEI), on and end-user basis. CO_2 emissions are estimated, by sector, for each local authority in the UK. The data help identify the key sources of CO_2. By utilising this data, it is possible to disaggregate CO_2 emissions in Sheffield for:

- Industrial and commercial
- Domestic
- Transport
- Agriculture, Waste and Land Use

In addition to the CO_2 data, the main component of GHG emissions, an analysis has been carried out of the key non-CO_2 GHG's, methane (CH_4) and nitrous oxide (N_2O). These data have been extracted from the 1x1km gridded data of the NAEI following the same basic sectoral structure as the CO_2 data. However, these data are calculated on a source basis, i.e. where the emissions are emitted, rather than an end user basis. Therefore, they are not directly consistent with the CO_2 data but give a good estimate of the other GHG's to allow a full picture of GHG's to be presented. The combination of these core datasets is illustrated in Figure 1.

As well as the sectoral breakdown of the data we are also able to provide a spatial disaggregation of the data. The level of spatial disaggregation in the LA CO_2 data is illustrated in Figure 2 below. The spatial detail is different for sector, depending on the key data used for this sector. For the non-CO_2 GHG data from the NAEI the core spatial disaggregation level is the 1x1km grid.

A key element of underlying data that drives the LA CO_2 data is the BEIS regional energy data derived from consumption of gas and electricity at meter points. This data is also reported and analysed in this report, and like the emissions data can be considered spatially.

Figure 1 Core data sources underlying the analysis

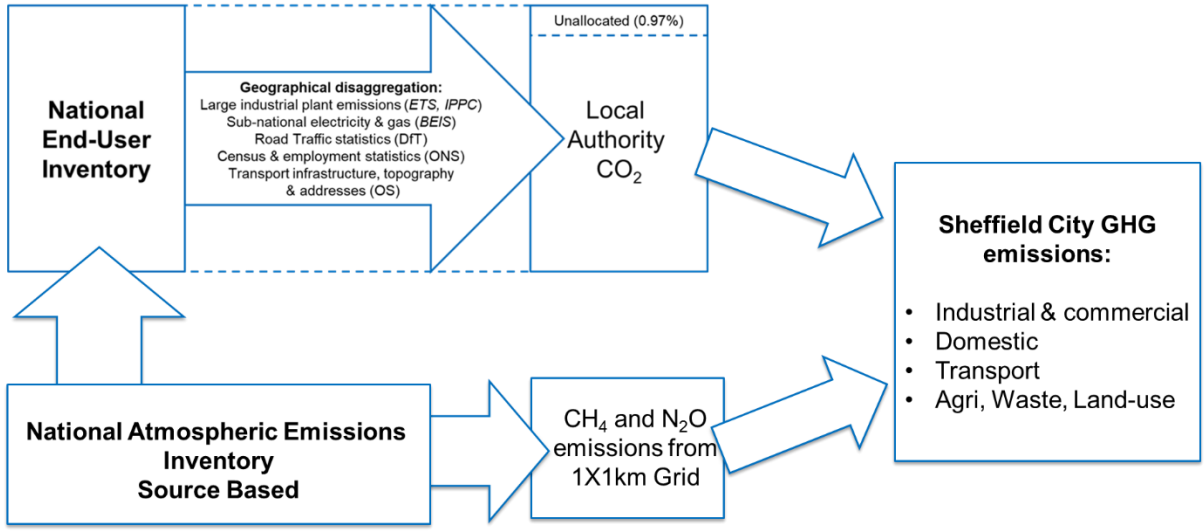
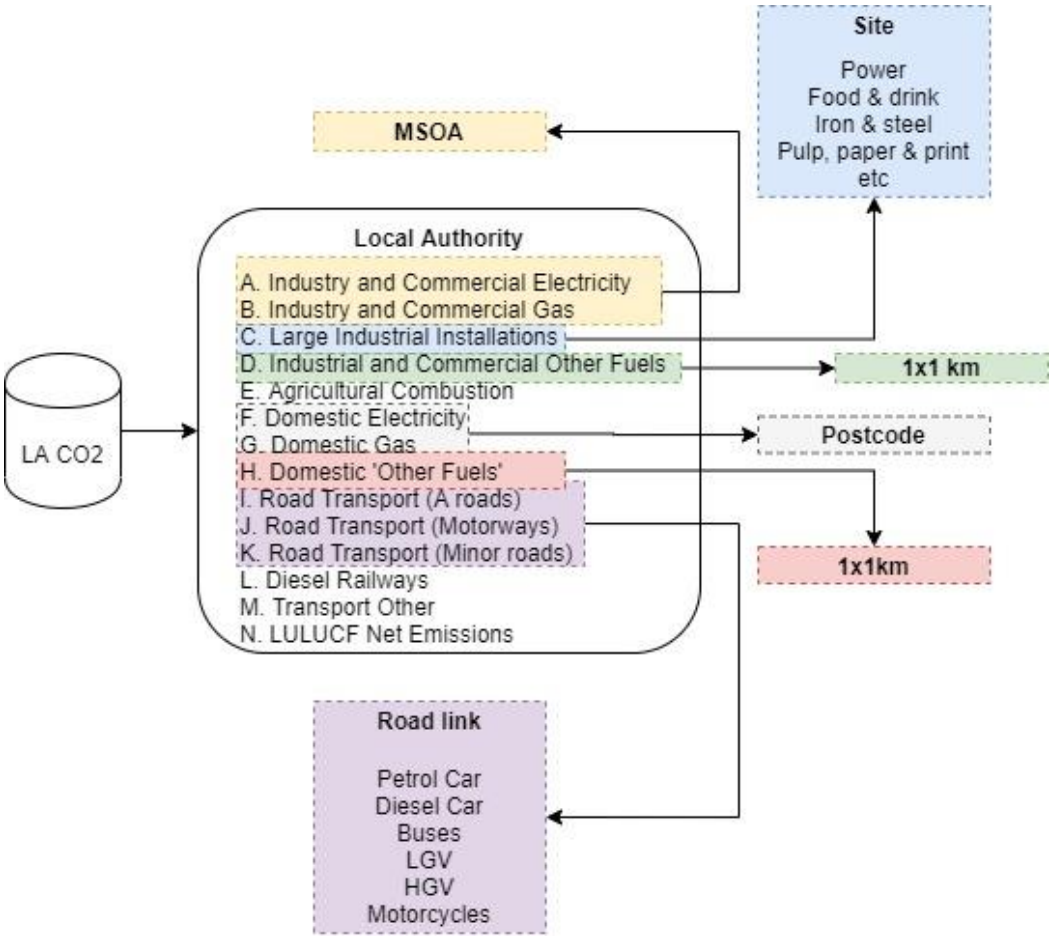


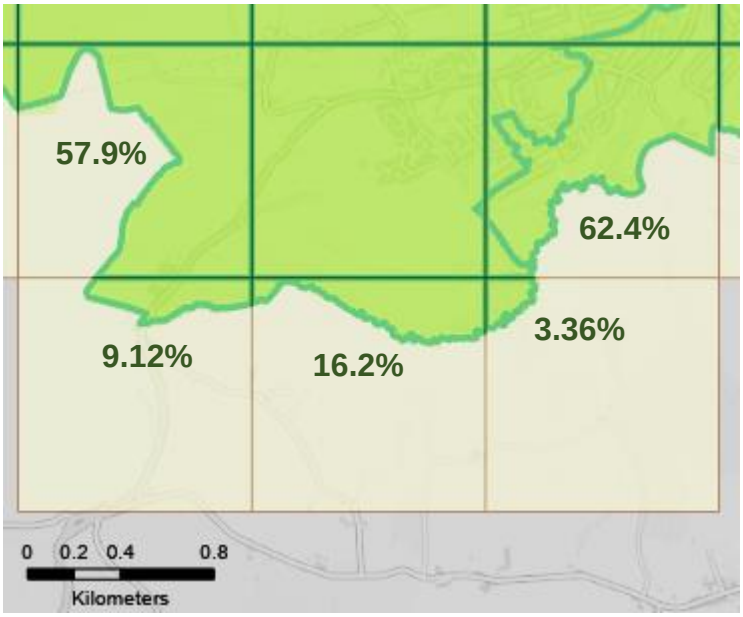
Figure 2 Spatial disaggregation of the local authority CO_2 statistics.



In order to provide a more consistent spatioal analysis of the data from sector to sector we have produced a common spatial mapping of energy consumption and emissions at MSOA level (Middle Layer Super Output Area) – a geospatial unit adopted by the Office for National Statistics to facilitate the reporting of small area statistics. The data utilised for these maps have not always been obtained at MSOA level. The following sequence of applying data to the MSOAs aids the aforementioned.

1. Where MSOA energy consumption data were available the maps used these data
2. Where postcode level data (domestic sector) were provided, emission factors were applied to energy consumption to get emission estimates at MSOA level.
3. Where gridded data (1x1km grids) were utilised, an area weighted approach was adopted to account for the bordering effect. Specifically, for the MSOAs located at the border of Sheffield, the emissions were calculated as a fraction of total emissions per the overlaying 1x1km grid. See Figure 3 for a visualisation.

Figure 3 Percentages of each MSOA section (green) within each 1x1 km grid (yellow).



Further to this approach to overcome the bordering effect, the interpretation of data at MSOA level differs to grid level – when grids were used to present MSOA maps. Specifically, the MSOAs are not consistent in area leading to different interpretations as many grids' data may contribute to one MSOA's data. Following the methods utilised to ensure the appropriate emission estimates are applied to the MSOAs, it is important to clarify that emissions in this report are, therefore, modelled and not obtained directly via in-situ measurements nor via meter readings.

1.2 Structure of the report

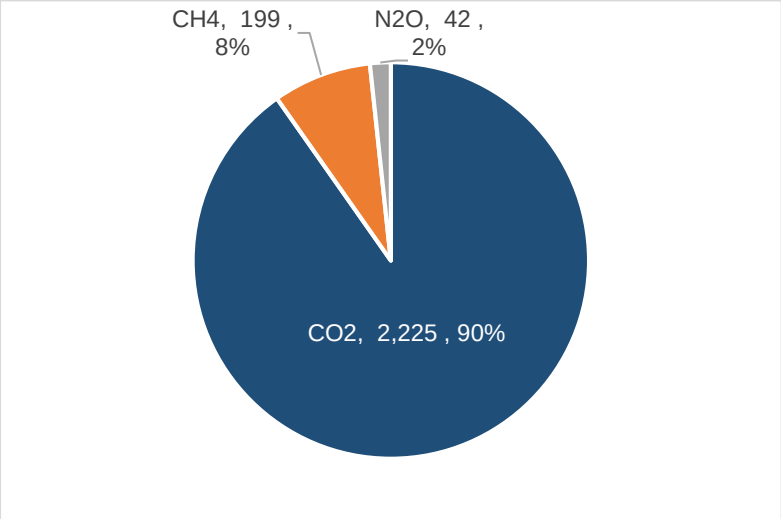
Chapter 2 of this report provides an overview of the key GHG data at the city level. The following chapters then provide a more detailed analysis of each of the 4 key sectors covering energy use data, underlying activity and structure of the sector and resulting CO_2 and GHG emissions. Chapter 8 provides an analysis of current levels of local energy generation and storage and the final chapter pulls together the key points of the analysis and implications for achieve near zero carbon emissions.

The detailed analysis of energy use and CO_2 emissions for each of the sectors in chapters 3 to 6 uses the detailed structural and spatial disaggregation of the local authority CO_2 statistics and NAEI data described above.

2 Overview of CO_2 and GHG emissions from all sectors

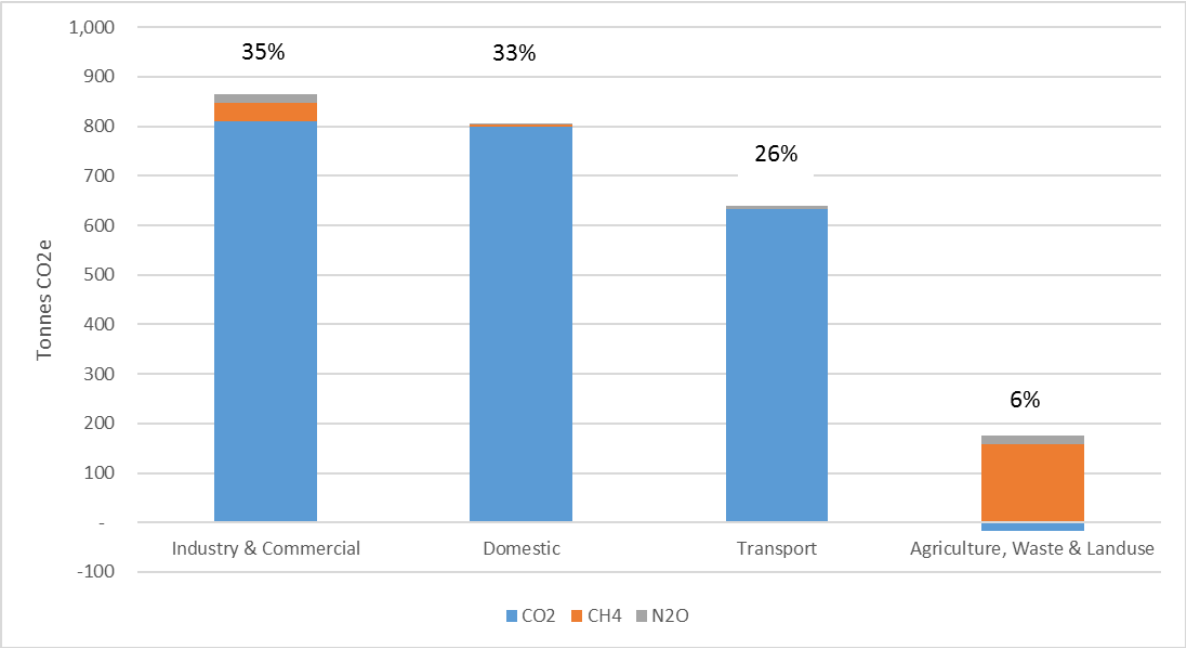
The key GHG at the city level is generally CO_2 driven by combustion of fossil fuels. However, there are other GHG emissions in the form of CH_4 and N_2O which have been included in this analysis. In order to compare these different gases consistently, as they have different global warming potential to CO_2, they have been reported in CO_2 equivalent units (CO_{2e}). The total GHG emissions from the city, in 2017 (the latest year of the data available) is shown in Figure 4 in kt CO_2e. The chart clearly shows that the emissions in kt CO_2e are dominated by carbon dioxide (90%) compared to methane (8%) and nitrous oxide (2%). Hence the focus for action will be to reduce the core CO_2 emissions.

Figure 4 GHG breakdown from all sectors in Sheffield for 2017 (kt CO_2e)



To further understand the GHG emissions and, subsequently, meet the zero-carbon target in Sheffield, it is crucial to understand their sources (i.e. sector). Hence Figure 5 below provides the GHG breakdown by sector and pollutant. Overall the largest emission sources are the industrial & commercial (35%) and domestic sectors (33%), followed relatively closely by road transport (26%). The agricultural, waste & land-use sector contributes to only 6% of all Sheffield's GHG emissions.

Figure 5 GHG by sector in Sheffield for 2017

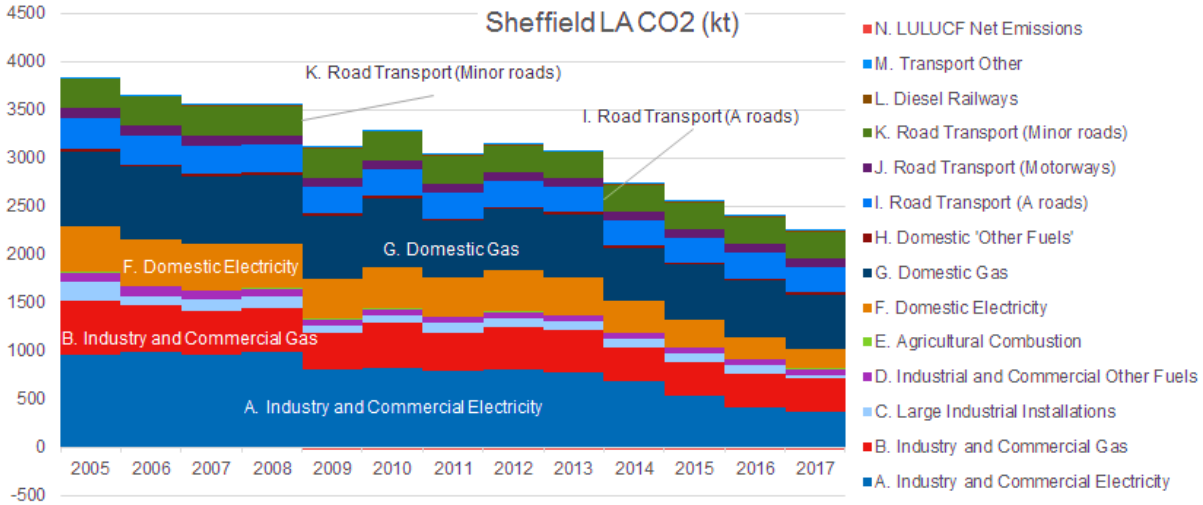


This figure also illustrates that the domestic and transport sectors are nearly all CO_2 emissions, with the industrial and commercial sector being mostly CO_2 emissions. Conversely the agriculture and waste sectors are mostly CH_4 emissions. The land-use sector also shows a small negative value (or sequestration) of CO_2 of some 17 tonnes CO_2e.

2.1 CO_2 timeseries by sector

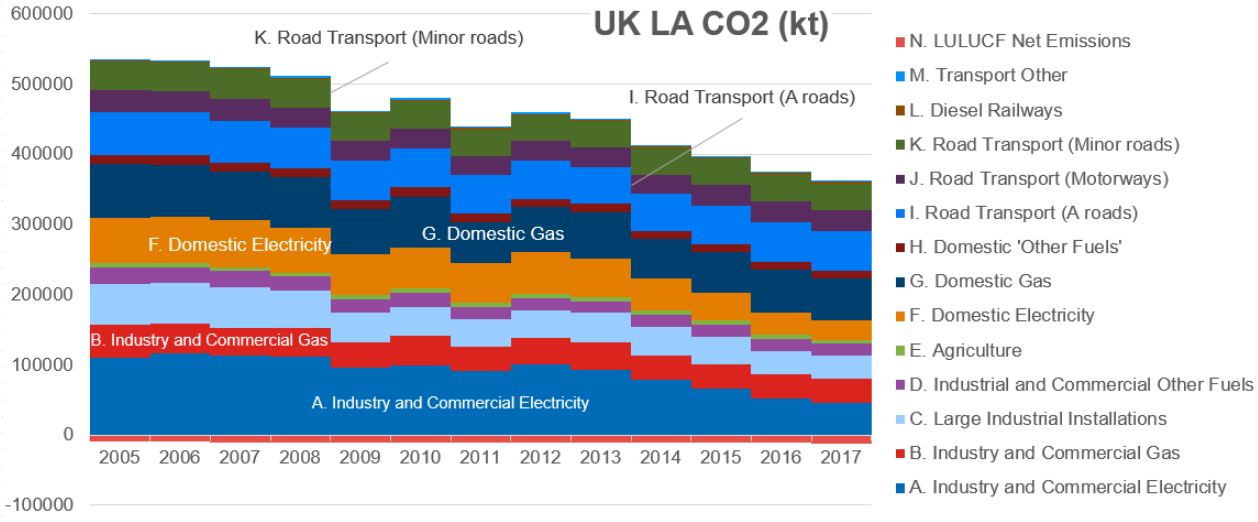
Focusing on the main pollutant of CO_2 a timeseries (Figure 6) is provided showing the emissions' trends between 2005-2017. This provides an illustration of how the different sectors have developed over time. This indicates a significant reduction in emissions in the industrial and commercial sectors, as well as the domestic sector. Conversely the transport sector has little if any reduction in emissions. You can also see the drop in emissions associated with the economic crash in 2008/2009. These trends are explored further in each of the sector focused chapters below.

Figure 6 CO_2 emissions (tonnes) timeseries by sector in Sheffield 2005 to 2017



In order to obtain a more comprehensive understanding and examine the significance of Sheffield's data, Figure 7 was plotted to make comparisons with the UK's LA CO_2 emissions.

Figure 7 CO_2 emissions (tonnes) timeseries by sector in the United Kingdom from 2005 to 2017



A common trend is observed as the CO_2 emissions decrease overall (where from 2014 and onwards the rate of decrease has been greater). Despite this trend, certain sectors contribute to a lesser/greater extent to the total emissions compared to the UK. We can see that Sheffield's emissions from Industrial and Commercial gas consumption are proportionally greater when compared to the total emissions in the UK. On the contrary, Sheffield appears to have a lower contribution to the CO_2 emissions from the traffic on main roads and the Large Industrial Installations compared to the UK as a whole.

Additional comparisons were made with other major cities (Manchester, Leeds, Newcastle, Bristol and Nottingham). Figure 8 shows the total emissions for each city by main sector in 2017. This shows that Sheffield has similar emissions per capita to Manchester, Bristol and Nottingham, but lower than Leeds and Newcastle. Also in general all cities so emissions are split roughly a thord between each of the 3 main sectors, though leads has a somewhat higher contribution from transport at over 40%. The general trend amongst the cities follows the reduction of CO_2 emissions over the years with a noticeable decrease from 2014 and onwards seen in the following charts.

Figure 8 Emissions of CO_2 (kt) for the four sectors from six cities in England (2017).

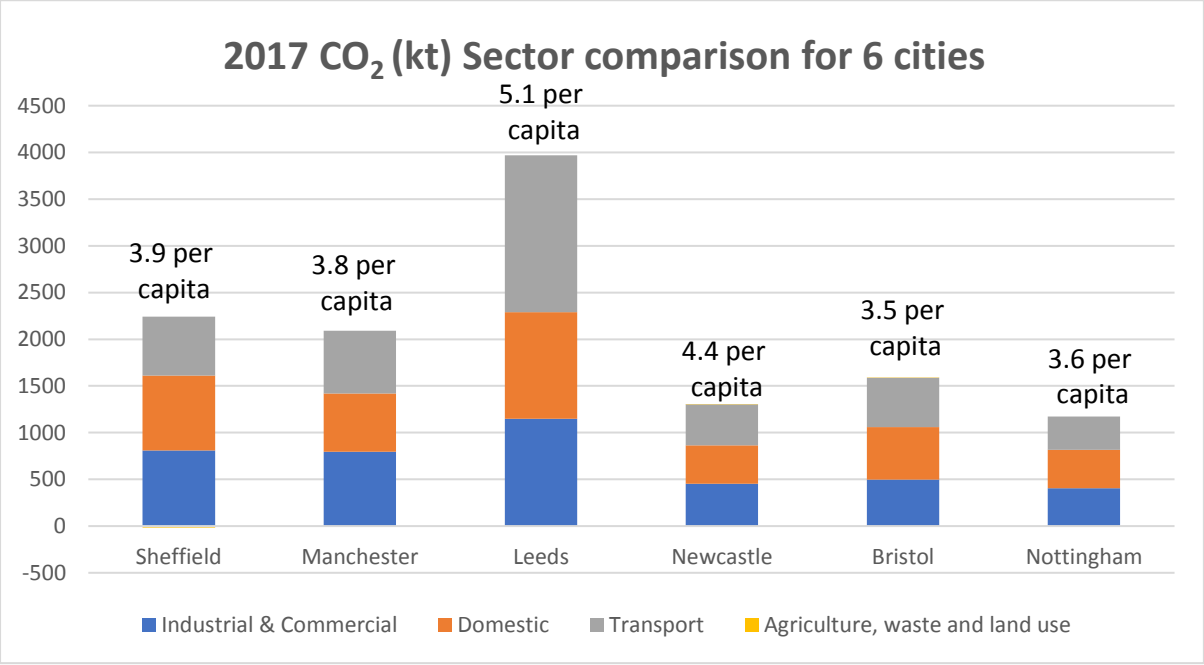
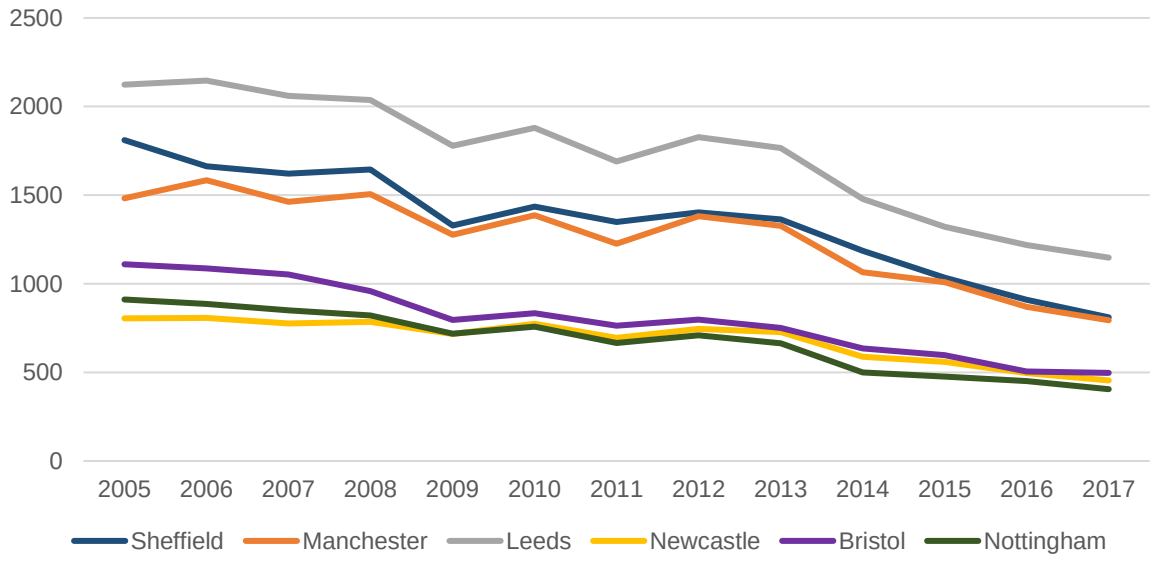
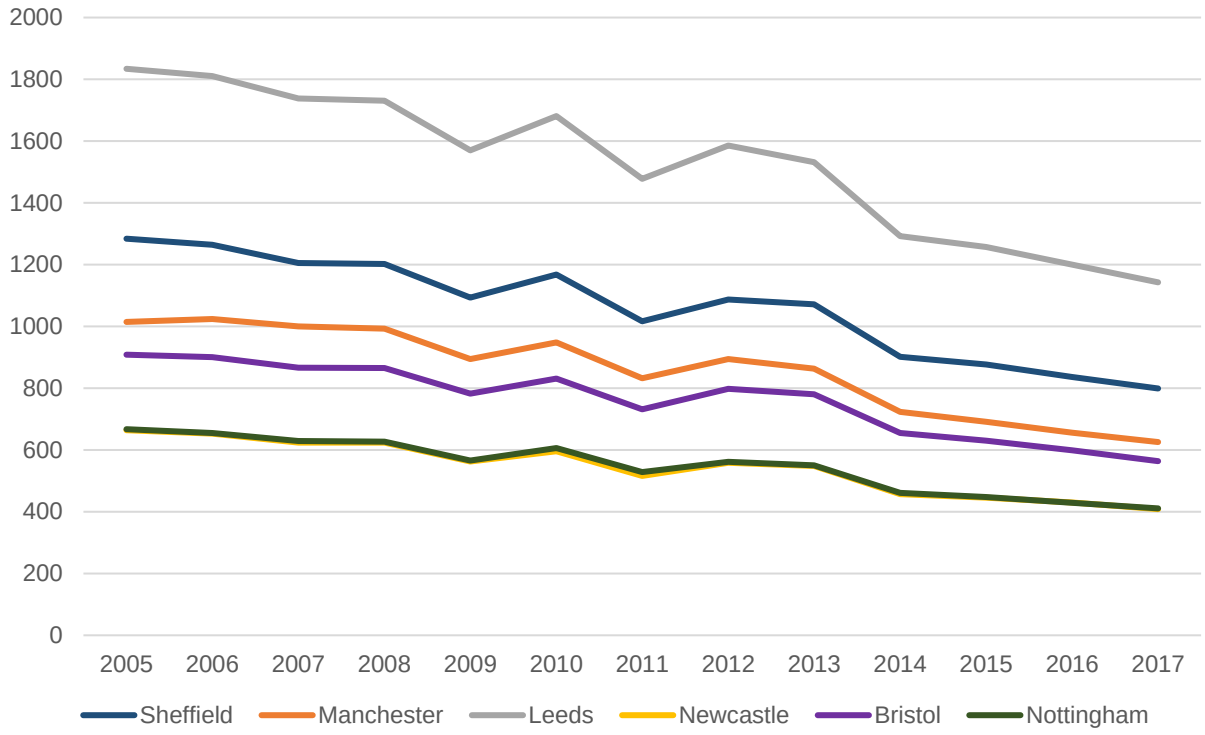


Figure 9 Trend analysis (2005-2017) of Industrial and Commercial CO_2 emissions (kt) in the six cities



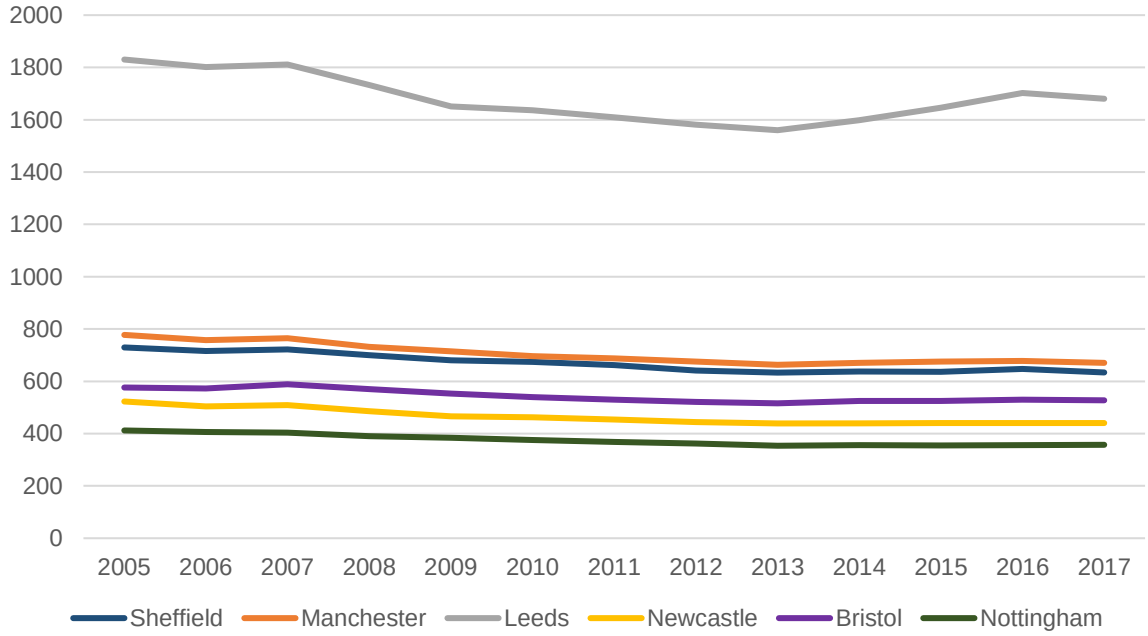
For the Industrial and Commercial sector, the trend indicates a decrease of CO_2 emissions where Leeds is the highest emitter since 2005 and Sheffield still the second highest, despite the decrease in the last three years compared to Manchester.

Figure 10 Trend analysis (2005-2017) of Domestic CO_2 emissions (kt) in the six cities



The Domestic sectors' CO_2 emissions still follow the same trend as the I&C, however Sheffield is a much higher emitter compared to Manchester (since 2005).

Figure 11 Trend analysis (2005-2017) of Transport CO_2 emissions (kt) in the six cities



As seen in Figure 8 Leeds is the greater emitter of CO_2 compared to the other cities. Contrary to the other sectors, Manchester is the second highest emitter of CO_2. All cities with the exception of Leeds follow a similar and unchanged trend from 2005 to 2017.

For the detailed timeseries graphs of the other major cities (Manchester, Leeds, Newcastle, Bristol and Nottingham) please see Appendix A1.

3 Industrial and commercial emissions

This chapter focuses on emissions in Sheffield from the industrial and commercial sector. The subsections present the historic energy consumption, underlying structure and activity in the sector and CO_2 trends including their corresponding data for 2017 (maps) as well as methane and nitrous oxide (GHG) emissions at MSOA and grid level.

3.1 Energy consumption data

Table 1 Table Industrial and commercial energy consumption in Sheffield[1] [2]

Year	I&C Gas (GWh)	I&C Electricity (GWh)	I&C 'Other fuels*' (ktoe)
2005	3,015	1,845	74
2006	2,648	1,786	58
2007	2,536	1,745	52
2008	2,455	1,776	56
2009	2,060	1,608	59
2010	2,234	1,604	48
2011	2,184	1,616	39
2012	2,184	1,532	44
2013	2,107	1,594	42
2014	2,275	1,663	64
2015	1,877	1,518	45
2016	1,772	1,420	32
2017	1,880	1,437	32

*Where ‘other’ includes petroleum, coal, manufactured solid fuels

The results from Table 1 present noticeable trends. Firstly, the gas consumption in Sheffield from 2005 has been on a bumpy decrease - from 3015 GWh in 2005 to 1880 GWh in 2017 (overall decrease 37.6%). The electricity consumption has also experienced a steady decrease over the years – from 1845 GWh in 2005 to 1437 GWh in 2017 where a slight increase took place from the previous year. The overall decrease in electricity consumption in Sheffield is 22.1% with an average annual decrease of 1.95%. The consumption of other fuels in Sheffield has also decreased over the years – 56.8% reduction from 2005 to 2017 with an average rate of reduction of 4.52% every year.

[1] Source: BEIS sub-national gas, electricity and residual fuel consumption statistics
[2] Excludes fuel consumption from Large Industrial sites

Figure 12 Industrial and commercial gas consumption at MSOA level in Sheffield

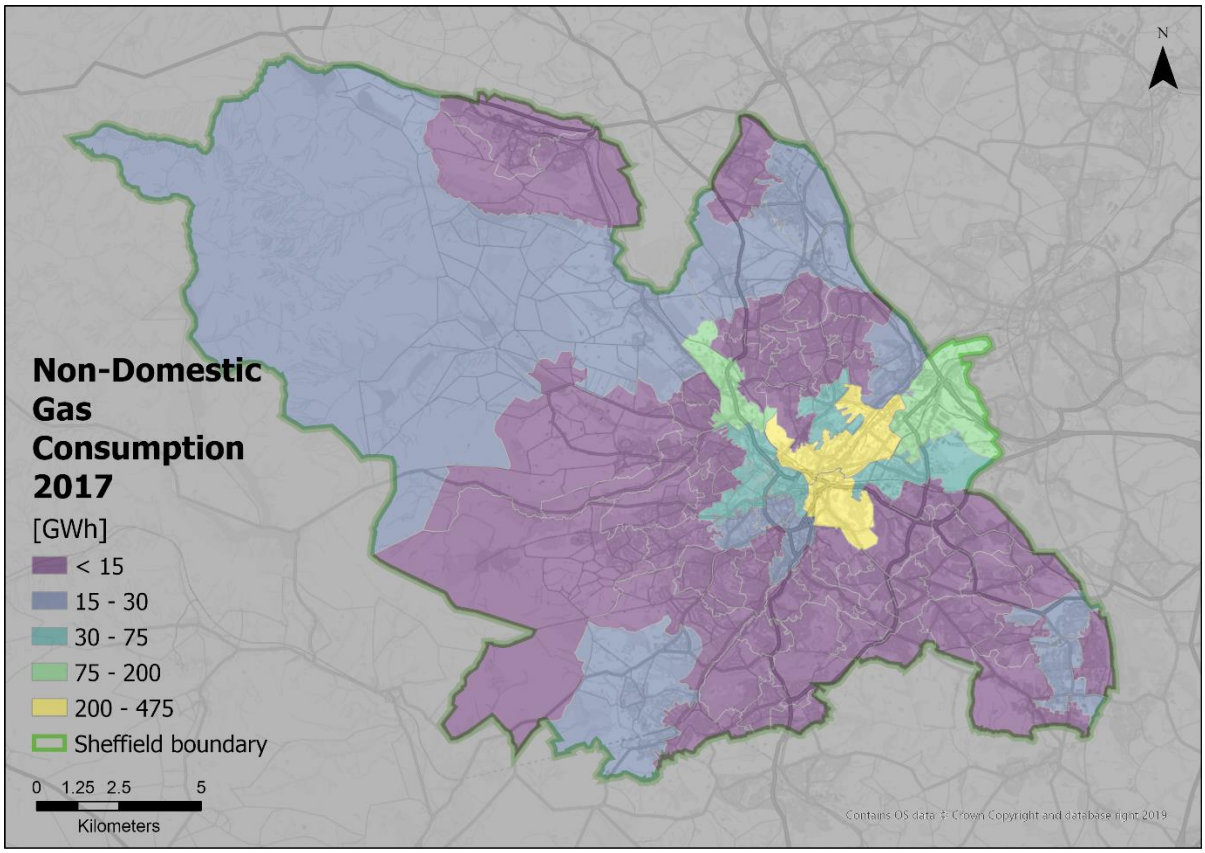
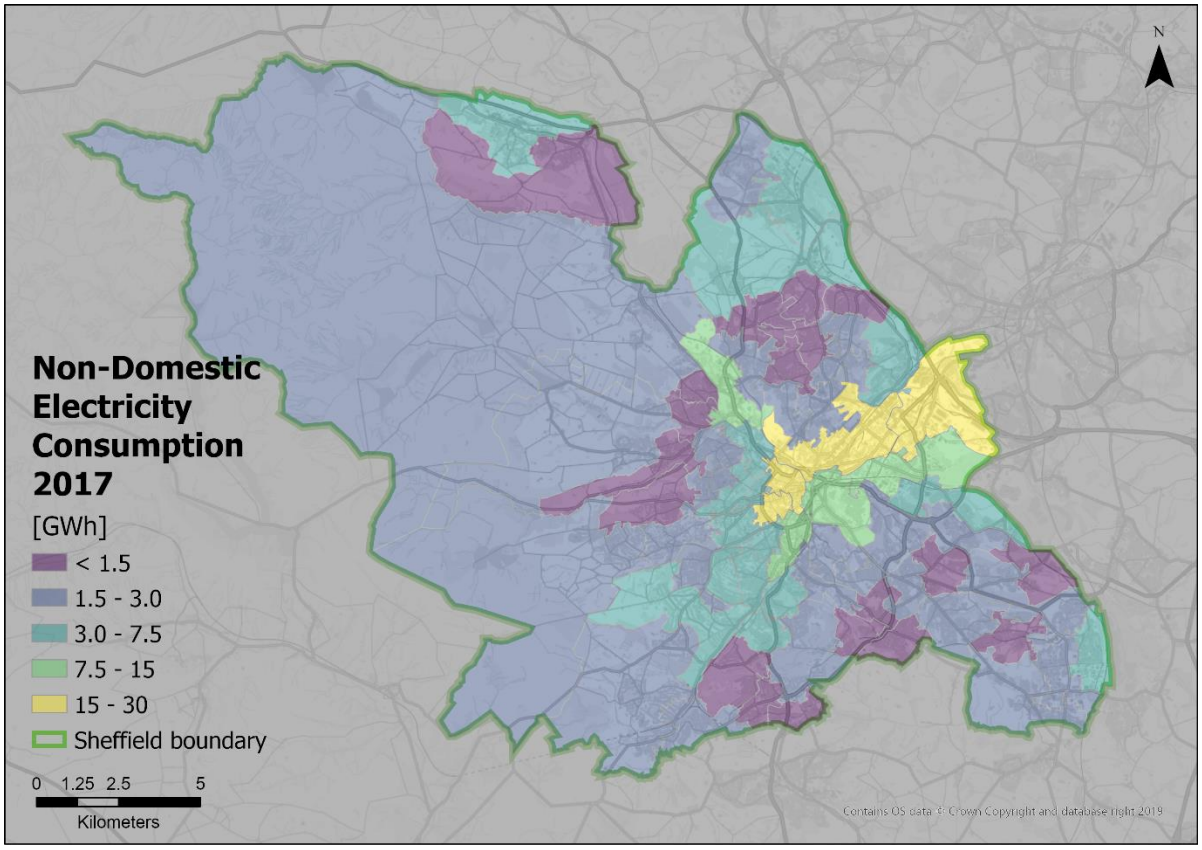


Figure 13 Industrial and commercial electricity consumption in Sheffield



The maps from Figure 12 and Figure 13 highlight important spatial trends. Specifically, the hotspots observed indicate that the city centre and surrounding's MSOAs (in yellow) dominate the energy consumption (for both gas and electricity). Also noticeable is the class range from the maps in Figure 12 and Figure 13 – the upper class (15 – 30 GWh) is an order of magnitude larger than the lower class indicating the big spatial variability in Sheffield.

3.1.1 Energy consumption trend analysis

The following analysis shows the intensity of industrial and commercial energy use with respect to GVA. Figure 14 to Figure 16 show both total consumption and consumption per unit GVA for each of the fuels. Figure 17 shows the intensity of all fuels relative to a 2005 base.

Figure 14 Industrial and commercial gas intensity per GVA compared to 2005 baselines in Sheffield.

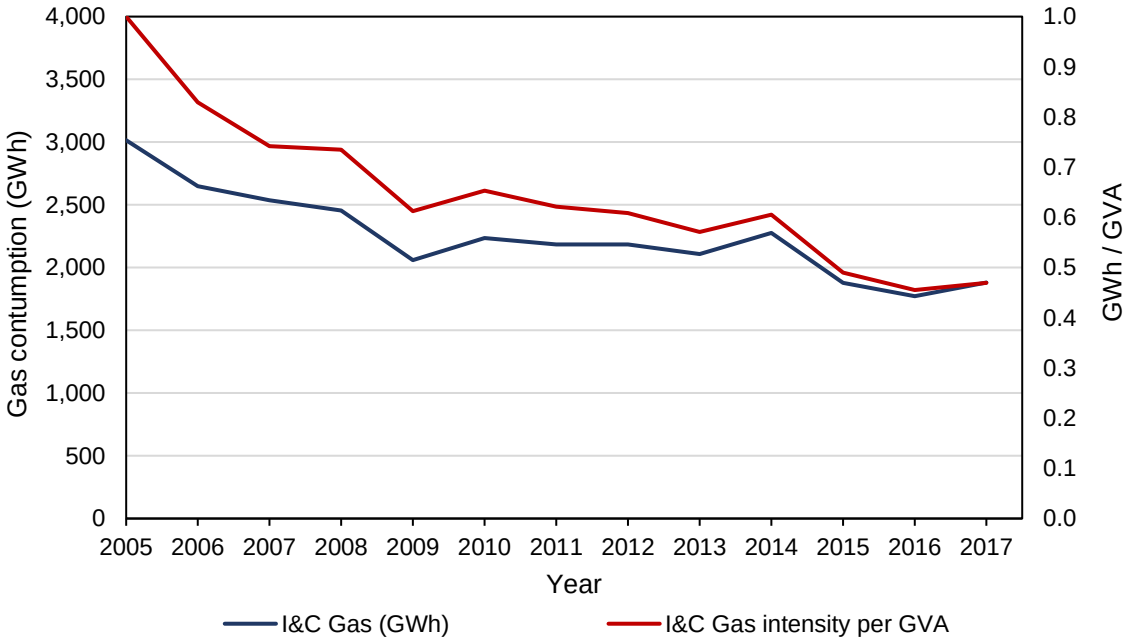
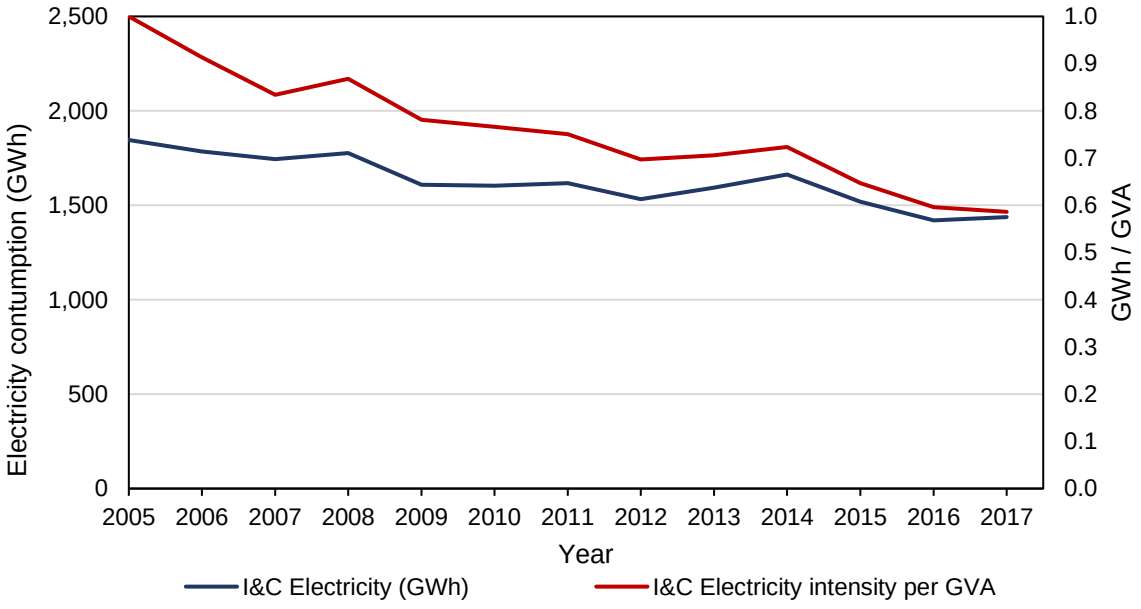


Figure 15 Industrial and commercial electricity intensity per GVA compared to 2005 baselines in Sheffield



The trends observed in Figure 14 and Figure 15 suggest that economic output (using GVA as a proxy) is closely linked to gas and electricity consumption for the first 5 years of the analysis (2005-

2009; coupled but not directly related – constant gap between the two lines). From 2009 and onwards the relationship starts to decouple indicating that the economic output contributes to a lesser extent (intensity line decreased relative to blue line) to the gas and electricity consumption in Sheffield. The same trend is also observed for the 'other fuels' consumption and its influence by the GVA (Figure 16). These results further suggest an increasing efficiency for this sector between 2009-2017 as the red line decreases in relation the consumption (GWh) blue line.

Figure 16 Industrial and commercial 'other fuels' intensity per GVA compared to 2005 baselines in Sheffield

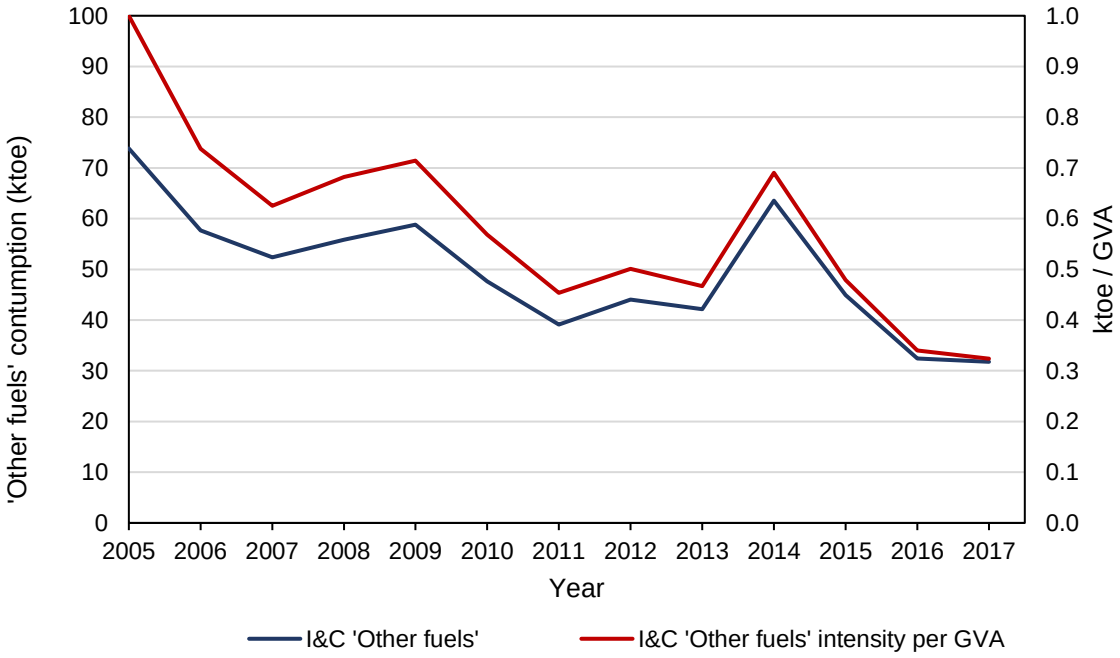
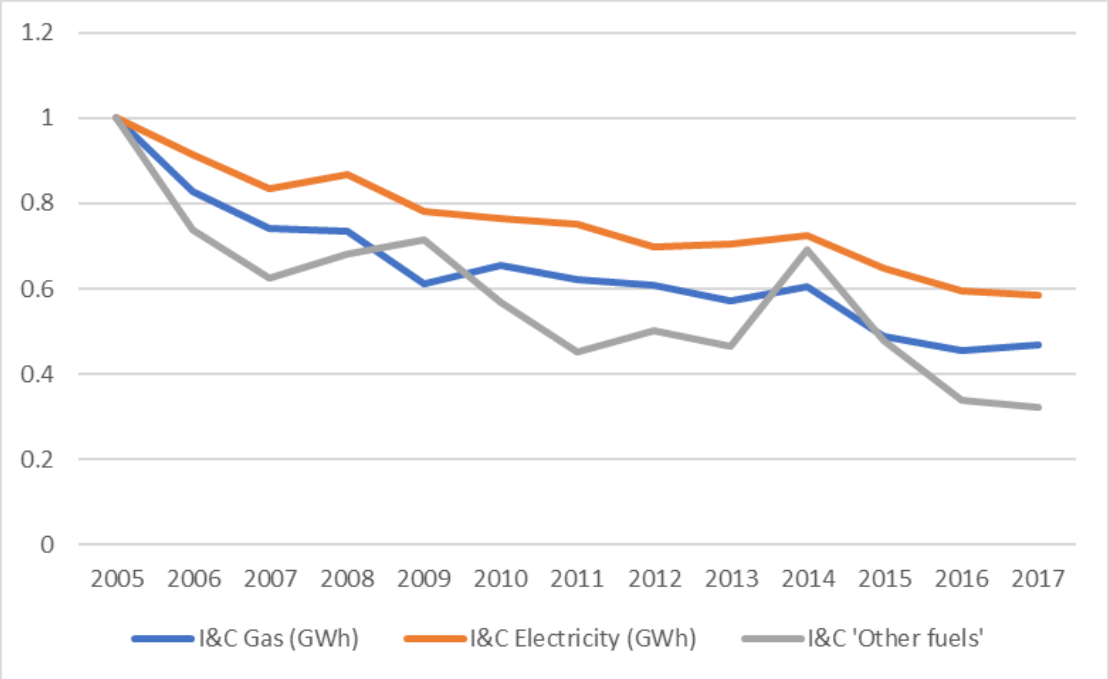


Figure 17 Industrial and commercial energy consumption intensity trend relative to 2005.



Overall the trends present a significant reduction intensity of energy use per GVA dropping by some 40% for electricity use, 50% for gas use and 60% for other fuels. This is likely to be as a result of a mixture of efficiency improvements and some fuel switching.

3.2 Activity data

This subsection summarises the key findings from a review of local data relating to commercial and industrial emissions in Sheffield Local Authority (LA). In 2019, the Office for National Statistics (ONS) reported that there was 15,985 VAT and/or PAYE based enterprises in Sheffield Local Authority. The business rates data provided by Sheffield City Council in March 2020, recorded 18,946 businesses.

Using the ONS date, the enterprises were split into three key sectors. The service sector accounted for the largest number of businesses with 78% of registered businesses in Sheffield LA, followed by the construction sector with 13% and production sector with 9%.

The business rates data provided by Sheffield City Council shows that retail and offices are the largest portion of business in Sheffield.

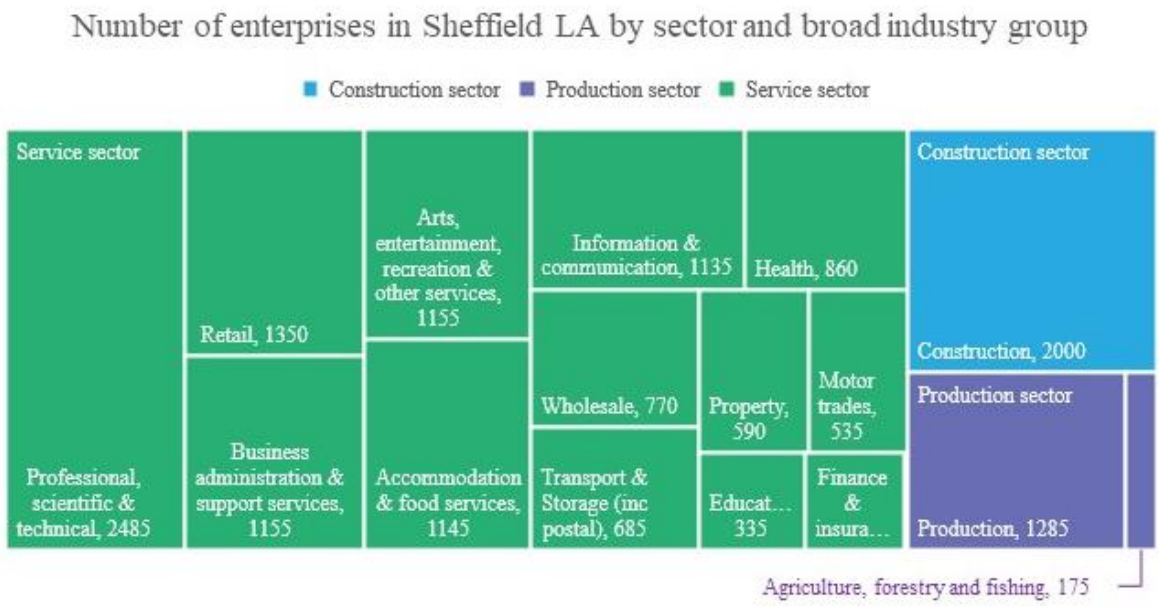
Table 2 Property types in Sheffield based on business rates data provided by Sheffield City Council, March 2020

Property type	Proportion of businesses
Retail	36%
Offices	20%
Warehouse and storage	11%
Industry	15%
Other	18%

3.2.1 Broad industry groups

Using the ONS date, the enterprises were split into 17 broad industrial groups. The professional, scientific and technical industry accounted for the largest number of businesses with 16% of registered businesses in Sheffield LA, followed by the construction industry with 13%.

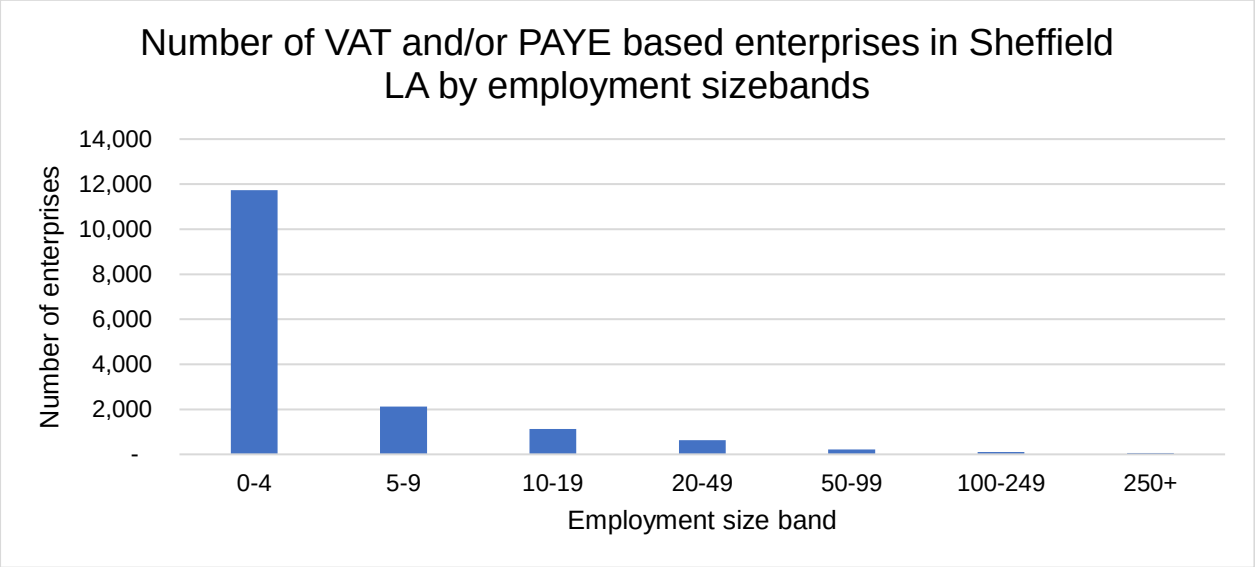
Figure 18 Number of VAT and/or PAYE based enterprises in Sheffield LA by broad industry group, 2019, ONS



3.2.2 Employment size

The enterprises were split into seven employment size bands. An employment size between 0-4 people accounted for the largest number of businesses with 73% of registered businesses in Sheffield Local Authority.

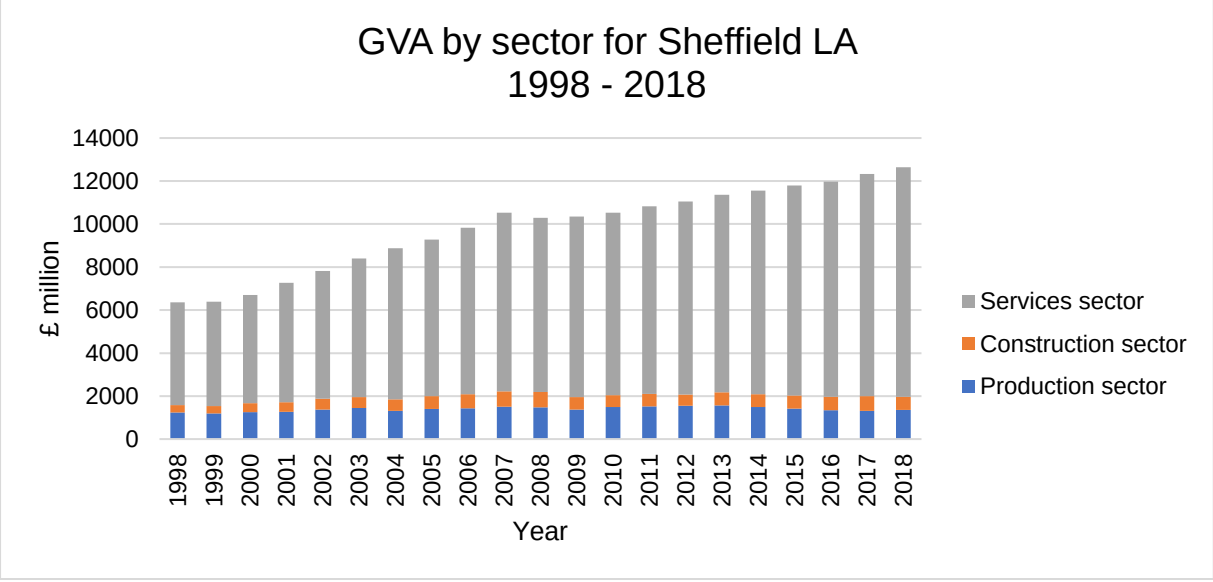
Figure 19 Number of VAT and/or PAYE based enterprises in Sheffield LA by employment size band, 2019, ONS



3.2.3 Gross Value Added

The Office for National Statistics reported that there was £12,639million of gross value added (GVA) in Sheffield Local Authority, for 2018.

Figure 20 GVA (balanced) based on current price for Sheffield LA, ONS



3.2.3.1 Sectors

The enterprises were split into three key sectors. The service sector accounted for the largest proportion of GVA based on current prices with 84%, followed by the production sector with 11% and construction sector with 5%.

3.2.3.2 Broad industry groups

The enterprises were split into 17 broad industrial groups. The wholesale and retail industry accounted for the largest proportion of GVA based on current prices with 13%, followed by the education industry with 12%.

3.2.4 Energy performance

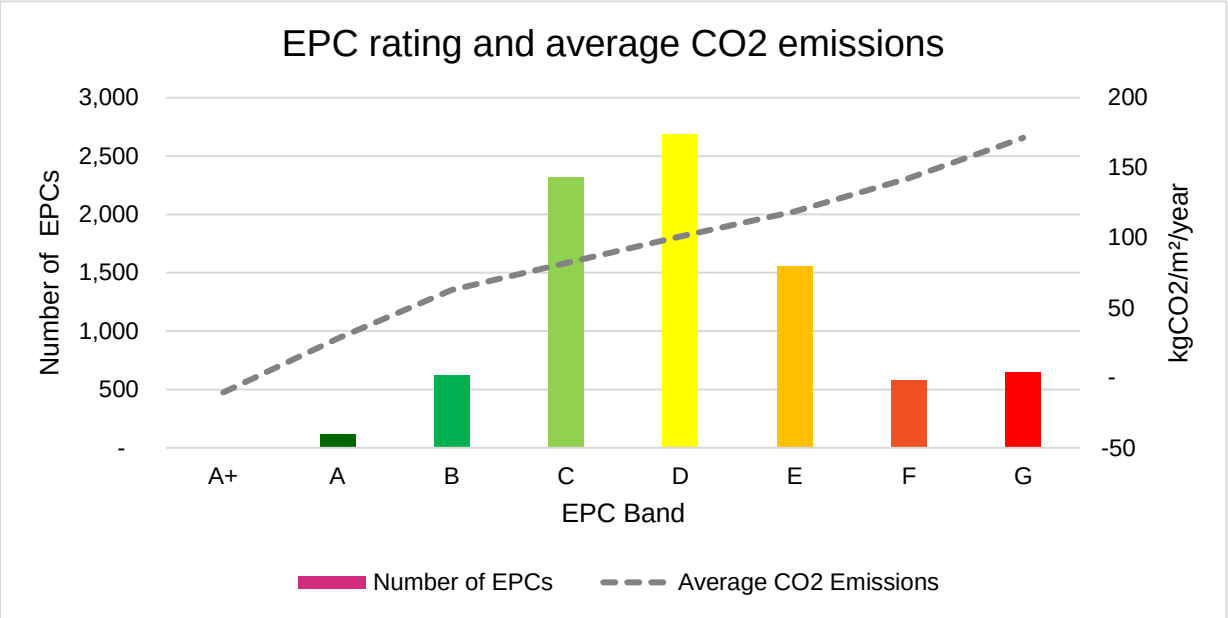
There have been approximately 8,528 energy performance certificates (EPCs) lodged for non-domestic properties in Sheffield from January 2008 to March 2020. The majority of the EPCs lodged for non-domestic properties in Sheffield have an EPC energy rating of D (31%), with the average EPC rating number of 92. Based on the EPC data, the average carbon dioxide emissions for non-domestic properties in Sheffield is 102 $kgCO_2/m^2/year$.

Table 3 Non-domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020

ECP Band	Proportion of EPCs	Average CO_2 Emissions ***($kgCO_2/m^2/year$)***
A+	0%	-10
A 0-25	1%	28
B 26-50	7%	63
C 51-75	27%	82
D 76-100	32%	101
E 101-125	18%	119
F 126-150	7%	143

The data shows the average carbon emissions per floor area reduce as the EPC band improves.

Figure 21 Non-domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020



3.2.5 Archetypes

The proportional data from the EPCs can be used to estimate the types of non-domestic properties, the heating fuel and the systems installed.

3.2.5.1 Property type

Over half of EPCs lodged were for retail units, and a quarter were for offices and workshops. The average CO_2 emissions per floor area are typically higher for retail units.

Table 4 Property types in Sheffield, based on non-domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020

Property type	Proportion of EPCs	Average CO_2 emissions ***($kgCO_2/m^2/year$)***	Average EPC Band
Retail	52%	128	D
Offices and Workshop	25%	66	E
Warehouse and storage	7%	70	D
Industry	7%	83	D
Other	9%	95	78

3.2.5.2 Main heating fuel

49% of EPCs lodged used grid supply electricity as the main heating fuel, and 46% used natural gas.

Table 5 Main heating fuel in Sheffield, based on non-domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020

Main heating fuel	Proportion of EPCs	Average CO_2 emissions ***($kgCO_2/m^2/year$)***	Average EPC Band
Grid Supplied Electricity	49%	116	D
Natural Gas	46%	92	D
Other	2%	39	D
District Heating	1%	60	D
Oil	1%	122	F

3.2.5.3 Building environment

Two thirds of EPCs lodged had heating and natural ventilation, and a quarter had air conditioning. Excluding the unconditioned properties, the average CO_2 emissions were lowest for properties that were mixed mode with natural ventilation, however these accounted for 1% of the sample size.

Table 6 Building environment in Sheffield, based on non-domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020

Building environment	Proportion of EPCs	Average CO_2 emissions ***($kgCO_2/m^2/year$)***	Average EPC Band
Heating and Natural Ventilation	67%	108	D
Air Conditioning	25%	98	D
Heating and Mechanical Ventilation	4%	95	D
Unconditioned	2%	40	D
Mixed mode with Natural Ventilation	1%	69	C
Mixed mode with Mechanical Ventilation	<1%	100	D

3.3 CO_2 data

By utilising BEIS' LA CO_2 dataset and Middle Super Output Areas (MSOA) gas and electricity consumption datasets, it is possible to disaggregate LA CO_2 data further into CO_2 emissions per MSOA level within Sheffield. Therefore, emissions estimates for the following sectors have been produced:

- Industrial and Commercial Electricity
- Industrial and Commercial Gas
- Large Industrial Installations
- Industrial and Commercial Other Fuels

Table 7 CO_2 emissions estimates for the industrial and commercial sector in Sheffield 2005-2017 (kt CO_2)[3].

Year	Gas	Electricity	Large Industrial Installations	Other Fuels
2005	554.9	963.0	196.5	96.2
2006	483.1	984.4	100.3	94.4
2007	448.4	963.6	114.2	94.5
2008	464.2	981.6	112.2	86.9
2009	385.4	803.4	70.4	69.1
2010	463.8	822.9	81.1	66.7
2011	394.6	797.1	100.1	57.1
2012	434.3	810.9	92.4	64.9
2013	440.6	779.4	90.7	52.7
2014	347.0	683.5	97.8	56.9
2015	353.8	535.3	81.6	63.4
2016	355.6	409.6	80.4	63.9
2017	348.5	365.7	29.2	67.2

The results from Table 7 indicate an overall reduction in CO_2 emissions in Sheffield, between 2005 and 2017, from electricity and gas consumption as well as large industrial installations and other fuels. Specifically, CO_2 emissions from electricity consumption have experienced an average decrease of 3.11% year-on-year (37.3% overall decrease from 2005 to 2017), from gas consumption an average annual decrease of 7.27% (62.0% overall decrease), from large industrial installations an average decrease of 9.91% year-on-year (85.1% overall decrease) and from other fuels an average annual decrease of 2.33% (30.1% overall decrease).

Table 8 presents the breakdown of CO_2 emissions by source for the Large Industrial Installations. The results indicate a variation in carbon dioxide emissions' increase and decrease by sector. What stands out is the large contribution of CO_2 emissions by the production of iron and steel plants (via combustion processes) despite a 23.5% reduction from 2005. This source accounts for more than 1/3 of the total CO_2 emissions in 2017. For more detailed data for each Large Industrial Installation please refer to Appendix A2.

[3] Source: BEIS LA CO_2 statistics

Table 8 Breakdown of CO_2 emissions for Large Industrial Installations in Sheffield 2010-2017 ($ktCO_2$).

Source Name	2010	2011	2012	2013	2014	2015	2016	2017
Pulp, Paper and Print (combustion)	0.006	0.006	0.006	0.006	0.003	0.003	0.003	0.000
Electric arc furnaces	22.550	26.628	23.892	22.531	24.749	19.283	24.948	26.155
Food & drink, tobacco (combustion)	0.002	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Iron and steel - combustion plant	56.554	72.943	68.194	67.782	72.989	62.087	54.454	1.953
Public sector combustion	0.141	0.102	0.109	0.140	0.038	0.180	0.086	0.229
Other industrial combustion	1.826	0.396	0.166	0.268	0.031	0.083	0.130	0.110
Non-Ferrous Metal (combustion)	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000
Industrial urea use	0.000	0.000	0.000	0.000	0.000	0.000	0.811	0.710

The following maps present the CO_2 emissions from gas, electricity and other fuels in Sheffield in 2017.

Figure 22 CO_2 emissions from industrial and commercial gas consumption in Sheffield

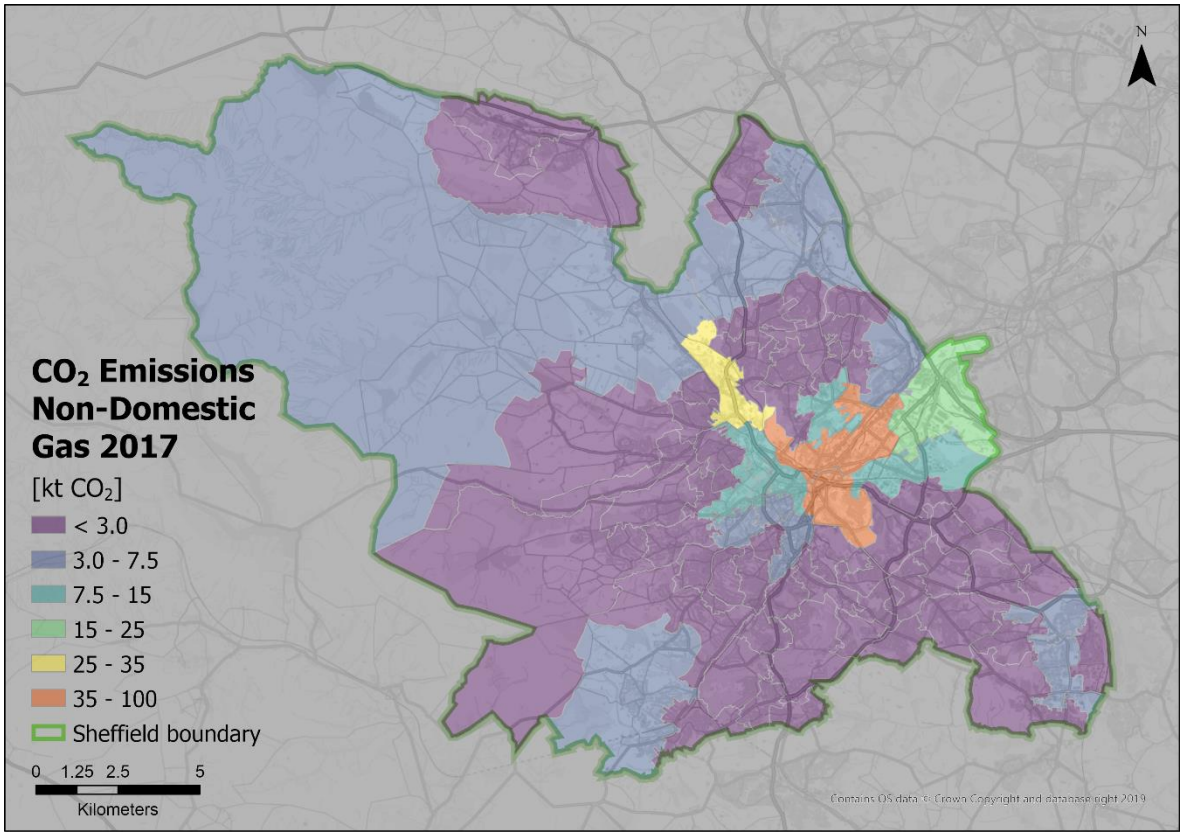


Figure 23 CO_2 emissions from industrial and commercial electricity consumption in Sheffield

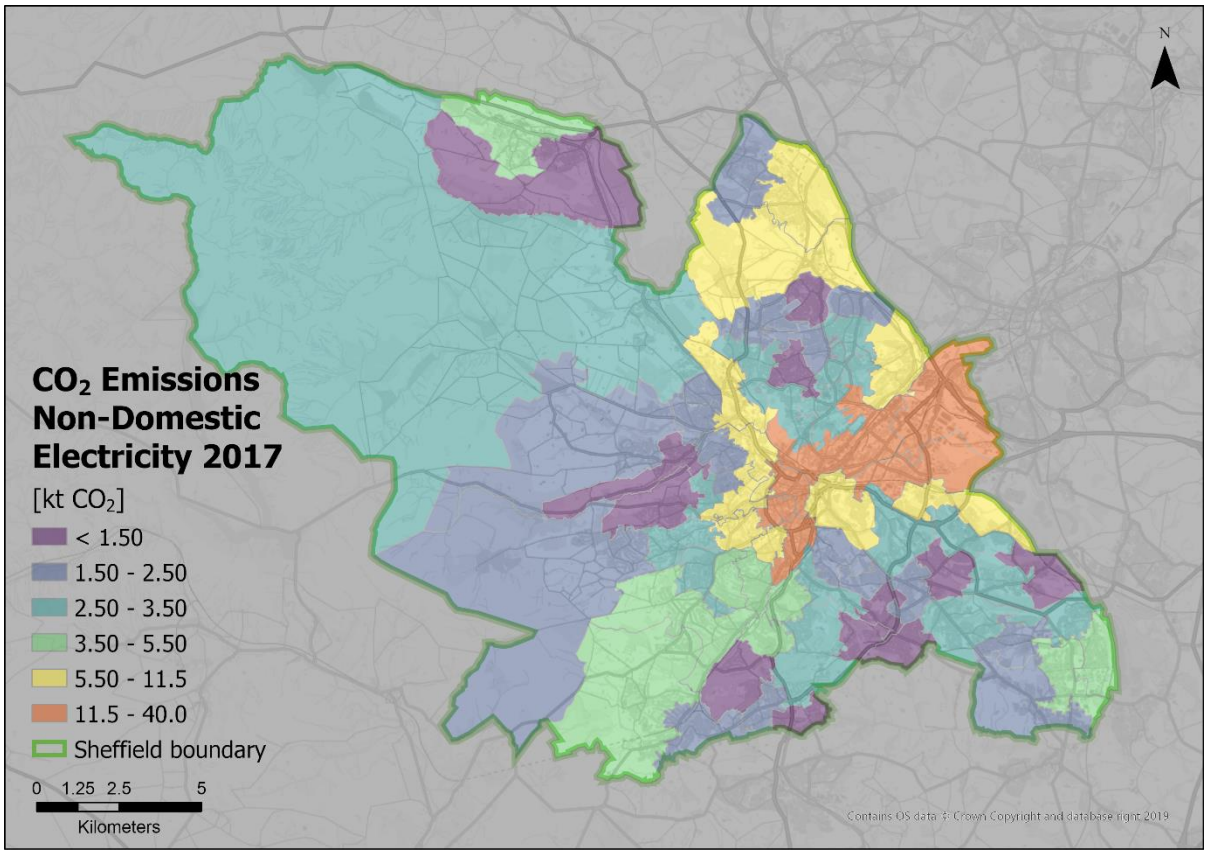


Figure 24 Locations of Large Industrial Installation in Sheffield

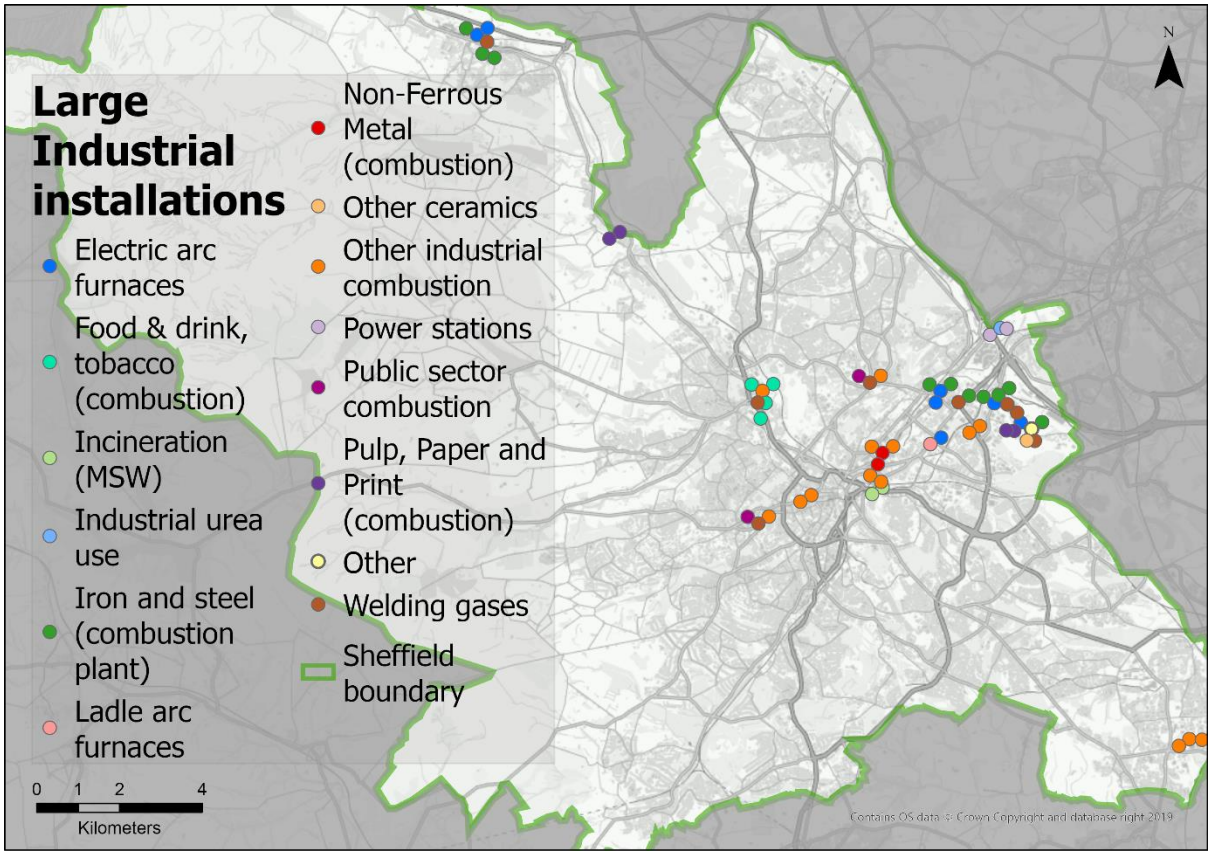


Figure 25 CO_2 estimates from Large Industrial Installations in Sheffield in 2017

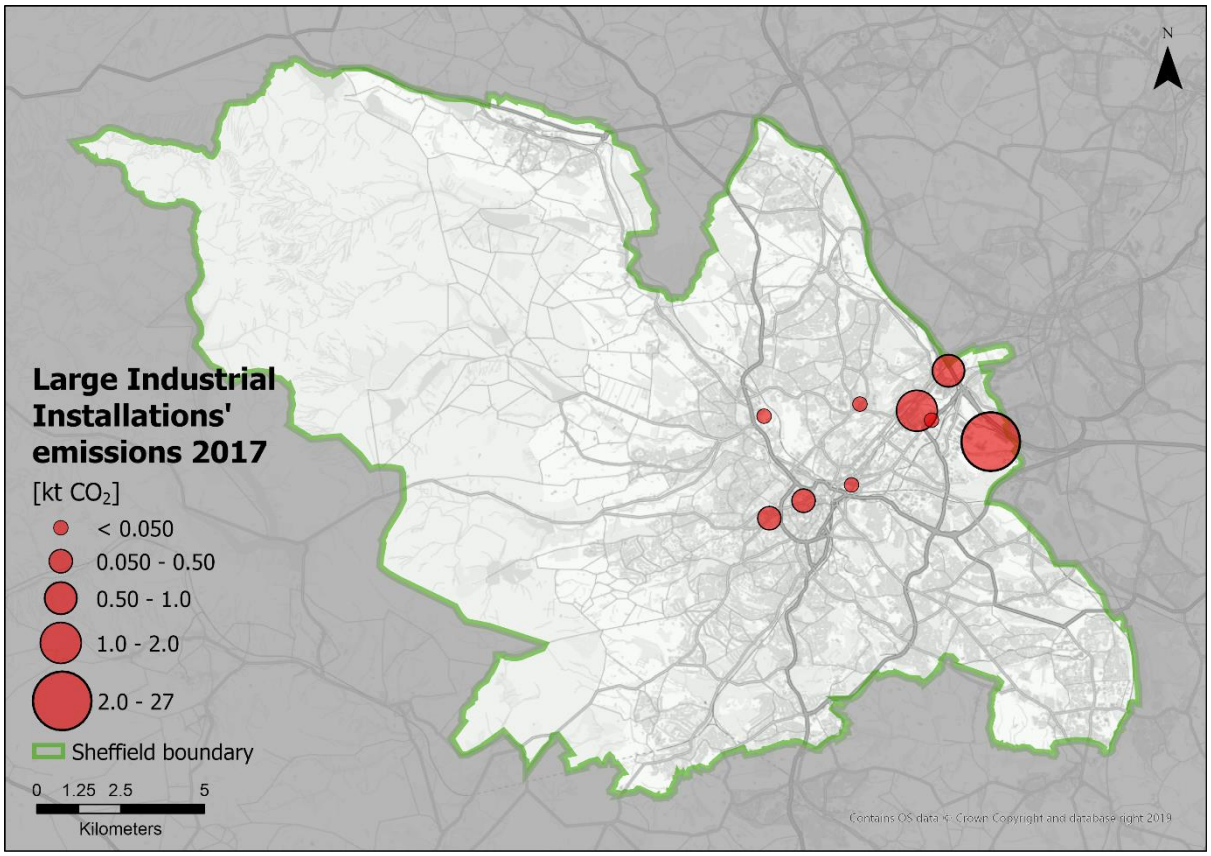
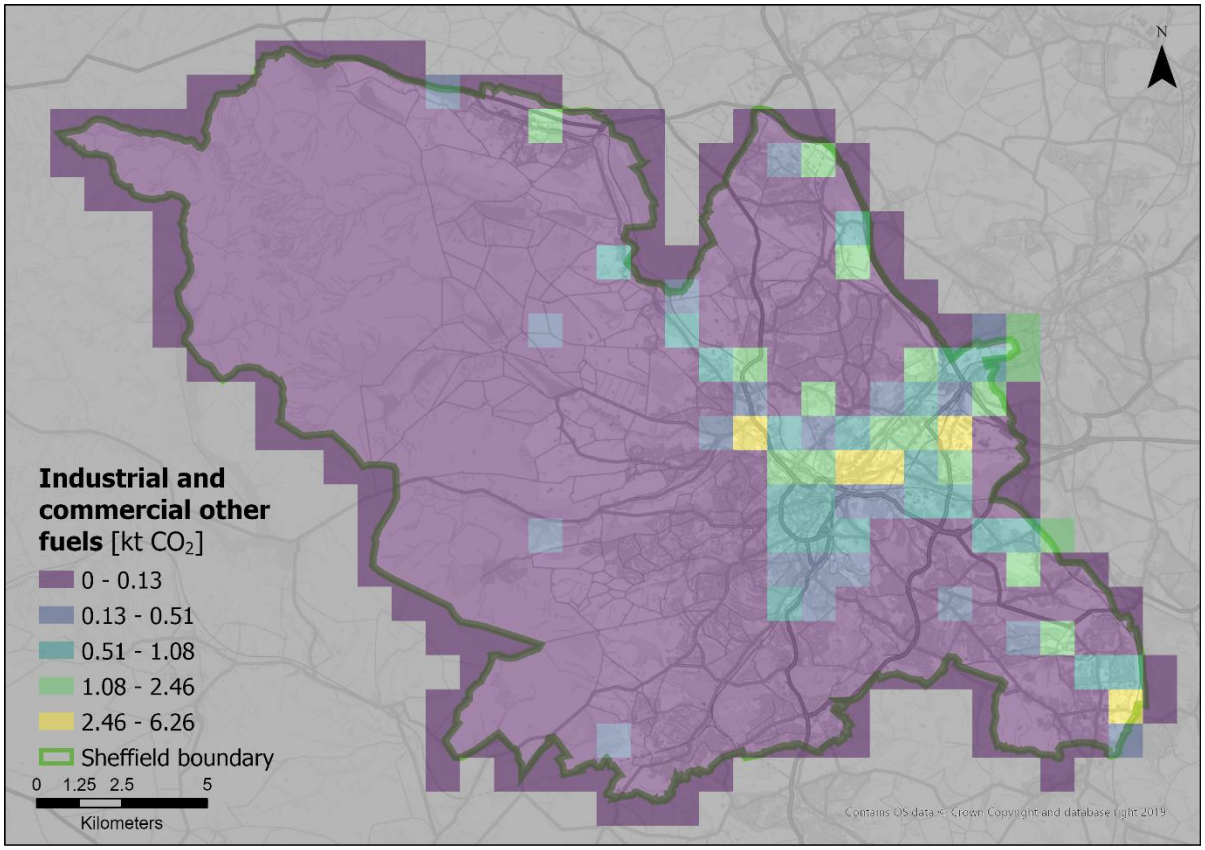
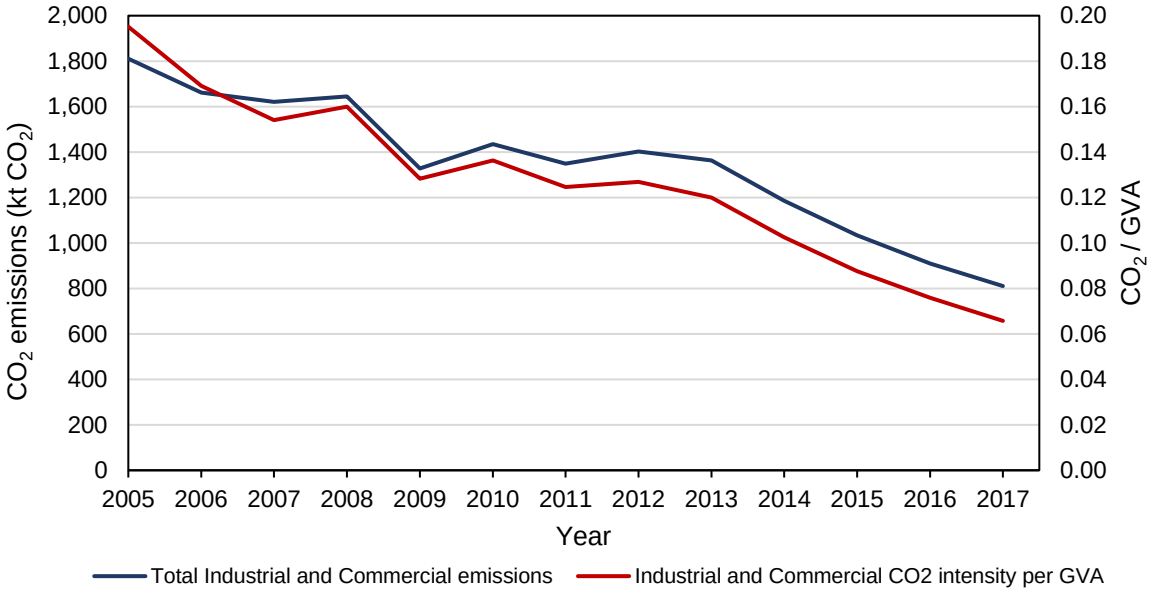


Figure 26 CO_2 emissions from industrial and commercial 'other fuels' in Sheffield at 1x1km level



The maps of CO_2 emissions estimates support the spatial trends from the consumption maps seen in section 3.1 where the city centre of Sheffield dominates such activities – supported by both MSOA and grid-level maps. The CO_2 emission estimates trend analysis (seen in Figure 27 below) also supports the results from section 3.1.1 as the economic output intensity line (red) starts to decouple from the total emissions line (blue) after 2009 – indicating higher efficiency in terms of consumption and, subsequently, lower carbon dioxide emissions.

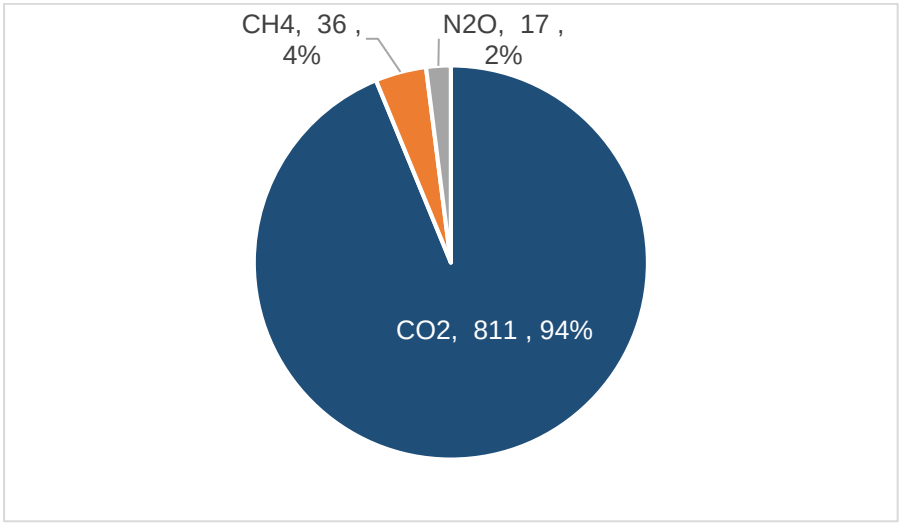
Figure 27 CO_2 emissions and intensity per GVA from the industrial and commercial sectors in Sheffield



CH_4 and N_2O data

In addition to understanding the CO_2 emissions from the sources seen so far in this section, it is also vital to provide insights on methane and nitrous oxide emission estimates from the industrial and commercial sector. Hence, the is subsection of the report focuses on these estimates by providing the GHG breakdown in ktCO_2-equivalent and the relevant maps of GHG emissions at grid level – the MSOA maps can be seen in Appendix A3.

Figure 28 GHG breakdown from industrial and commercial sector (kt CO_2e)



The chart from Figure 28 indicates a 95% dominance in CO_2e by CO_2 emissions and 6% split by methane (4%) and nitrous oxide (2%) indicating the minimal contribution by the later pollutants to CO_2 emissions in Sheffield.

Reinforcing an aforementioned statement on the presence of Large Industrial Installations, the following maps' spatial variability and relatively low emissions show the importance and large contribution of the Large Industrial Installations to the carbon dioxide emissions in Sheffield. Furthermore, the relevant maps indicate that nitrous oxide's largest sources of emissions are found at the west of the city centre and specifically where industrial combustion activities are taking place (Non-ferrous metal (combustion) and other industrial combustion).

Figure 29 Methane emissions from industrial and commercial at 1x1km level in Sheffield

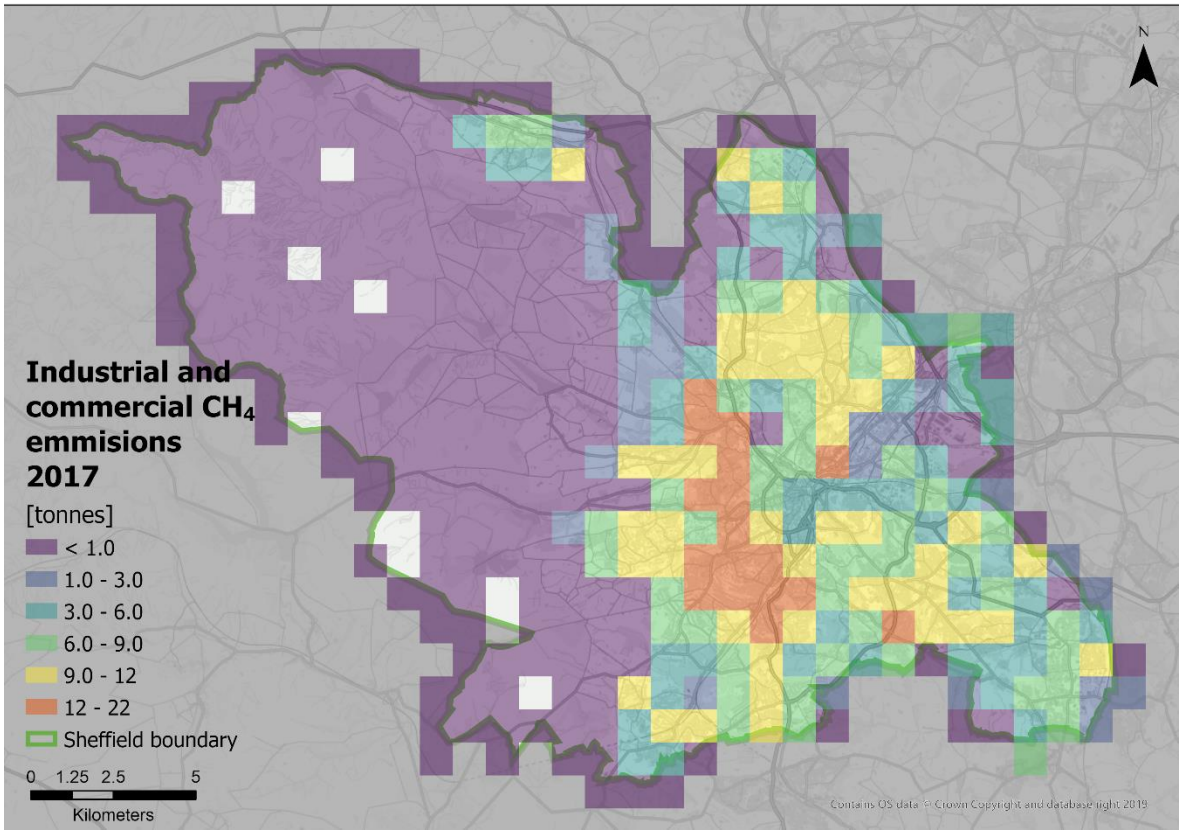
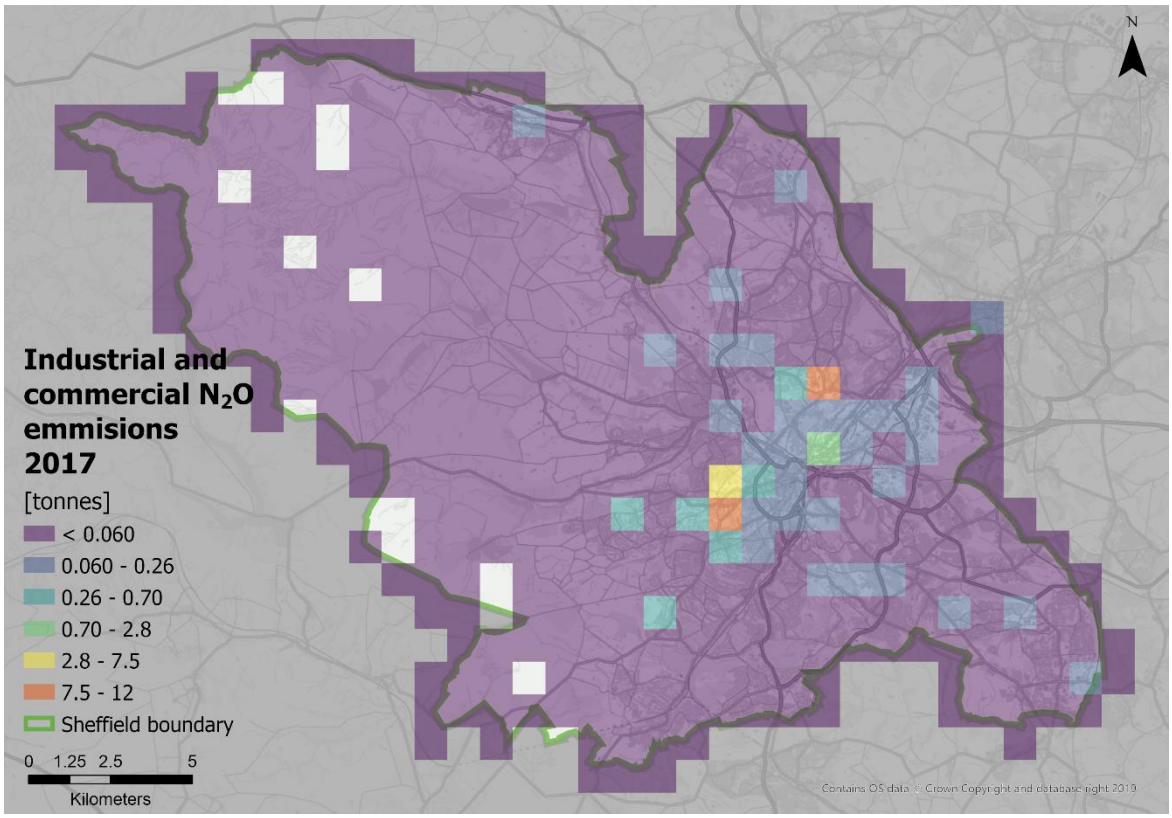


Figure 30 Nitrous oxide emissions from industrial and commercial at 1x1km level in Sheffield



4 Domestic emissions

This chapter concerns emissions in Sheffield from the domestic sector. The subsections that follow present the historic energy consumption, structure and activity in the sector and CO_2 trends including their corresponding data for 2017 (maps) as well as methane and nitrous oxide (GHG) emission maps.

4.1 Energy consumption data

Table 9 Domestic energy consumption in Sheffield[4]

Year	Domestic Gas (GWh)	Domestic Electricity (GWh)	Domestic 'Other Fuels*' (ktoe)
2005	4,248	906	4.2
2006	4,091	893	4.0
2007	3,959	870	4.0
2008	3,782	832	4.3
2009	3,465	840	3.8
2010	3,405	845	4.1
2011	3,204	836	3.8
2012	3,160	822	3.9
2013	3,085	813	3.9
2014	3,065	818	3.6
2015	3,004	804	3.6
2016	2,956	783	3.6
2017	3,053	775	3.6

The domestic gas consumption in Sheffield from 2005 has been on a steady decrease - from 4248 GWh in 2005 to 3053 GWh in 2017 (the only year of a slight increase; overall decrease 28.1%). The domestic electricity consumption has also experienced a steady decrease over the years – from 906 GWh in 2005 to 775 GWh in 2017. The overall decrease in domestic electricity consumption in Sheffield is 14.5% with an average decrease of 1.28% year on year. The domestic energy consumption of other fuels has also decreased over the years and experienced no change in the last 4 years (3.6 kt of oil equivalent).

The 4 maps below present the gas and electricity consumption (GWh) at MSOA and postcode level. The data, for the MSOA maps, have been derived from postcode level.

[4] Source: BEIS sub-national gas, electricity and residual fuel consumption statistics

Figure 31 Domestic gas consumption at postcode level in Sheffield

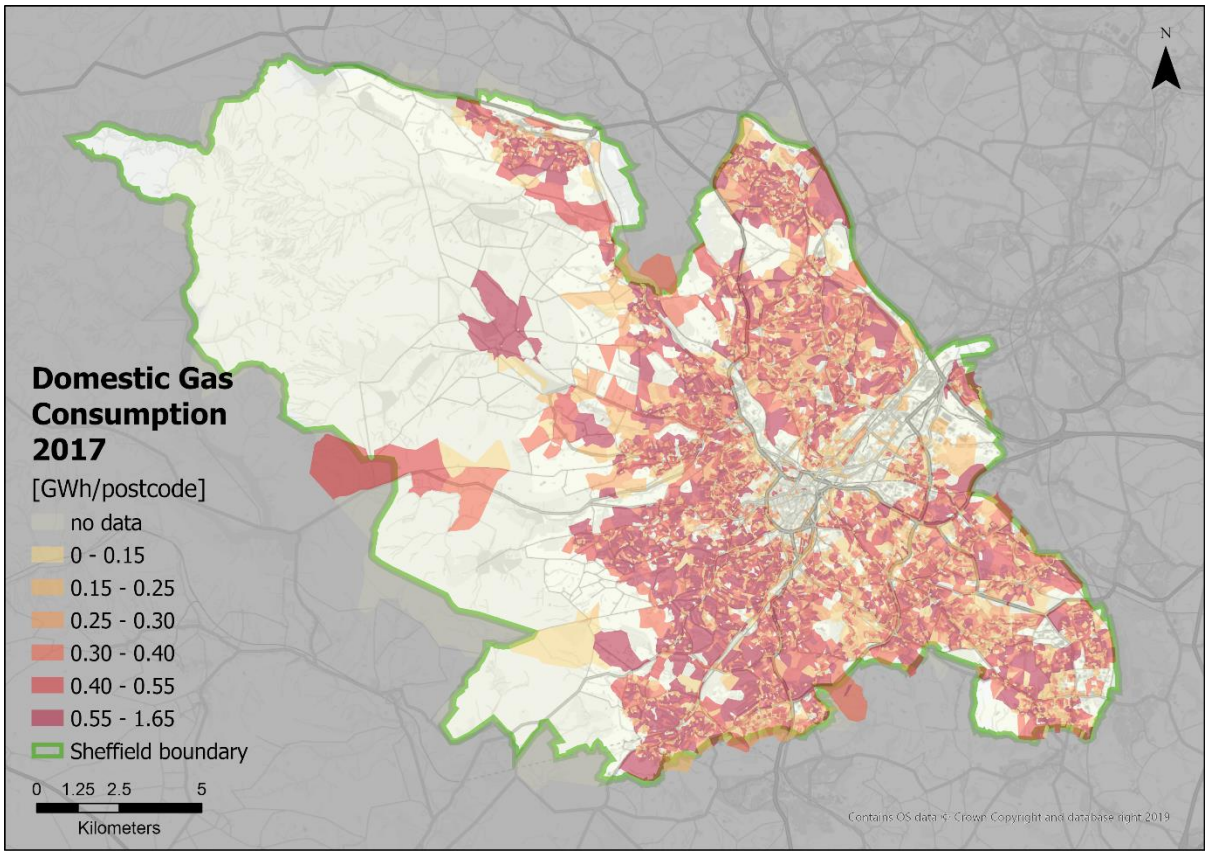


Figure 32 Domestic gas consumption at MSOA level in Sheffield

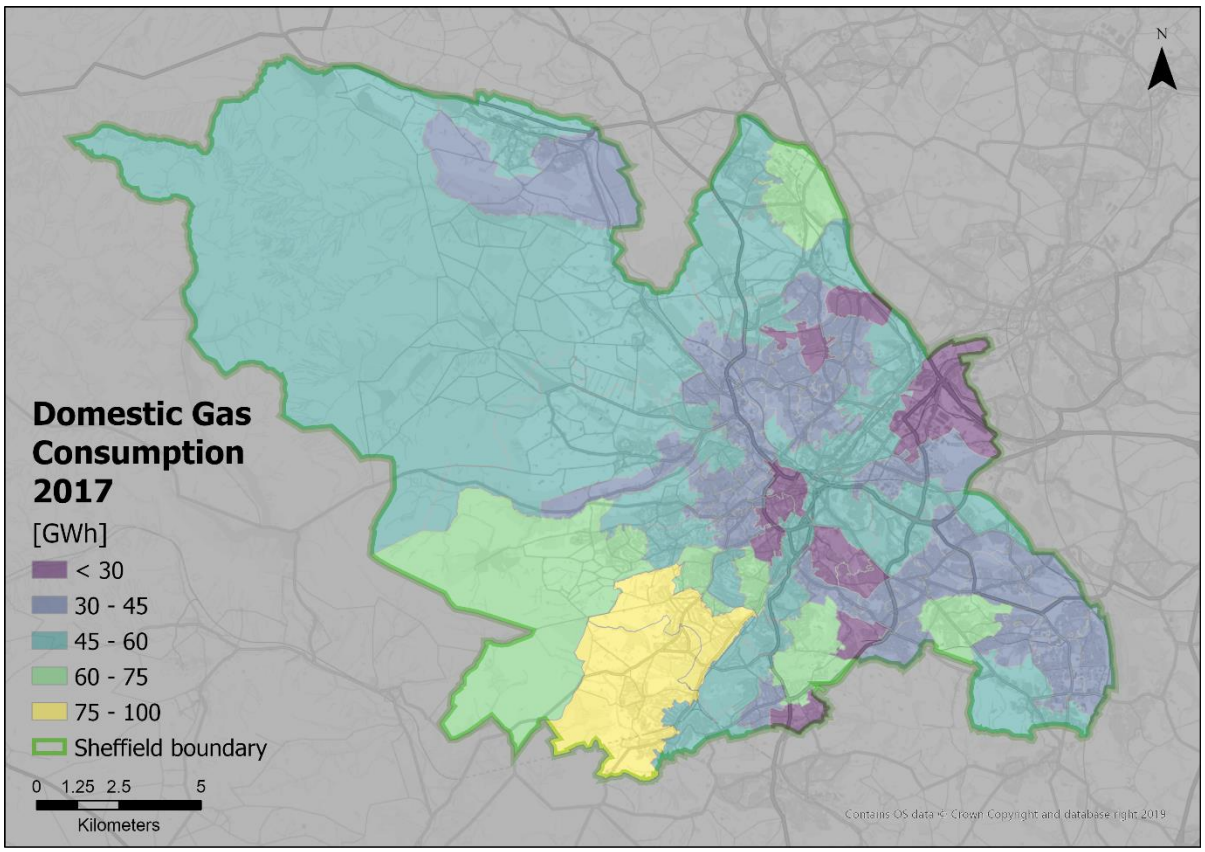


Figure 33 Domestic electricity consumption at postcode level in Sheffield

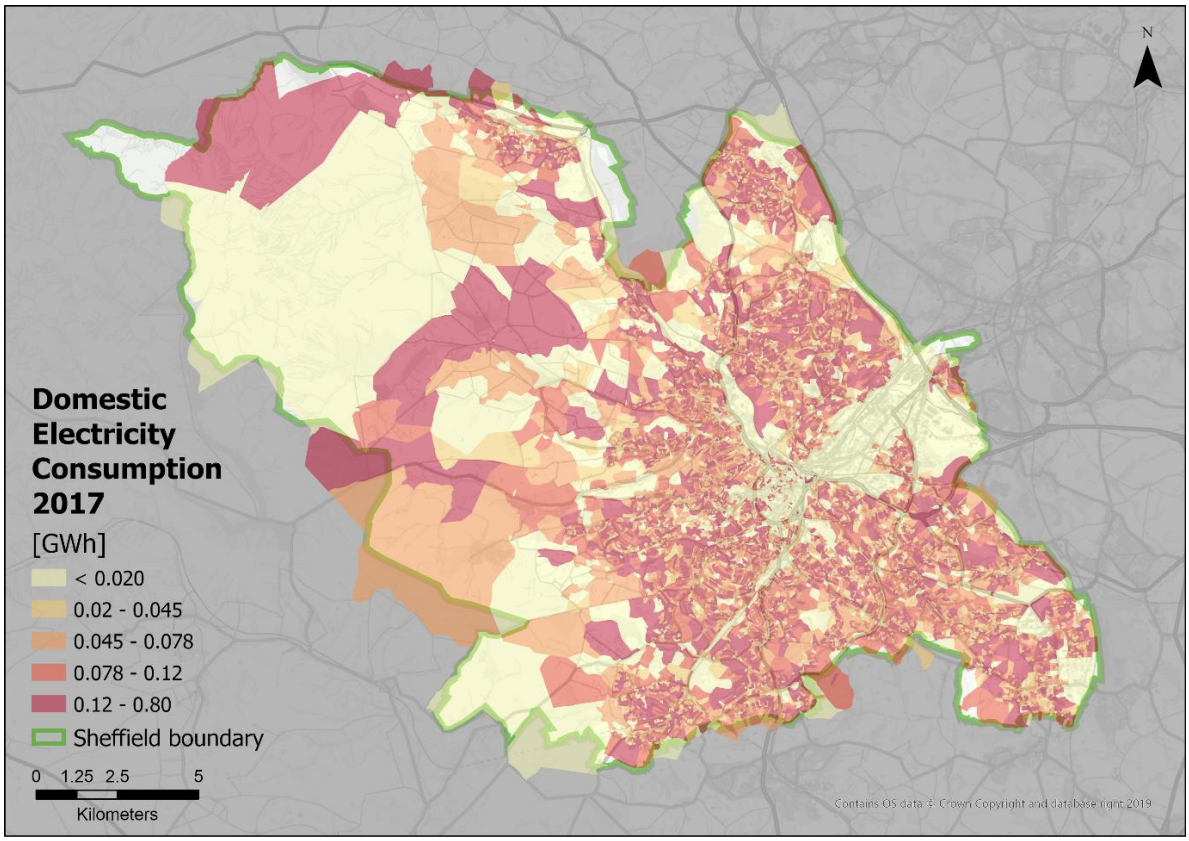
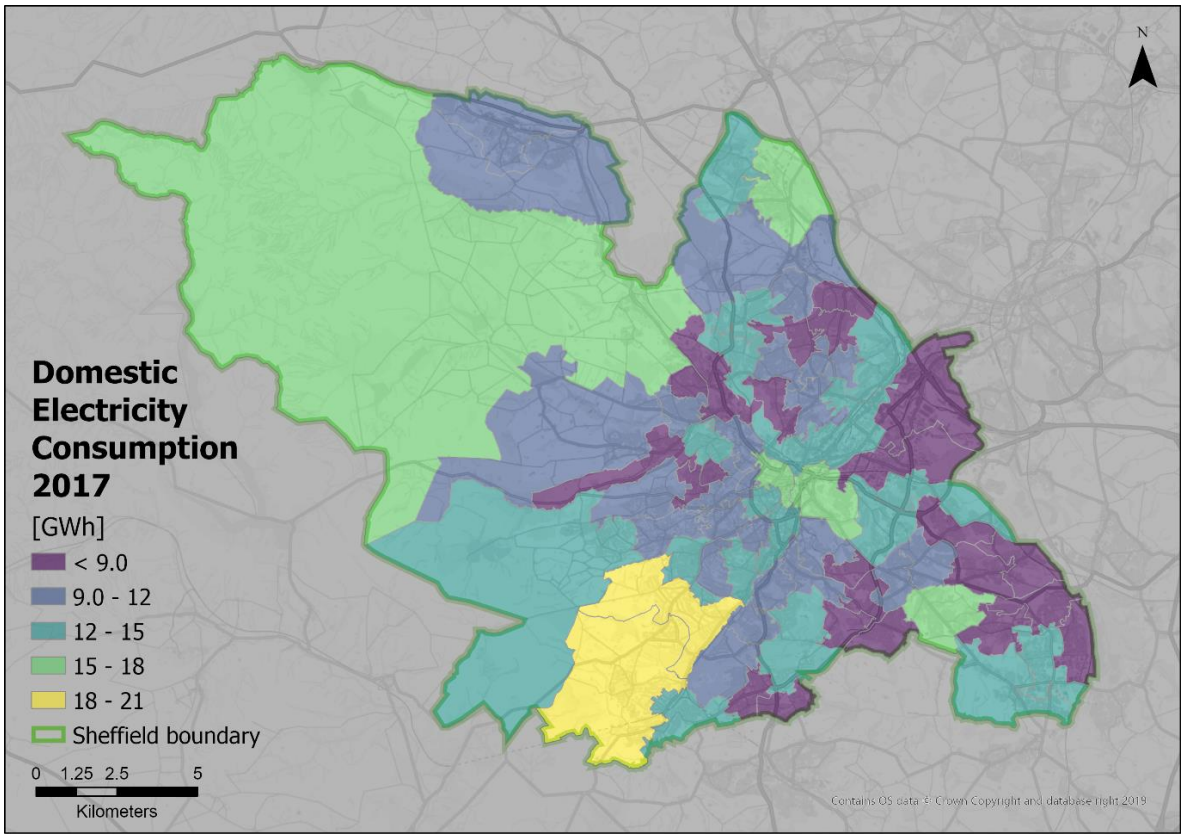


Figure 34 Domestic electricity consumption at MSOA level in Sheffield



Summarising the gas and electricity consumption in Sheffield at MSOA level, presents a more comprehensive and clearer pattern regarding consumption from this sector. The results indicate that the southern MSOAs have the highest consumption of both gas and electricity in 2017 (yellow MSOA from the relevant maps)

4.1.1 Energy consumption trend analysis

The following analysis shows the intensity of domestic energy use with respect to population. Figure 35 to Figure 37 show both total consumption and consumption per unit GVA for each of the fuels. Figure 38 shows the intensity of all fuel relatives to a 2005 base.

Figure 35 Domestic gas intensity per thousand population in Sheffield

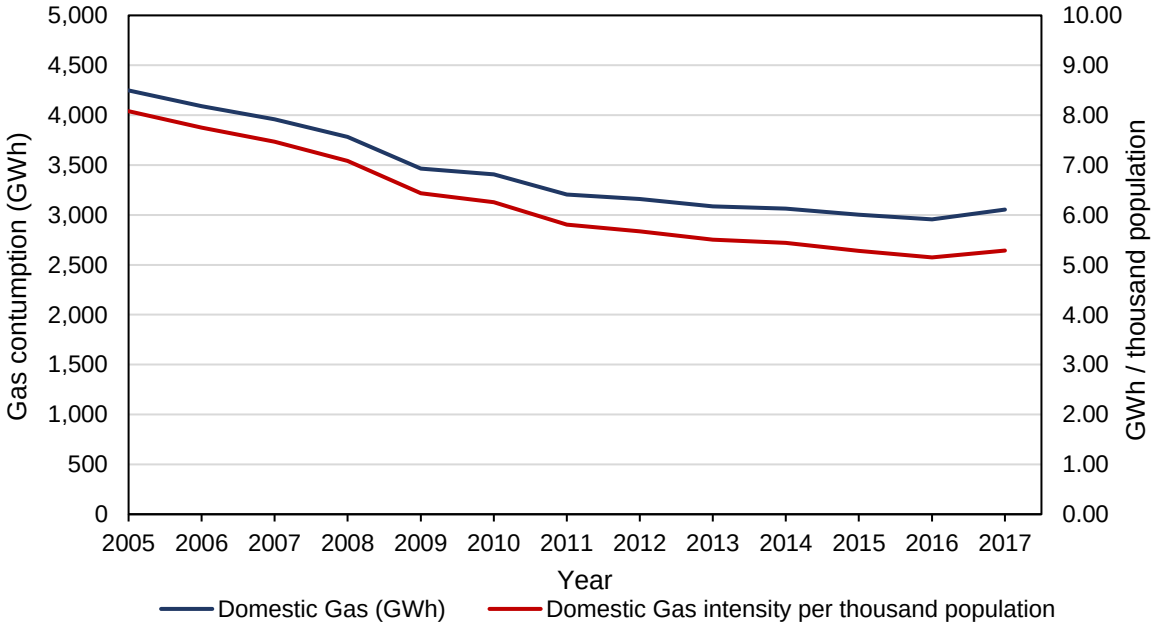


Figure 36 Domestic electricity intensity per thousand population in Sheffield

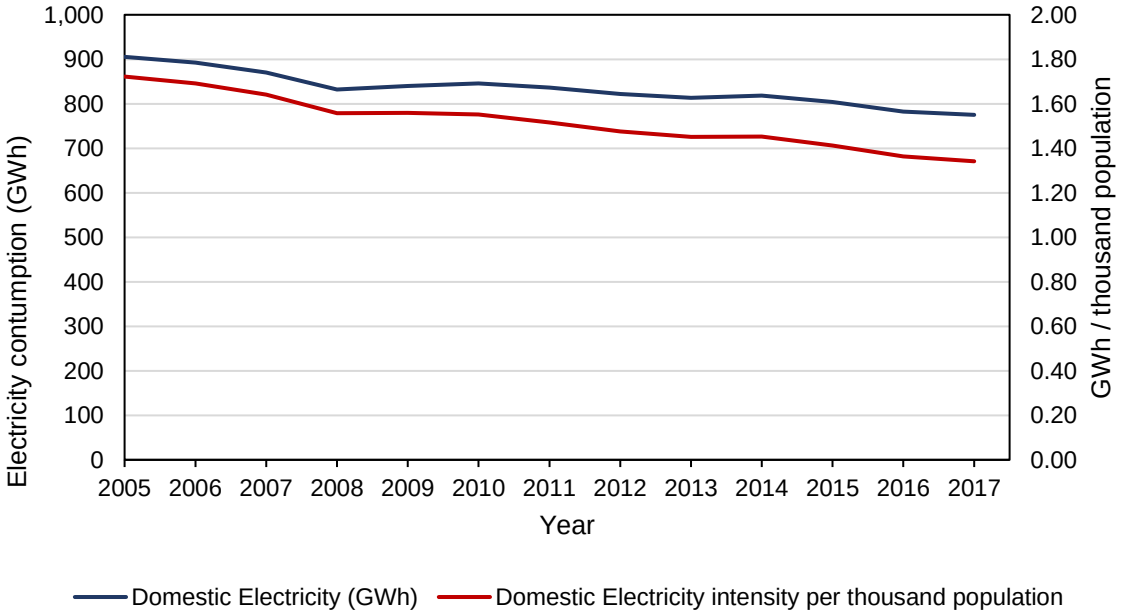
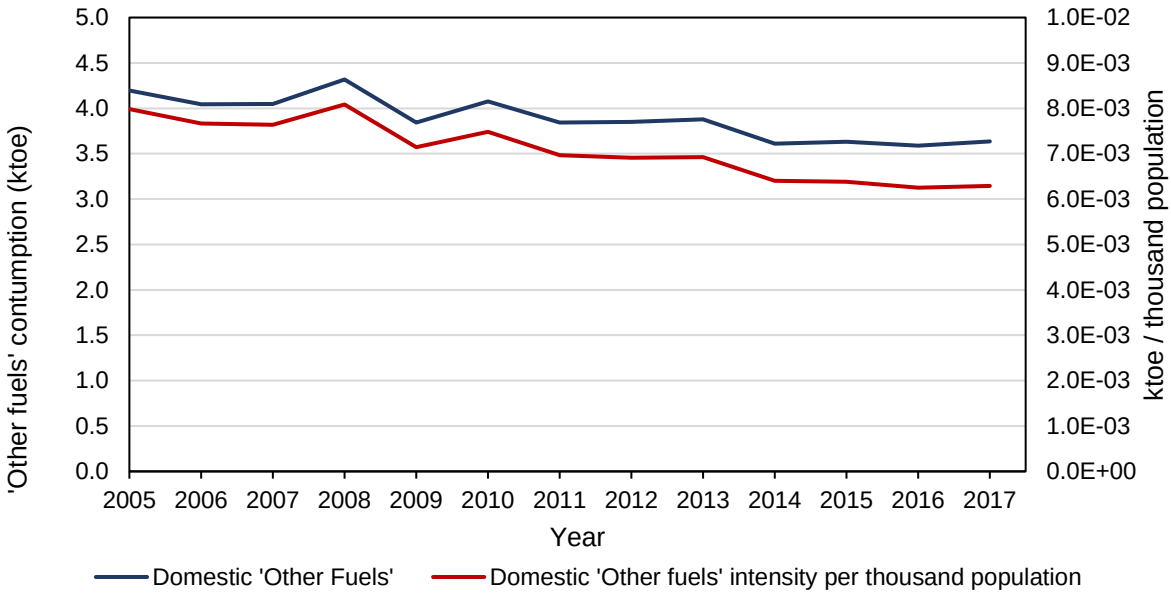
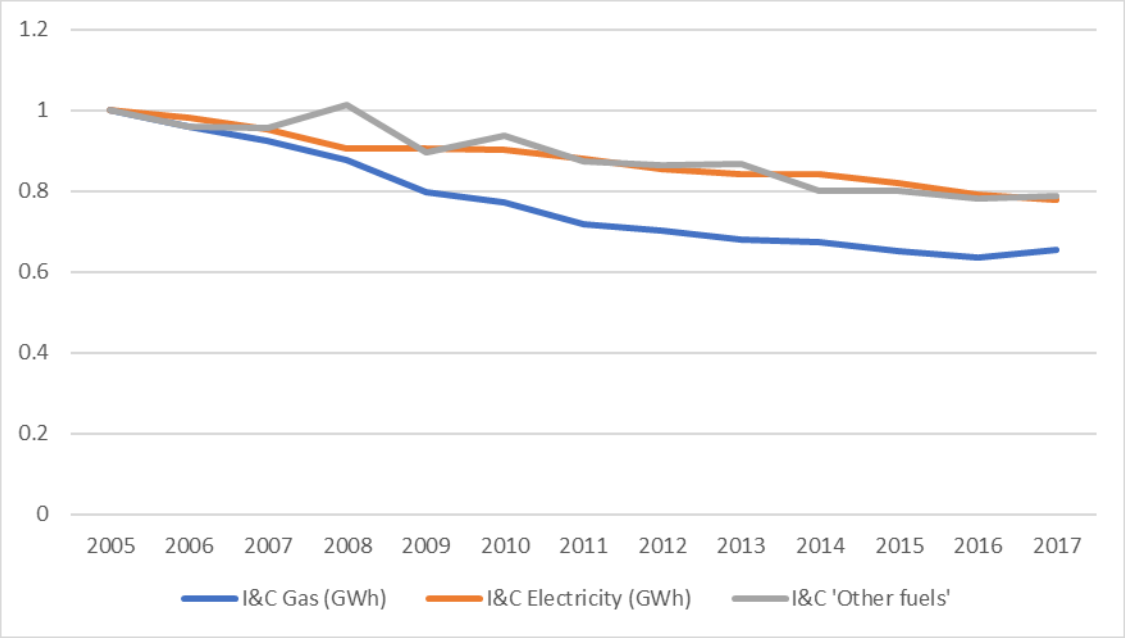


Figure 37 Domestic 'other fuels' intensity per thousand population in Sheffield



The energy consumption trend analysis observed in 4.1.1 (intensity lines /1000 population) are in conjunction with the data from Table 9. The main findings from the trend graphs is that, for the domestic electricity consumption, the effect of population change starts to play a less significant role after 2008 (where the difference between the two lines starts to increase) and for the gas and other fuels consumption this effect of populations starts after 2011.

Figure 38 Domestic energy use intensity relative to 2005



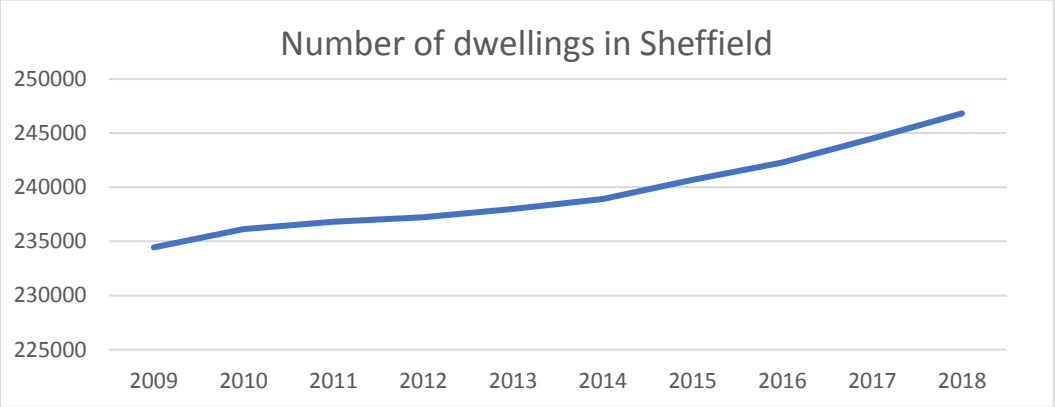
4.2 Activity data

The section summarises the key findings from a review of local data relating to domestic emissions in Sheffield Local Authority (LA).

4.2.1 Number of dwellings

In 2018, there was 247,000 dwellings in Sheffield, accounting for approximately 1% of the 24.2 million dwellings in England. The number of dwellings in Sheffield has increased by over 12,000 since 2009[5].

Figure 39 Number of dwellings in Sheffield between 2009 and 2018, Ministry of Housing, Communities & Local Government



4.2.2 Energy performance

There have been approximately 177,000 energy performance certificates (EPCs) lodged for domestic properties in Sheffield LA from January 2008 to March 2020.

The majority of the EPCs lodged for domestic properties in Sheffield LA have an EPC energy rating of D (39%) and C (30%), with the average EPC rating being 63 falling into the upper portion of band D.

Based on the EPC data, the average annual energy consumption for domestic properties in Sheffield LA is 278 kWh/m²/year and the average carbon dioxide emissions for domestic properties in Sheffield LA is 49 $kgCO_2/m^2$/year or 4 $tonnesCO_2$/property/year.

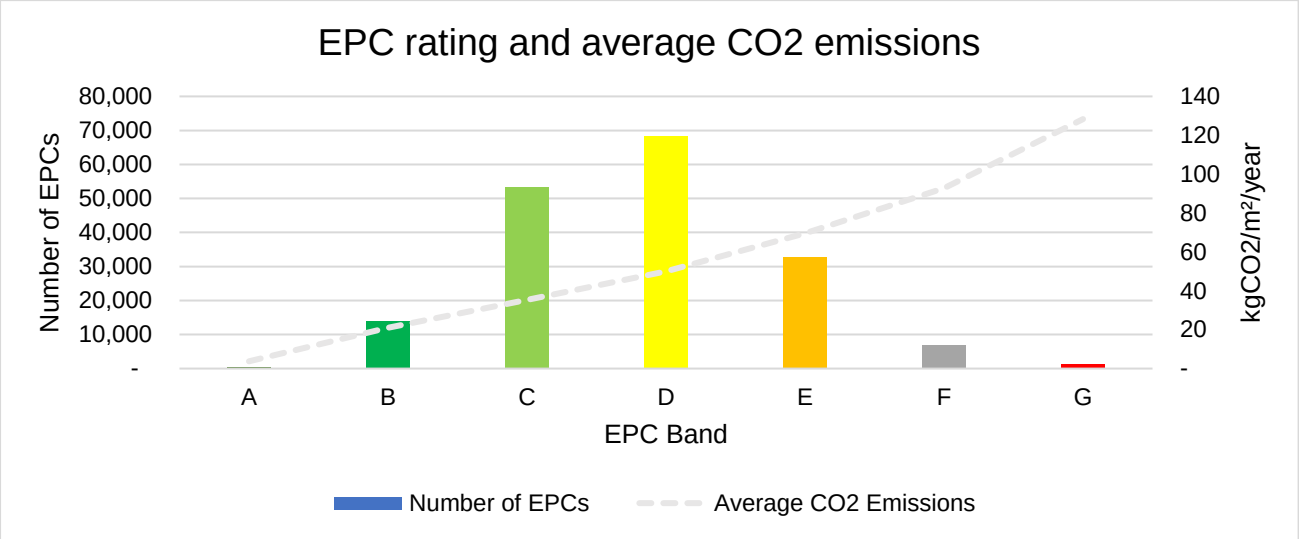
Table 10 Domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020, Ministry of Housing, Communities & Local Government

ECP Band	Proportion	Average Energy Consumption *(kWh//m²/year)*	Average CO_2 Emissions *($kgCO_2/m^2$/year)*
(92 plus) A	<1%	20	4
(81-91) B	8%	126	21
(69-80) C	30%	205	35
(55-68) D	39%	281	50
(39-54) E	18%	390	70
(21-38) F	4%	522	93
(1-20) G	1%	730	128

The data shows the average carbon emissions per floor area reduce as the EPC band improves.

[5] Number of Dwellings by Tenure and district: Sheffield; 2009 to 2018, Office for National Statistics and the Ministry of Housing, Communities and Local Government

Figure 40 The total number of domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020, Ministry of Housing, Communities & Local Government



4.2.3 Archetypes of dwellings

The proportional data from the EPCs can be used to estimate the types of dwellings, the typical construction, the systems installed and ownership.

4.2.3.1 Property types

66% of EPCs lodged were for houses, 27% were for flats, 4% were for bungalows and 3% were for maisonettes. The average CO_2 emissions per floor area are typically higher for bungalows and houses compared to flats and maisonettes.

Table 11 Property types in Sheffield, based on domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020

Property type	Proportion	Average CO_2 emissions *($kgCO_2/m^2/year$)*	Average EPC Band
Bungalow	4%	52	D
Flat	27%	43	C
House	66%	52	D
Maisonette	3%	40	D

4.2.3.2 Age

A large proportion (43%) of dwellings in Sheffield were constructed before 1950.

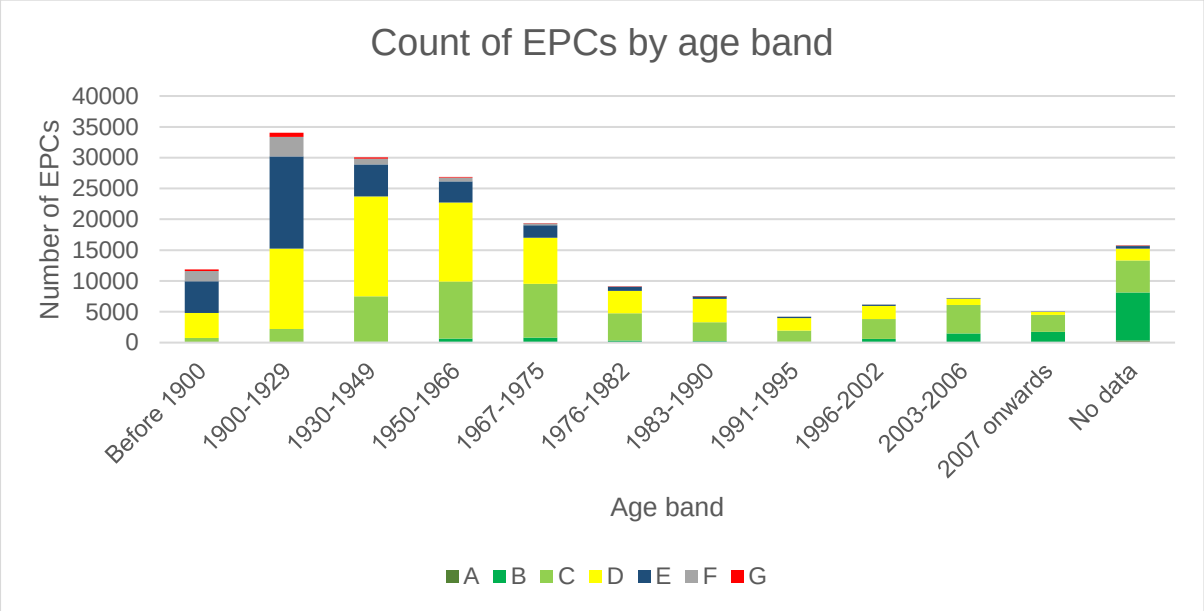
The average EPC rating improves based on the age of the property. The average EPC rating of properties constructed before 1929 is E, the average EPC rating of properties constructed between 1930 and 1995 is D and the average EPC rating of properties constructed after 1995 is C.

The average CO_2 emissions per floor area also decreases based on the age of the property.

Table 12: Age band of properties in Sheffield, based on domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020

Age band	Proportion	Average CO_2 emissions *($kgCO_2/m^2/year$)*	Average EPC Band
Before 1900	7%	67	E
1900-1929	19%	64	E
1930-1949	17%	51	D
1950-1966	15%	48	D
1967-1975	11%	47	D
1976-1982	5%	45	D
1983-1990	4%	45	D
1991-1995	2%	43	D
1996-2002	3%	39	C
2003-2006	4%	34	C
2007 onwards	3%	31	C
Other/unknown	9%	-	-

Figure 41: Age band of properties in Sheffield, based on domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020



4.2.3.3 Glazing

The vast majority (87%) of EPCs lodged had double glazing. Properties with improved glazing performance had a lower average CO_2 emissions and improved average energy rating. It should be noted that the glazing type would not be the only reason for the reduced CO_2 emissions and improved energy rating, as a generally higher standard of construction and system selection would be expected for properties that have triple glazing.

Table 13: Glazing type of properties in Sheffield, based on domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020

Glazing type	Proportion	Average CO_2 emissions *($kgCO_2/m^2/year$)*	Average EPC Band
Single glazing	1%	70	E
Secondary glazing	1%	61	D
Double glazing	87%	51	D
Triple glazing	<1%	37	C
Other/unknown	12%	-	-

4.2.3.4 Walls

The majority (61%) of EPCs lodged had cavity walls, 18% had solid brick walls, 4% had sandstone or limestone walls, 4% had system built, 1% had timber frame walls.

Approximately 50% of buildings were recorded to have insulated wall constructions, compared with 37% that were recorded as having no insulation.

Not surprisingly, properties with insulated wall constructions had a lower average CO_2 emissions and improved average energy rating.

4.2.3.5 Heating system

The main heating system for the vast majority (over 80%) of EPCs lodged was gas boilers and radiators. Properties connected to a community heating scheme typically had better energy efficiency ratings. The average CO_2 emissions are not based on current grid carbon factors.

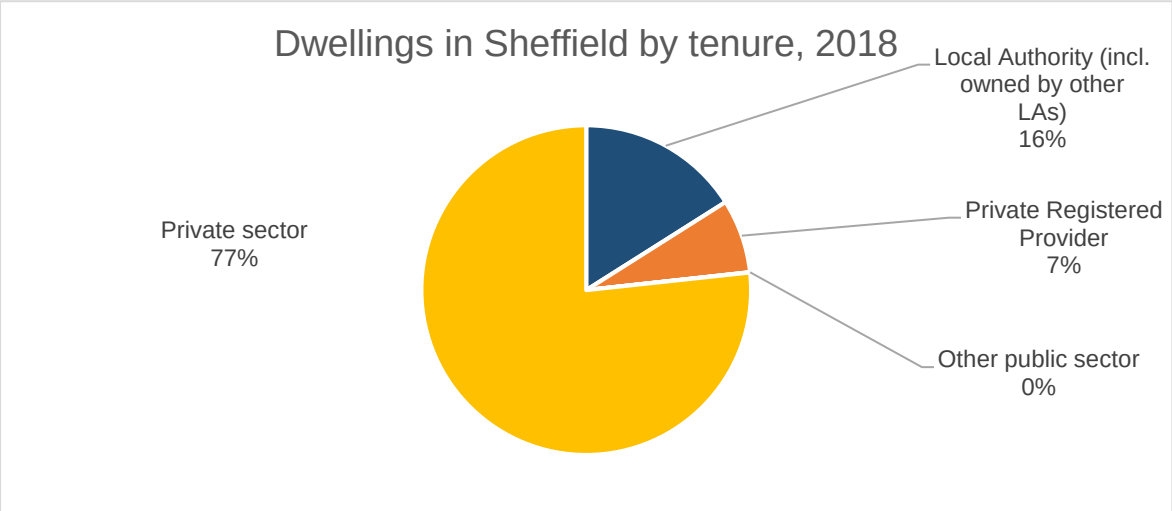
Table 14: Main heating systems of properties in Sheffield, based on domestic EPCs lodged in Sheffield LA region between January 2008 and March 2020

Heating type	Proportion	Average CO_2 emissions *($kgCO_2/m^2/year$)*	Average EPC Band
Boiler and radiators, mains gas	81%	49	D
Room heaters, electric	7%	43	D
Community scheme	5%	38	C
Electric storage heaters	3%	68	D
Other/unknown	4%	-	-

4.2.4 Tenure

In Sheffield in 2018, 189,000 (77%) dwellings were within the private sector (owner-occupied or private rented), 40,000 (16%) dwellings were rented from local authorities and 18,000 (7%) dwellings were rented from private registered providers (social housing).

Figure 42: Proportion of dwellings by tenure in Sheffield, 2018, Office for National Statistics and the Ministry of Housing, Communities and Local Government



4.2.5 Geography

The neighbourhoods with the highest average EPC ranks are neighbourhoods with higher current or ex Council house stock. The neighbourhoods which fall below an average EPC of 55.61 (Category E or F) tend to be on the West of Sheffield, in higher income, owner-occupied or privately rented neighbourhoods. The neighbourhoods with the highest average EPC scores are neighbourhoods with a greater presence of socially rented properties.[6]

[6] Sheffield Energy Extract, Private Sector Condition Survey 2015 filtered by ACORN Income Data 2019

Figure 43: Average SAP based on a Private Sector Condition Survey 2015

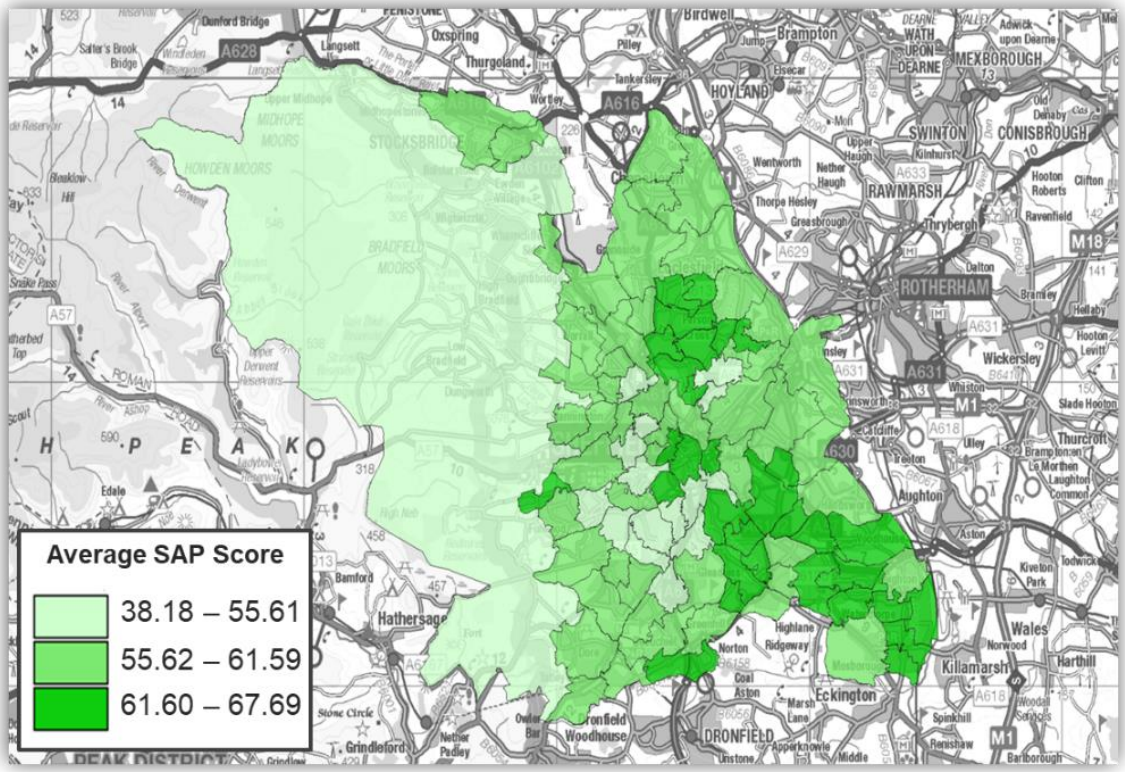
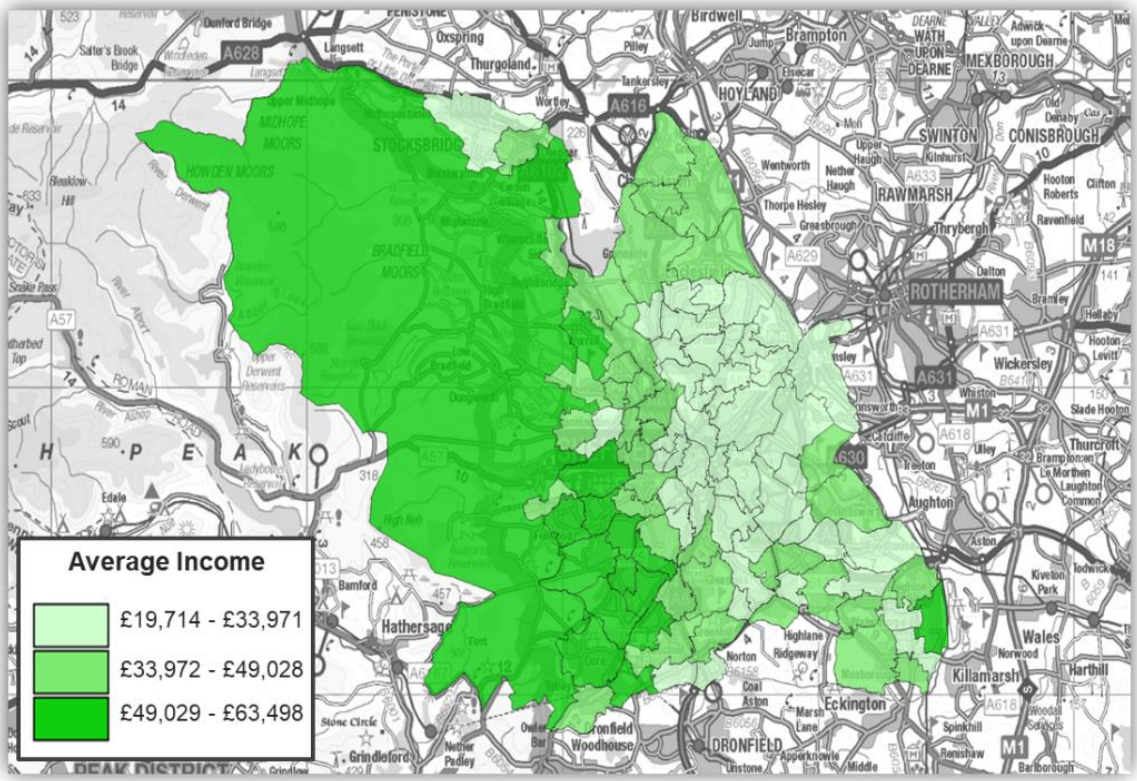


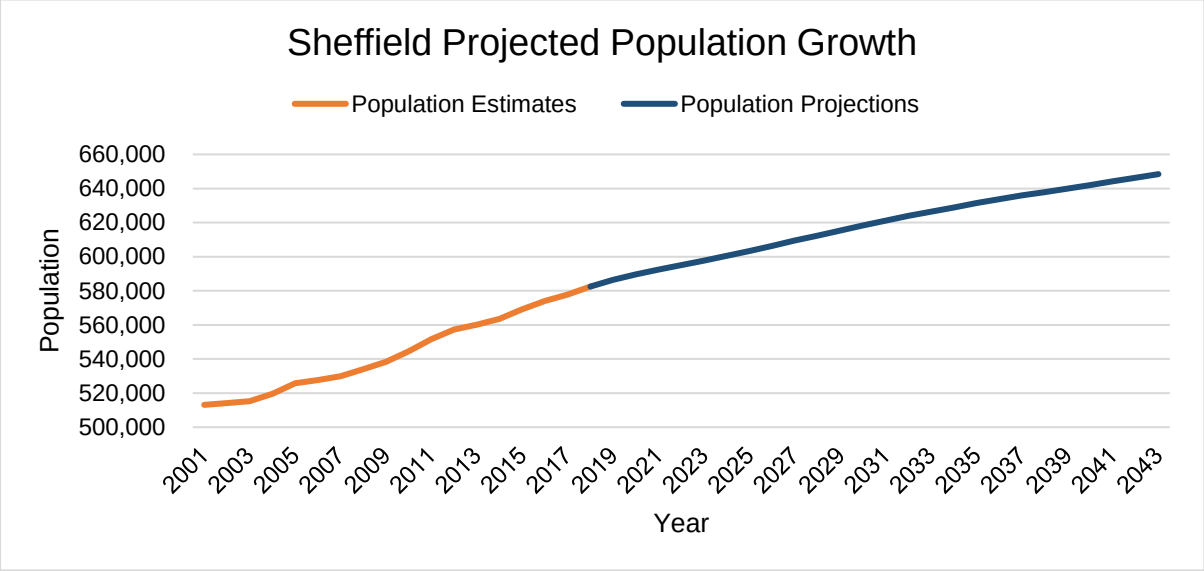
Figure 44: Average Income based on an ACORN Income Data 2019



4.2.6 Population

The population of Sheffield is projected to increase by 29,000 (5%) over the next decade, from an estimated in 590,000 in 2020 to 618,000 by 2030 and to 648,000 by 2043[7].

Figure 45: Sheffield population projected to rise to 618,000 by 2030 and to 648,000 by 2043



4.2.7 New homes

The Sheffield City Council New Homes Delivery Plan, published in 2018, sets out a plan to support the building of over 2,000 new homes, including 725 new affordable homes a year over the next 5 years.

[7] Office for National Statistics Population Estimates and Office for National Statistics Population Projections (2018 based)

4.3 CO_2 data

Table 15 CO_2 emissions estimates from residential in Sheffield 2005-2017 (kt CO_2)[8]

Year	Domestic Gas	Domestic Electricity	Domestic 'Other Fuels'
2005	781.9	472.5	29.5
2006	746.4	492.1	25.8
2007	700.1	480.5	24.3
2008	715.2	460.0	26.8
2009	648.3	419.5	25.8
2010	706.9	433.7	27.2
2011	578.7	412.5	25.7
2012	628.3	435.1	23.7
2013	645.0	397.6	28.4
2014	539.4	336.3	26.1
2015	567.7	283.6	25.8
2016	582.9	228.0	25.1
2017	566.3	197.2	35.5

The results from 4.3 indicate an overall reduction in CO_2 emissions estimates from domestic electricity and gas consumption, between 2005 and 2017. Contrary to these, the CO_2 emissions from other fuels have increased over the years. Specifically, CO_2 emissions estimates from domestic electricity consumption have experienced an annual average decrease of 2.26% (27.6% overall decrease from 2005 to 2017) and from gas consumption an average annual decrease of 6.68% year-on-year (58.3% overall decrease. CO_2 emissions from other fuels have increased by 20.3% from 2005 to 2017 with an average annual increase of 2.47%.

The maps below present the CO_2 emissions from domestic gas, electricity and other fuels' consumption. For the gas and electricity maps data have been derived from postcode-level data and for the other fuels from gridded data – the MSOA-level CO_2 emissions map can be seen in A4.1.

[8] Source: BEIS LA CO_2 statistics

Figure 46 CO_2 emissions from domestic gas consumption at postcode level in Sheffield

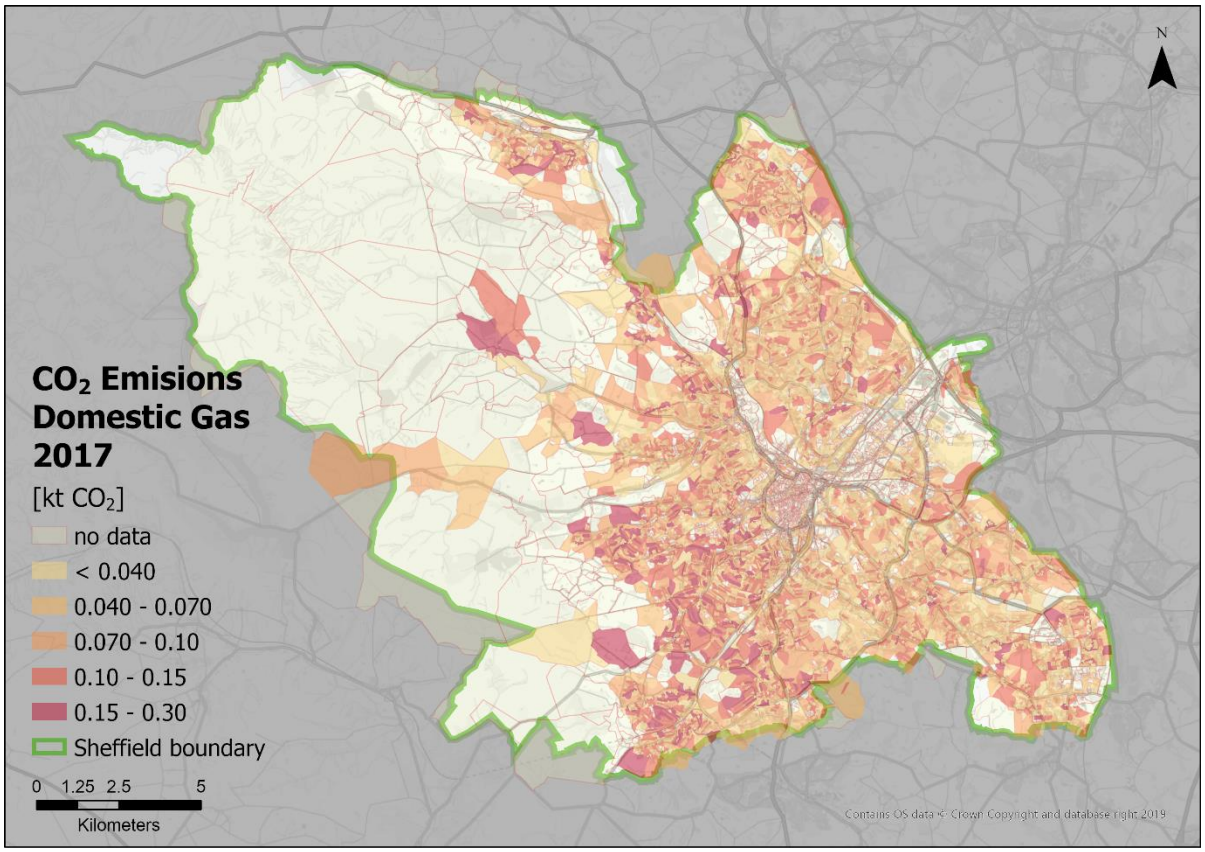


Figure 47 CO_2 emissions from domestic gas consumption at MSOA level in Sheffield

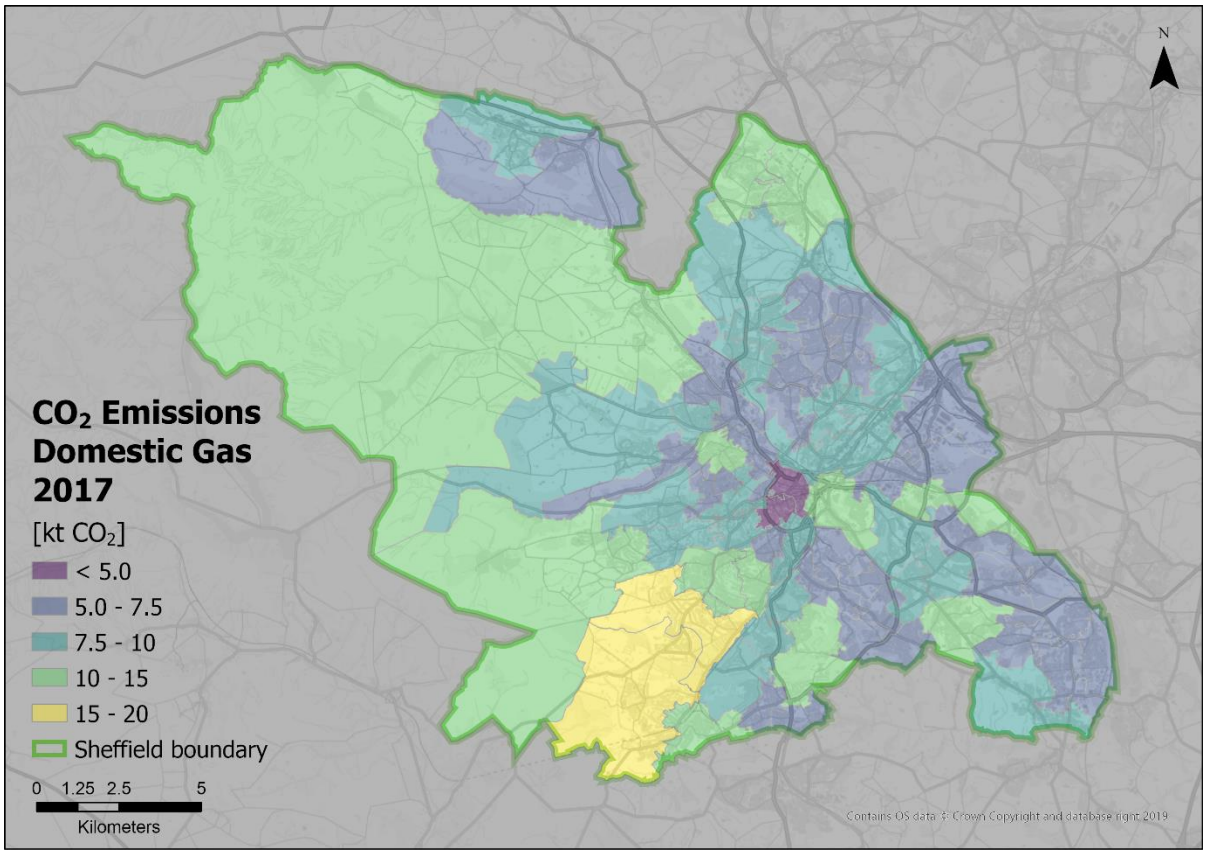


Figure 48 CO_2 emissions from domestic electricity consumption at postcode level in Sheffield

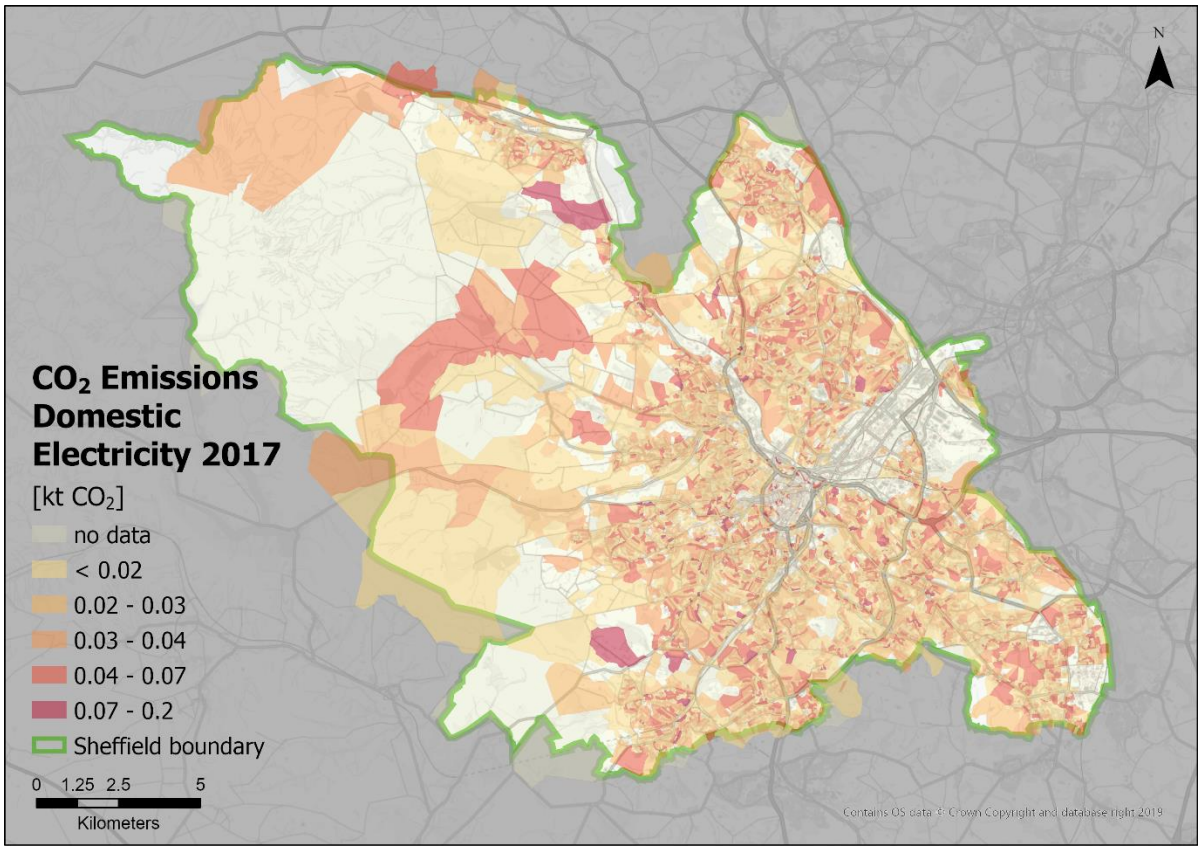


Figure 49 CO_2 emissions from domestic electricity consumption at MSOA level in Sheffield

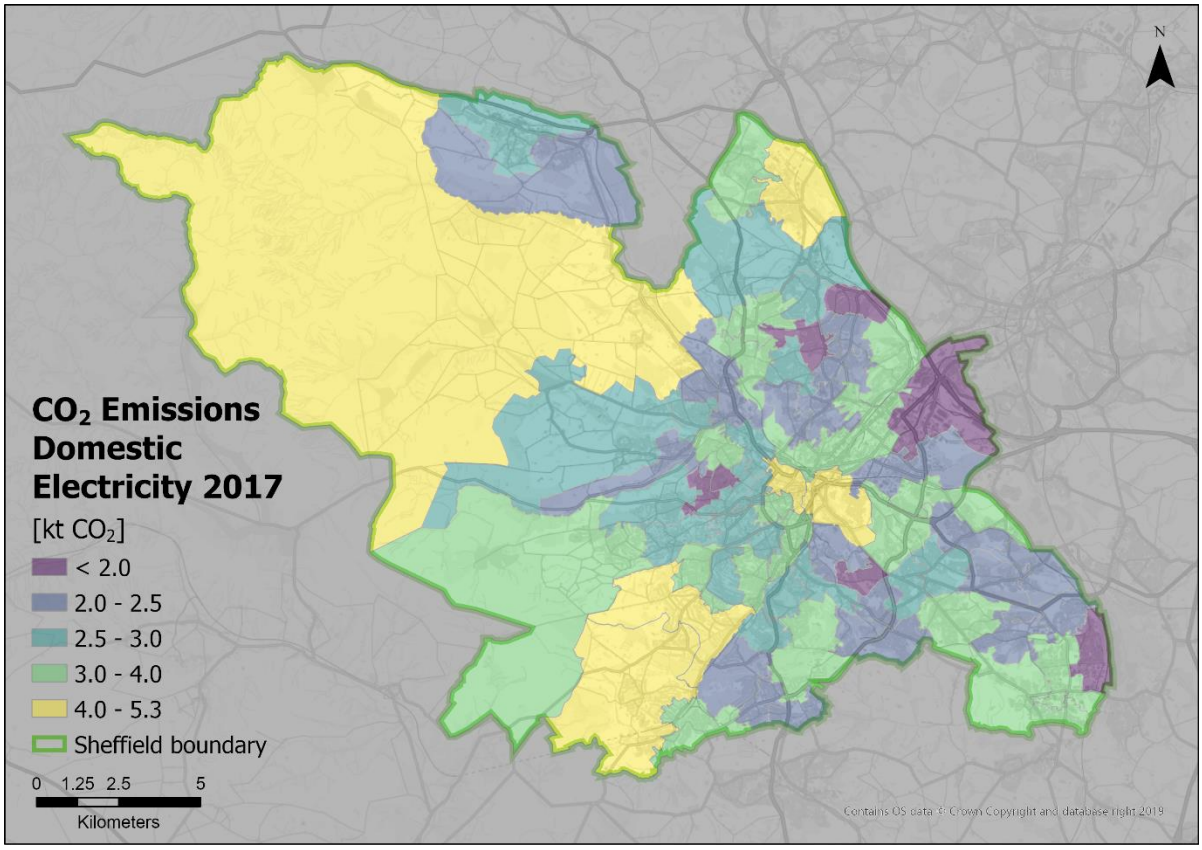
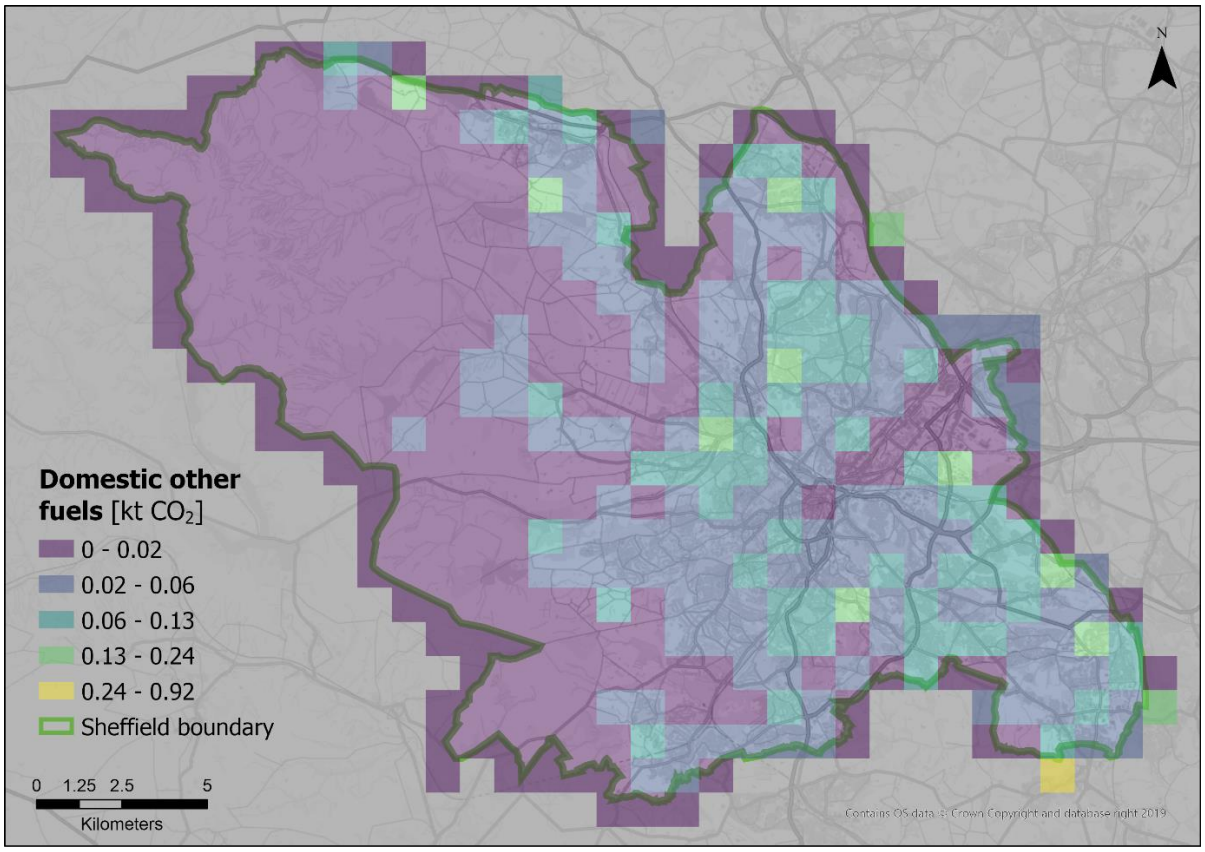


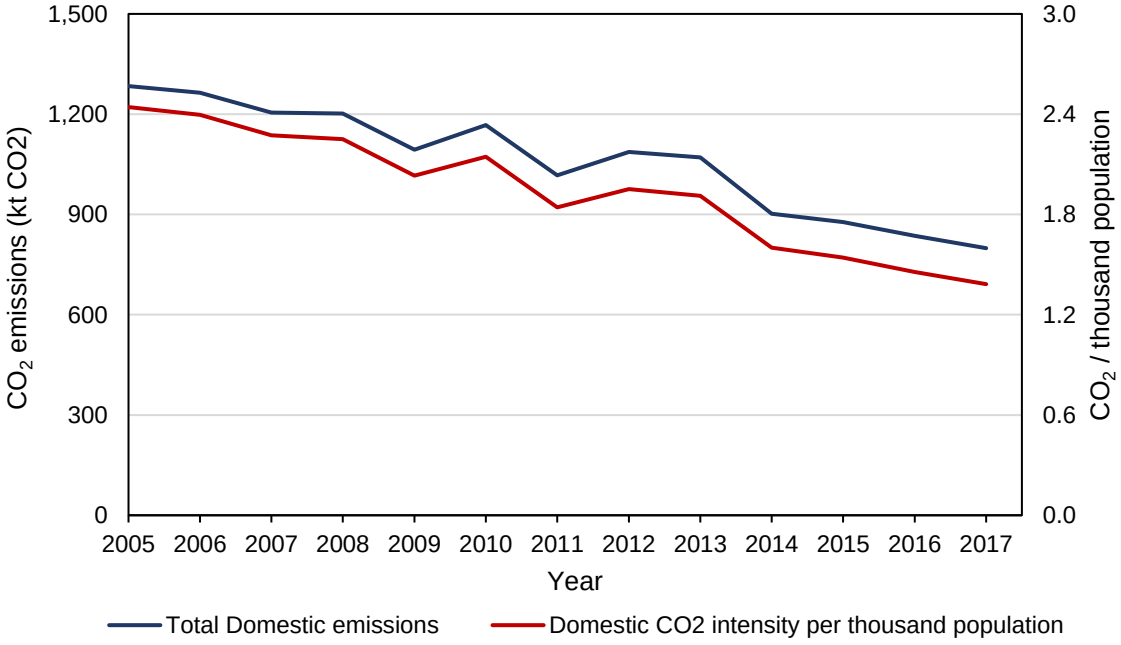
Figure 50 CO_2 emissions from domestic 'other fuels' at 1x1km level in Sheffield



The maps of CO_2 emissions from gas consumption indicate that southern MSOAs (in yellow) are the highest emitters whereas for CO_2 emissions from electricity consumption present the rural area, city centre, southern area and the north-eastern MSOAs as the highest emitters indicating a higher spatial variability in Sheffield for this sector. The map of Figure 50 present the highest CO_2 emissions from other fuels' consumption to be the south-eastern region of the border (near the town of Eckington).

4.3.1 CO_2 trend analysis

Figure 51 CO_2 emissions and intensity per population from the domestic sector in Sheffield

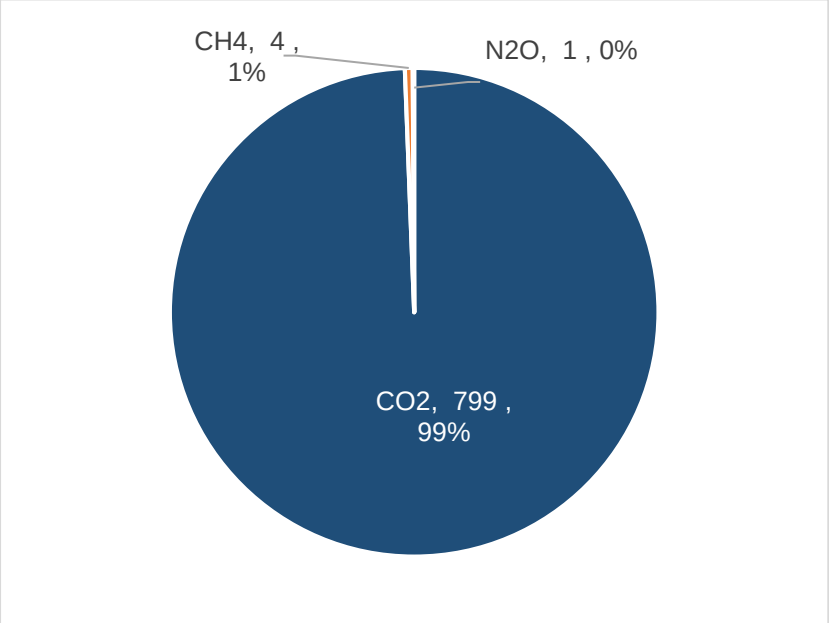


The trend from the line graph indicates that carbon dioxide emissions in Sheffield decrease over time and that population's intensity line (red) starts to decouple from the total domestic emissions indicating an increased efficiency of CO_2 emissions with regards to population change over the years.

4.4 CH_4 and N_2O data

Further to previous trends of the CO_2 emissions from the sources, it is also important to provide insights on methane and nitrous oxide emission estimates from the domestic sector. This subsection of the report focuses on these estimates by providing the GHG breakdown in $ktCO_2$-equivalent and the relevant maps of GHG emissions at grid level – the MSOA maps can be seen in Appendix A4.

Figure 52 GHG breakdown from residential (kt CO_2e)



The chart from Figure 52 indicates that CO_2 dominates the emissions (99%) in CO_2e where methane contributes to ~1% and nitrous oxide to <1%. The maps, in Figure 53 and Figure 54, present the methane and nitrous oxide emissions at grid level. The spatial distribution of these GHG indicates the same patterns for the two gases. Specifically, the highest emissions are located at areas surrounding the city centre – where the low emissions are located at the rural region of Sheffield (west).

Figure 53 Methane emissions from residential at 1x1km level in Sheffield

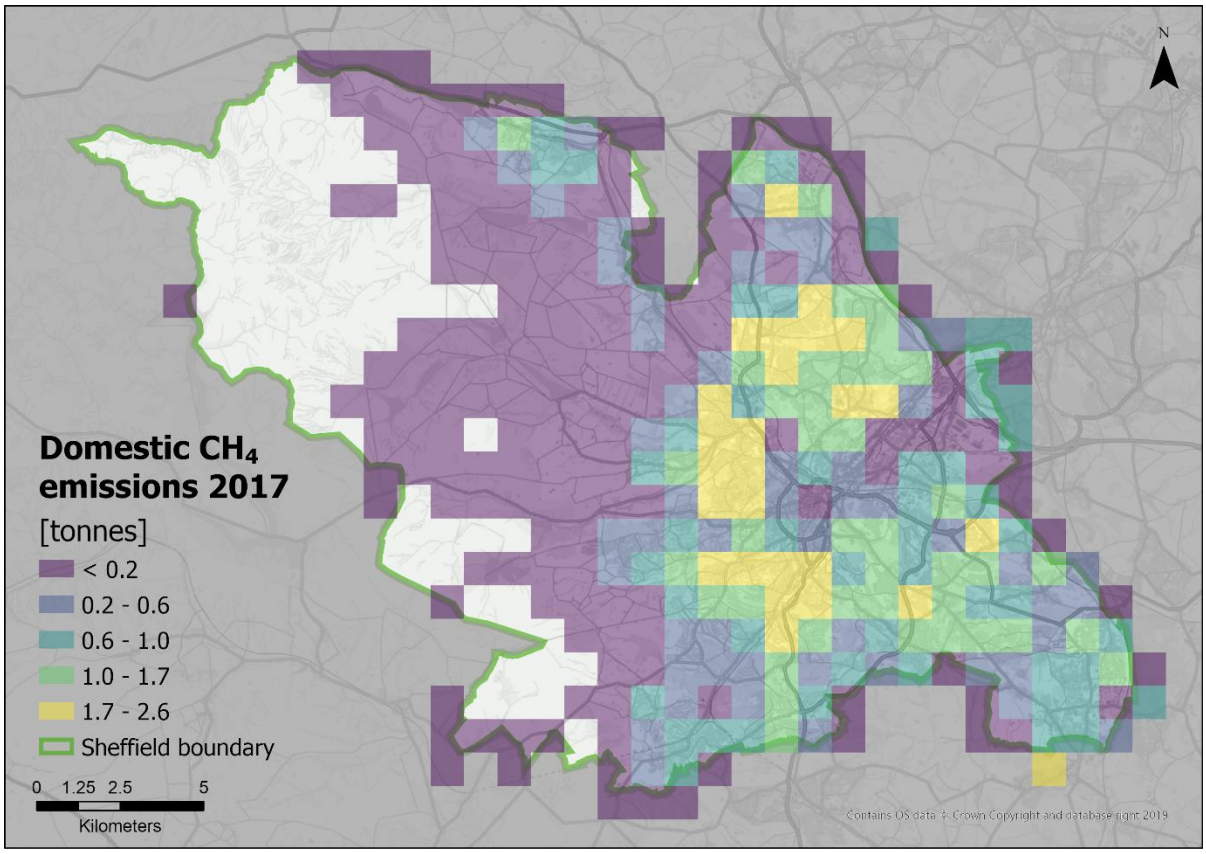
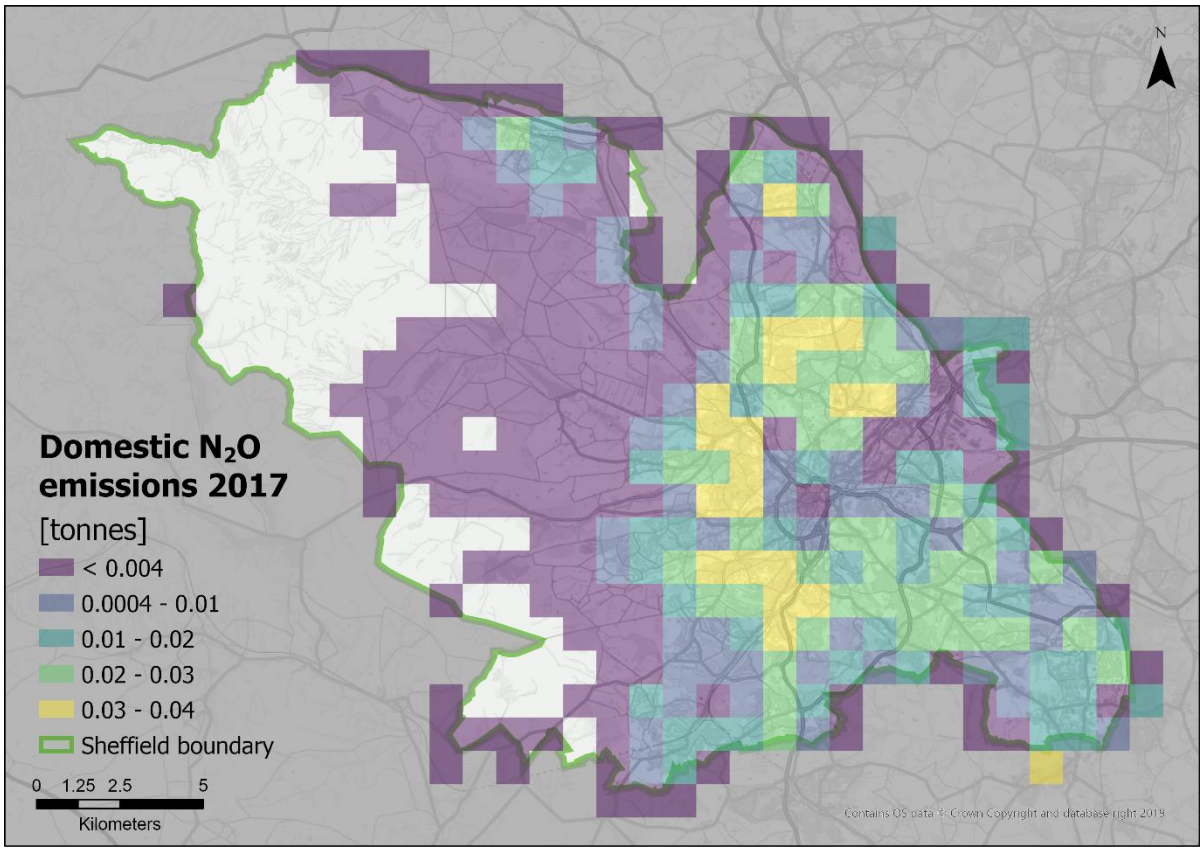


Figure 54 Nitrous oxide emissions from residential at 1x1km level in Sheffield



5 Road Transport emissions

This section concerns emissions in Sheffield from the Road Transport sector and relates only to traffic within the city boundary. It does not account for travel related to the city but beyond its administrative boundary as this is considered scope 3 emissions and has been excluded from the analysis. The subsections present the historic energy consumption and CO_2 trends including their corresponding data for 2017 (maps) as well as methane and nitrous oxide (GHG) emissions at grid level.

5.1 Fuel consumption data

Table 16 Road transport energy consumption in Sheffield.

Year	Buses	Diesel Cars	Petrol Cars	Motorcycles	HGV	Diesel LGV	Petrol LGV
2005	14,108	33,281	104,948	1,173	25,635	25,831	3,111
2006	14,028	36,764	102,169	1,085	25,972	26,377	3,094
2007	14,258	40,497	100,259	1,169	25,032	28,042	2,866
2008	13,282	44,777	95,207	1,076	26,414	28,171	2,568
2009	13,014	45,832	93,862	1,092	24,065	27,703	2,325
2010	13,222	46,624	88,923	989	24,166	28,757	2,193
2011	12,151	49,261	85,789	1,009	21,583	30,299	2,104
2012	11,038	50,744	81,029	1,017	20,467	29,333	1,880
2013	11,089	52,654	76,490	955	21,078	29,656	1,719
2014	11,002	53,200	75,074	960	22,149	31,508	1,639
2015	10,348	53,460	73,349	932	21,122	31,602	1,481
2016	9,166	55,205	71,366	885	21,477	33,265	1,380
2017	9,038	55,703	67,793	919	21,373	32,050	1,214

The results from the Road Transport's energy consumption data (Table 16) indicate a decrease in consumption for most the vehicular classes – with Diesel Cars and Diesel LGVs the two exceptions. Specifically, buses' consumption decreased by 35.9% from the first year of record (3.54% average annual reduction), diesel cars' increased by 67.4% (4.45% average annual increase), petrol cars' consumption decreased by 35.4% from the first year of record (3.56% average annual reduction), motorcycles' decreased by 21.7% from 2005 to 2017 (1.87% average annual reduction), HGVs' decreased by 16.6% (1.37% average annual reduction), diesel LGVs' increased by 24.1% with an average annual increase of 1.84% and, lastly, petrol LGV's consumption decreased by more than half (60.1%) from 2005 to 2017 with a year-on-year annual average decrease of 7.48%.

The maps below present the Road Transport emissions at MSOA and link-by-link level for diesel and petrol vehicles. The highest level of emissions is found at the north of the city and dominated by the M1. More generally as you would expect the emissions are highest along the main road network.

Figure 55 Road transport fuel consumption from diesel vehicles in Sheffield at MSOA level.

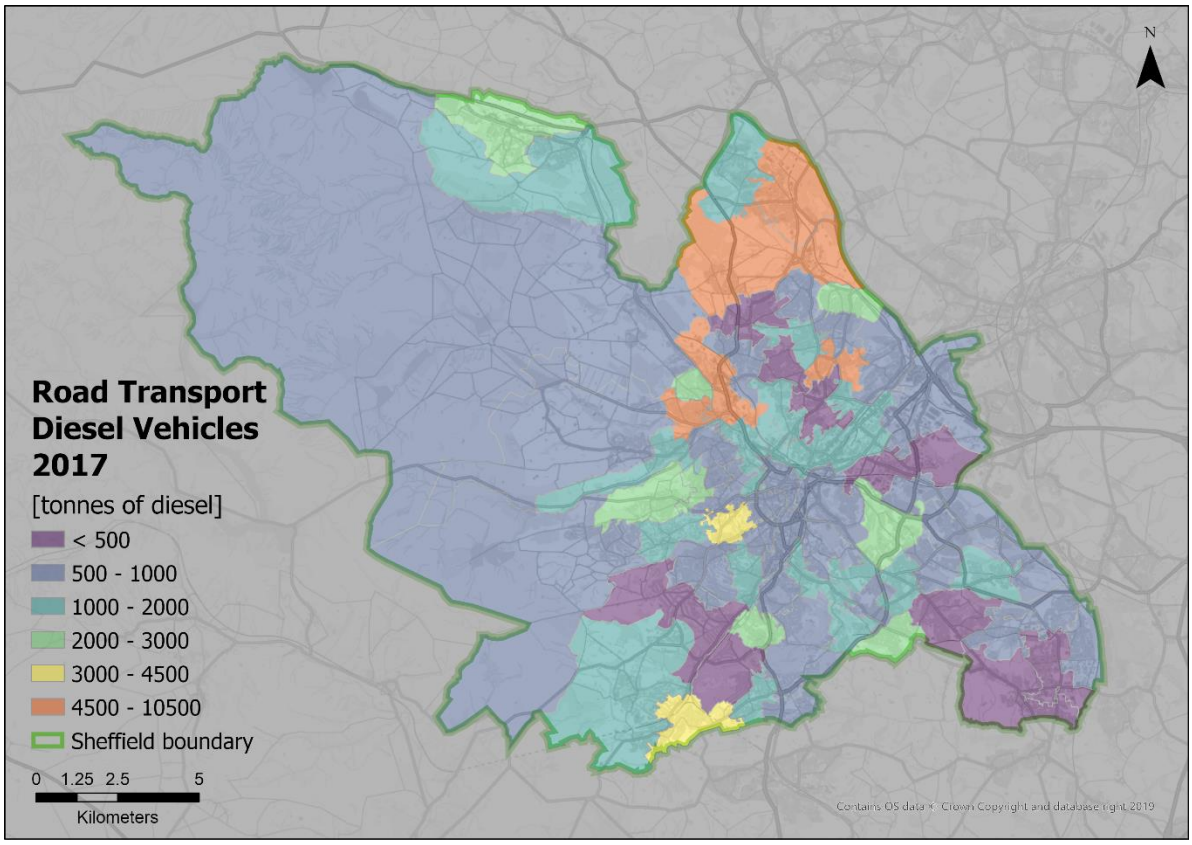


Figure 56 Road transport fuel consumption from diesel vehicles in Sheffield at road-link level (major roads).

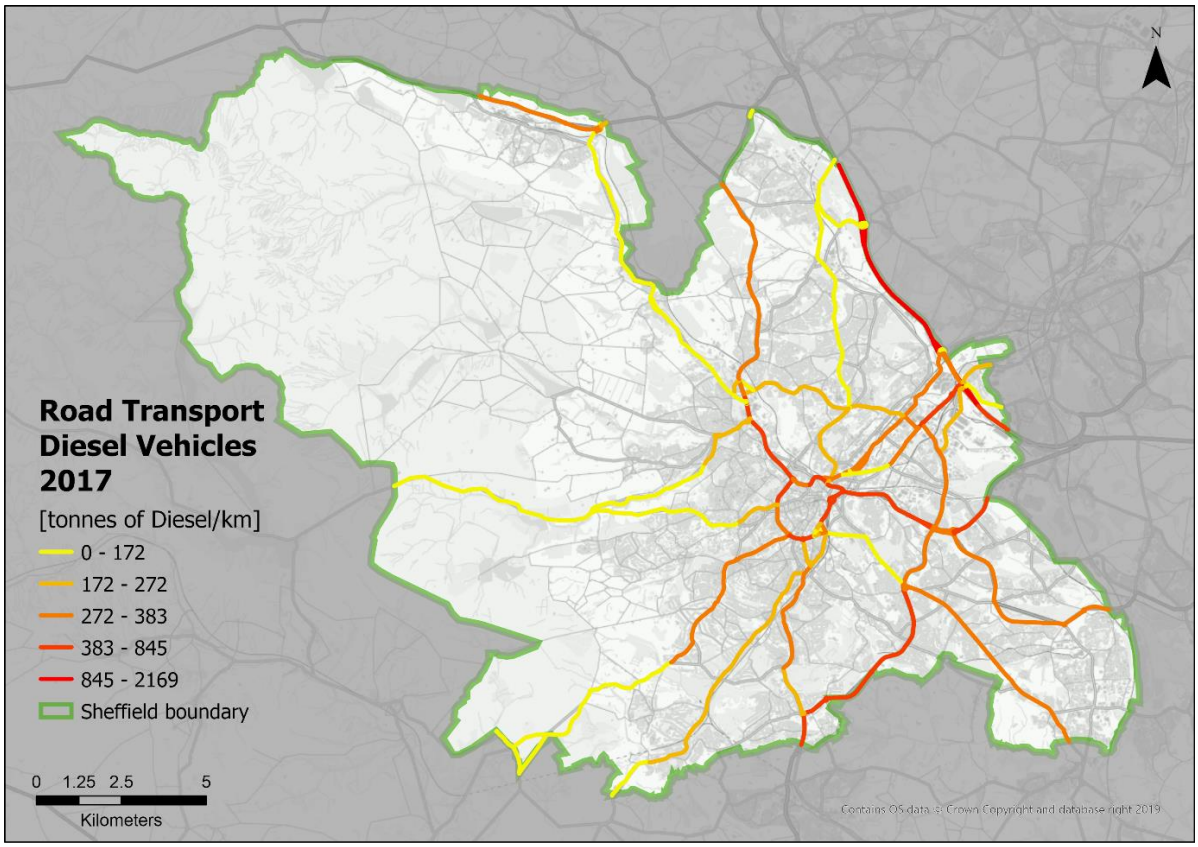


Figure 57 Road transport fuel consumption from petrol vehicles in Sheffield at MSOA level.

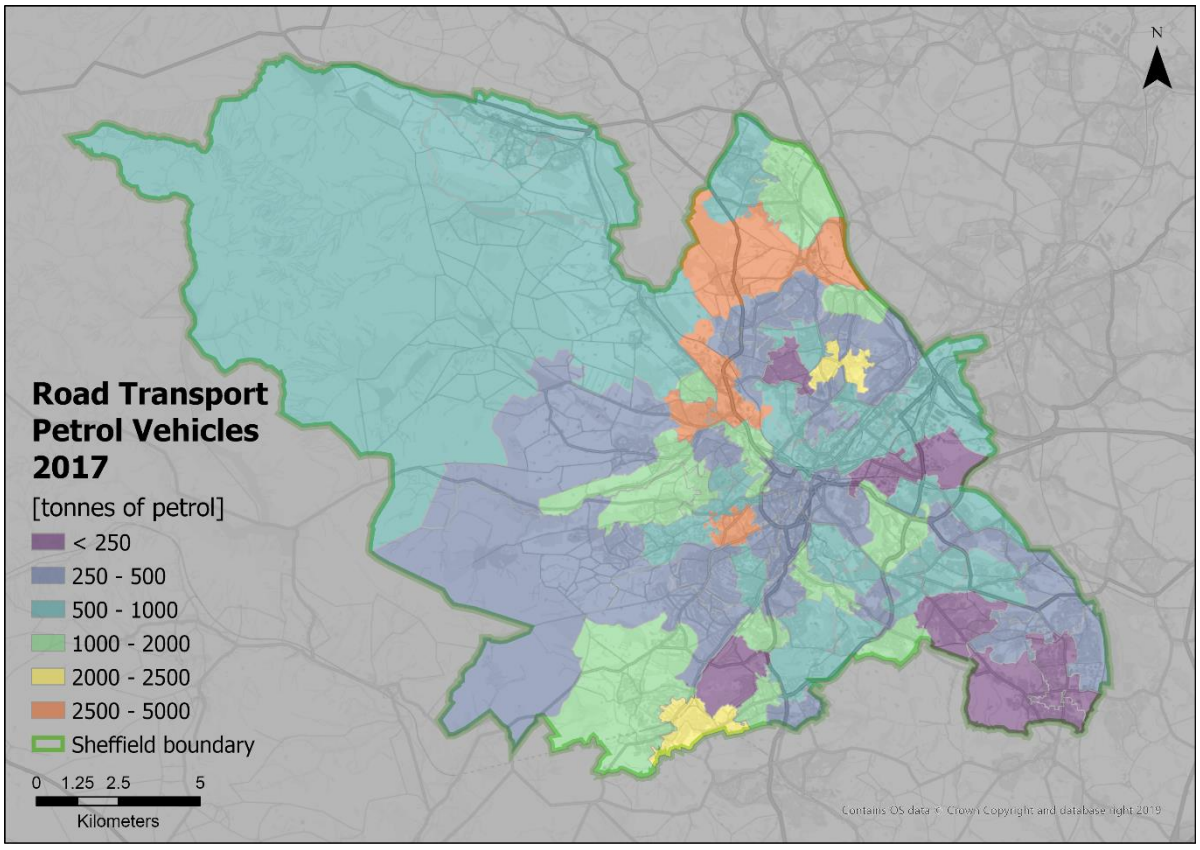
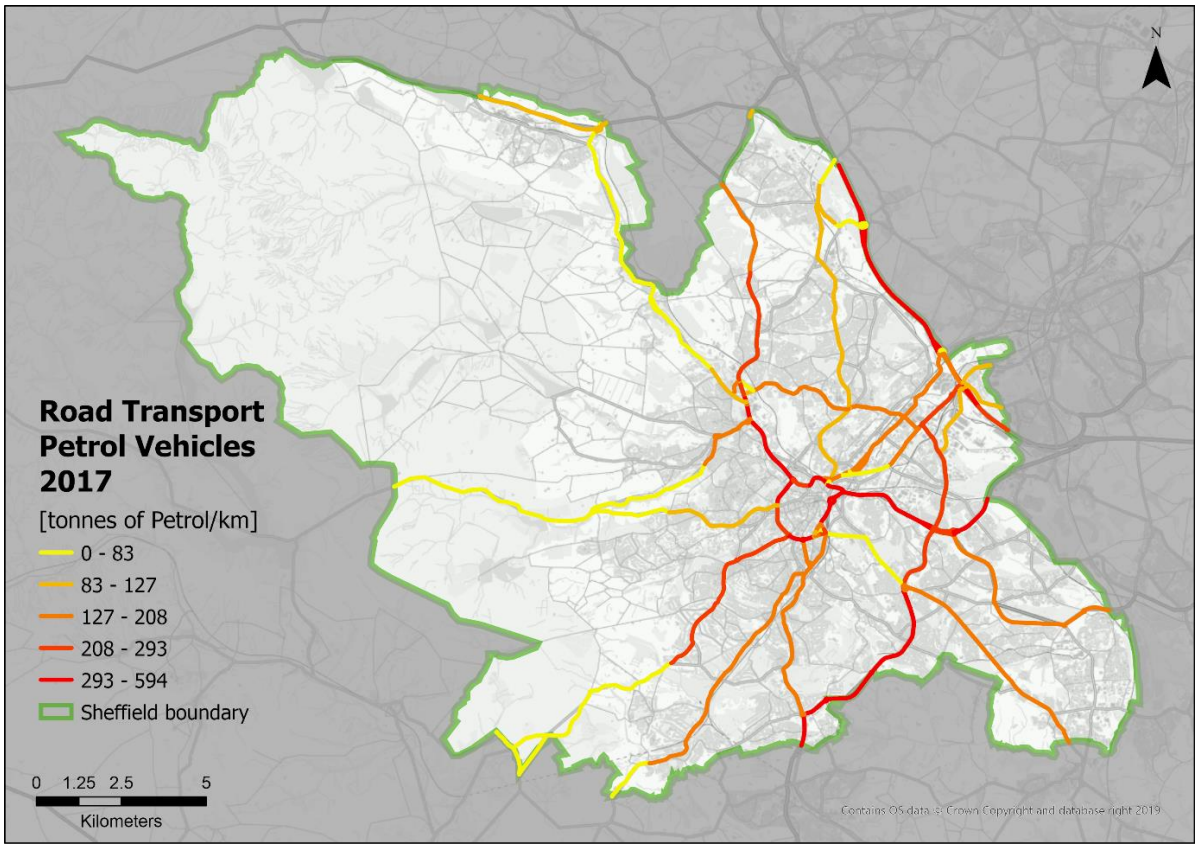


Figure 58 Road transport fuel consumption from petrol vehicles in Sheffield at road-link level (major roads).

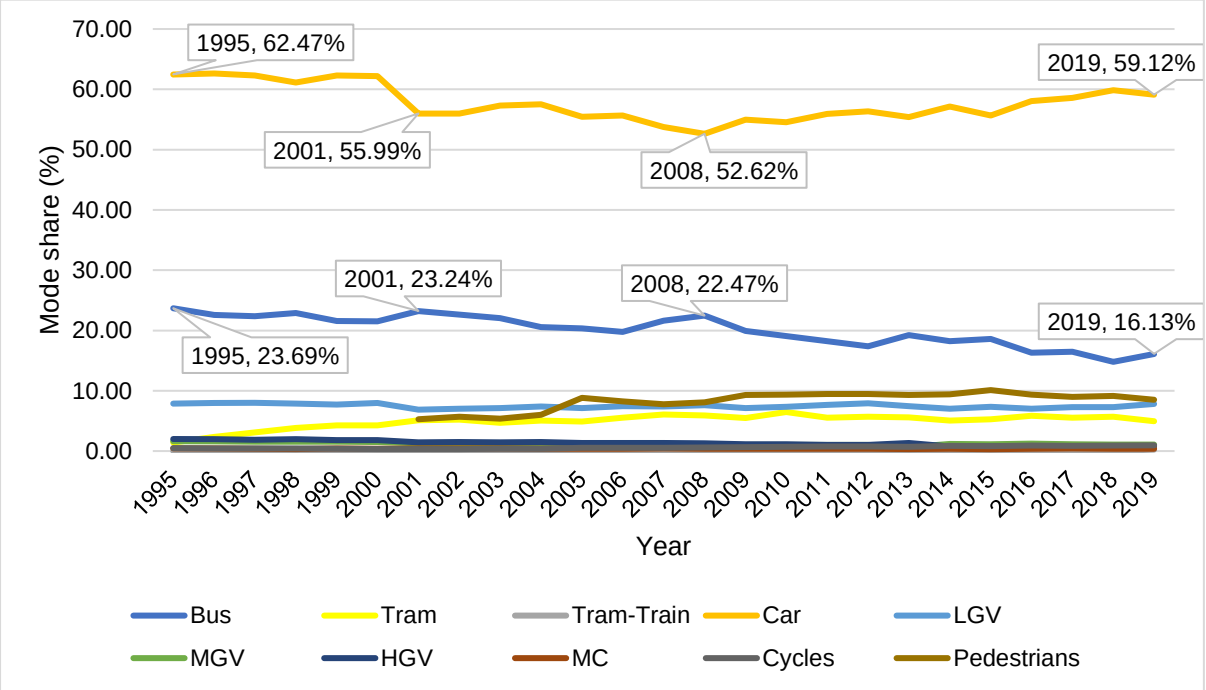


5.2 Activity data

5.2.1 Mode share

The daily proportion of people trips crossing the outer and inner Sheffield cordon by mode over the last 25 years[9].

Figure 59 Mode Share of People Trips



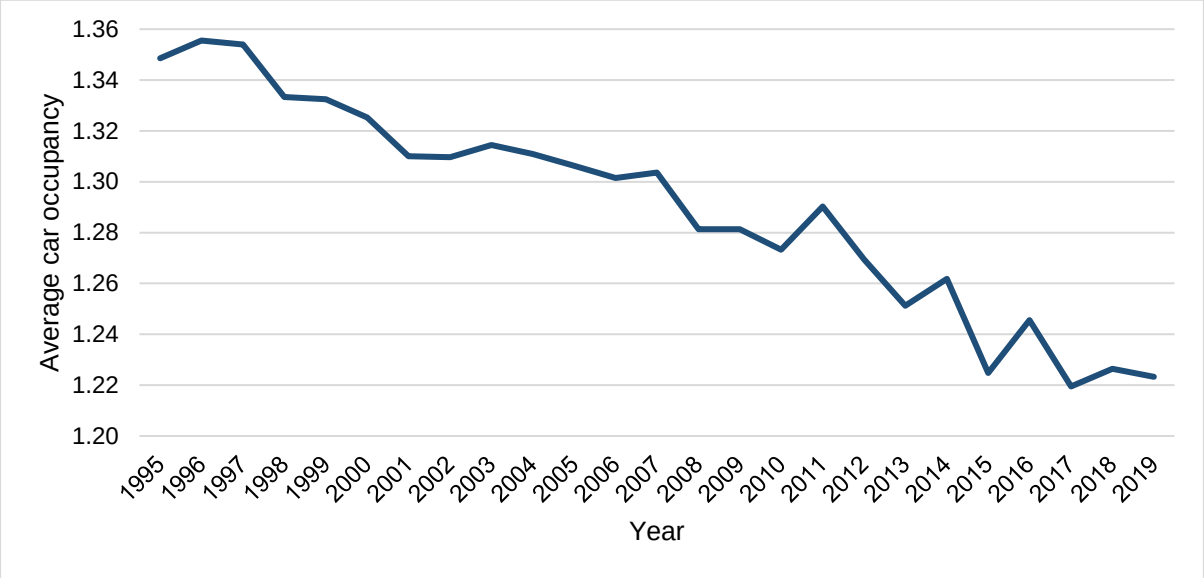
The data shows that since 1995, cars have accounted for approximately 60% of the mode share of person trips in Sheffield. In 2019, the combined share of bus, tram and tram-train was 21% of all trips. Cyclists and pedestrians accounted for 9% of the total mode share, and the remaining 10% constitutes goods vehicles and motorcycles.

5.2.2 Vehicle Occupancy

The average car occupancy in Sheffield has remained below 1.40 since the 1980s. Figure 60 shows the trend in average car occupancy recorded over the past 25 years. Occupancy has seen a continuous decline over the years, with current average car occupancy of 1.21

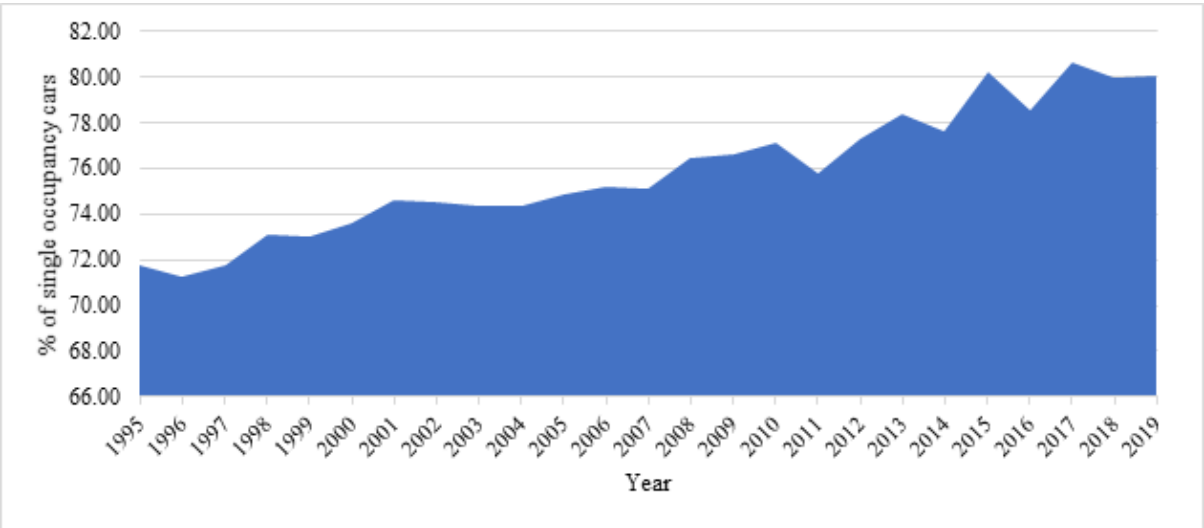
[9] Sheffield Cordon Data provided by SCC dated 2020-01-16

Figure 60 Average Car Occupancy in Sheffield



Historic trends indicate that the number of single occupancy cars have remained significantly high in Sheffield, with the percentage share rising each year[10]. Figure 61 shows the trend in percentage of single occupancy cars, over the years. In 2019 80% of cars had a single occupant.

Figure 61 Percentage of Single Occupancy Cars in Sheffield



5.2.3 Vehicle kilometres

Data from the Sheffield City Region Transport Model (SCRTM) showed that cars accounted for nearly 84% of the daily average vehicle kilometres in Sheffield District in 2016 (see Figure 61)[11]. Light Goods Vehicles (LGVs) and Heavy Goods Vehicles (HGVs) accounted for 12% and 3% of all vehicle kilometres respectively, with buses taking up less than 2% of all vehicle kilometres. Total daily average vehicle kilometres by vehicle type is provided in Table 17.

[10] Ibid
[11] Based on Annual Average Daily Flow

Figure 62 Proportion of Vehicle Kilometres in Sheffield District by Vehicle Type (2016)

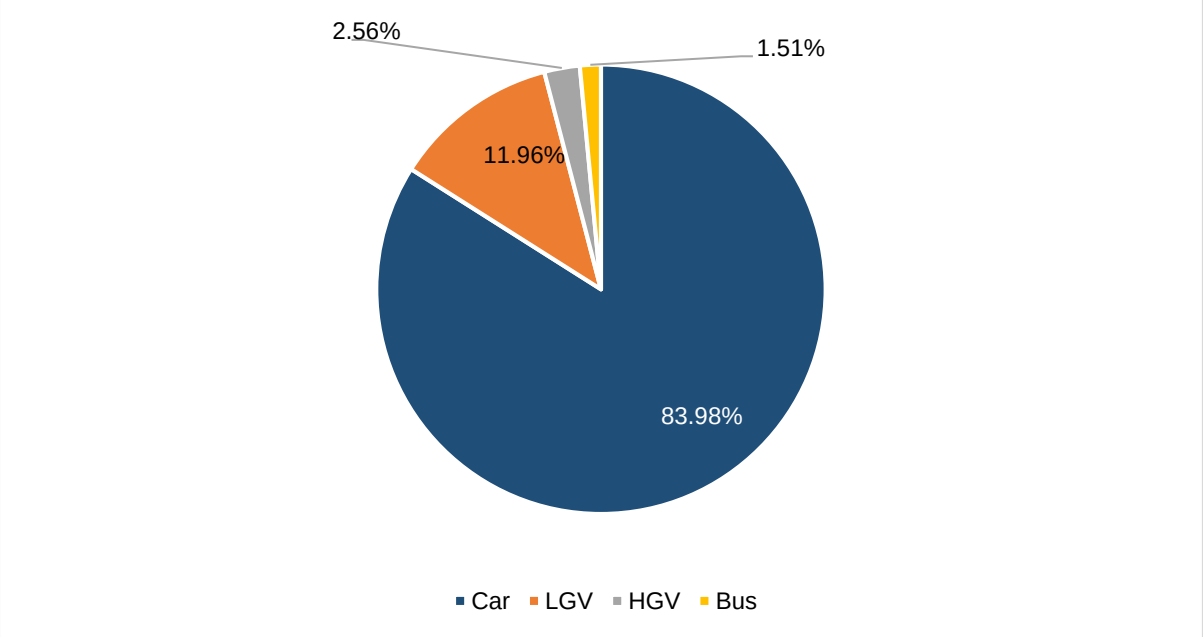


Table 17 Total Daily Average Vehicle Kilometres in Sheffield District by Vehicle Type (2016)

Vehicle Type	Total Vehicle Kilometres
Car	3,809,900
LGV	542,380
HGV	116,080
Bus	68,348

5.2.4 Fuel split

Automatic Number Plate Recognition (ANPR) data from 2019 showed that among all the unique vehicles recorded in Sheffield City Centre, 54.3% were diesel-engine, 43.5% petrol and 1.9% hybrid-electric vehicles. The total proportion of full electric vehicles was less than 2.2%. Figure 62 shows the proportion of different vehicle classes by fuel type and Table 18 shows the number of unique vehicles corresponding to each fuel type for an average day.

It can be noted that diesel is the predominant fuel type of most classes of vehicles in Sheffield City Centre, except for private cars which have around 4% more petrol-engine vehicles than diesel-engine vehicles.

Figure 63 Fuel Split by Vehicle Type

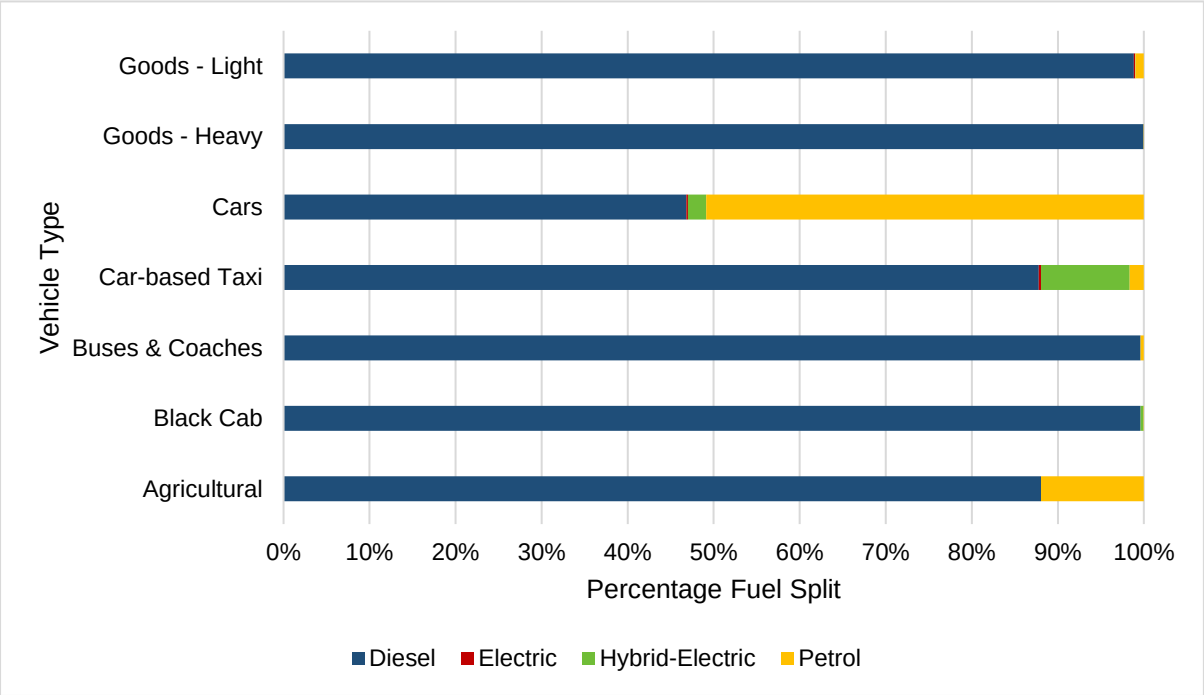


Table 18 Fuel Split by Number of Vehicles (daily average)

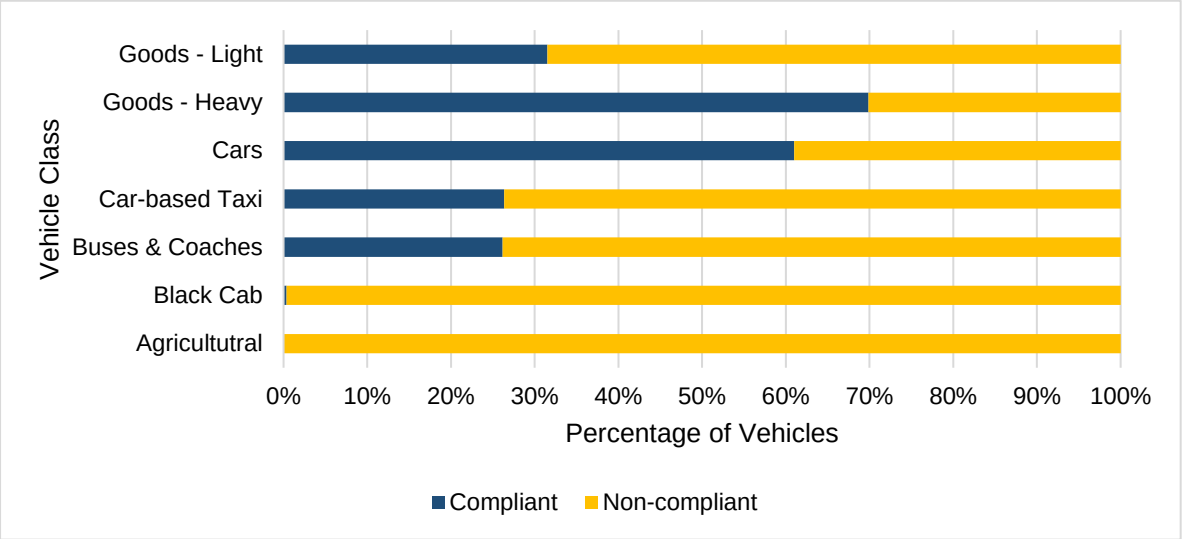
Fuel	Number of Vehicles
Diesel	393,276
Petrol	314,868
Hybrid-Electric	13,715
Electricity	1,454
Gas/Bi-Fuel	383
Hybrid DE	292
Petrol/Gas	59
Gas	32
Steam	5
Other	5

5.2.5 Euro standards

Euro emission standards define the permissible levels of exhaust emissions, mainly nitrogen oxides (NOx), hydrocarbons (HC), carbon monoxide (CO) and particulate matter (PM) produced by vehicles[12]. Analysis of ANPR data from Sheffield City Centre in 2019 showed that 44.7% of all vehicles recorded were not compliant with the respective Euro standards. Figure 63 shows the compliance split by vehicle type. 99.6% of black cabs, 73.8% of buses and coaches and 73.6% of car-based taxis were noted to fall below the permitted Euro standards. This shows that a significant proportion of vehicles were producing carbon monoxide, hydrocarbons, oxides of nitrogen and particulate matter beyond the permissible levels.

[12] https://ec.europa.eu/growth/sectors/automotive/environment-protection/emissions_en

Figure 64 Compliance to Euro Standards by Vehicle Type



5.2.6 Electric Vehicle Charging

Currently, there are electric vehicle charging points at around 20 locations within Sheffield, with around 26 slow chargers, 16 fast chargers and 9 rapid chargers in total[13]. Sheffield City Council (SCC) has received Early Measures Fund (EMF) funding from the Government's Joint Air Quality Unit (JAQU) and Ultra Low Emission Taxi Infrastructure Scheme funding from the Office of Low Emission Vehicles (OLEV) in order to provide 22 more rapid chargers (50kw) for electric vehicles[14]. Of the 22 chargers to be installed in 2020, 10 chargers will be for the exclusive use of hackney carriage taxis and private hire vehicles. The remaining 12 chargers will be available for use by the general public as well as taxi and private hire drivers.

[13] Next Green Car / Zap Map (2020) accessed at https://www.zap-map.com/live/
[14] Communication from SCC via email

5.3 CO_2 data

Table 19 CO_2 emissions estimates for transport in Sheffield 2005-2017 (kt CO_2)[15]

Year	Road Transport (A roads)	Road Transport (Motorways)	Road Transport (Minor roads)	Diesel Railways	Transport Other
2005	305.4	107.7	303.5	9.0	3.8
2006	298.8	107.3	296.7	8.8	3.9
2007	292.4	103.6	312.0	9.4	3.9
2008	280.2	95.0	311.6	9.1	4.1
2009	272.8	93.5	300.8	9.0	3.8
2010	272.2	95.2	294.4	9.1	3.8
2011	271.2	92.7	284.8	9.0	3.7
2012	260.2	91.5	276.7	9.5	3.6
2013	254.3	92.0	273.9	9.4	3.6
2014	255.0	89.3	280.5	9.4	3.6
2015	257.7	91.9	274.3	9.3	3.5
2016	261.5	94.0	279.7	9.1	3.4
2017	257.8	93.2	270.0	8.9	3.4

The results from Table 19 indicate an overall reduction in CO_2 emissions estimates for all sections of the Road Transport sector between 2005 and 2017. Specifically, A roads have experienced an average annual decrease of 1.4% and a 15.6% decrease from 2005 to the latest year, Motorways a 1.15% average annual decrease and 13.5% amongst all years, Minor roads a 0.9% average annual decrease and 11.0% decrease from 2005 to 2017, diesel railways a minimal decrease of 1.11% throughout this period and carbon dioxide emissions-decrease by 10.5% for Transport other.

The following maps present the carbon dioxide emissions at MSOA level and link-by link (tonnes of CO_2/km).

[15] Source: BEIS LA CO_2 statistics

Figure 65 Road transport emissions (kt CO_2) from diesel vehicles in Sheffield at MSOA level.

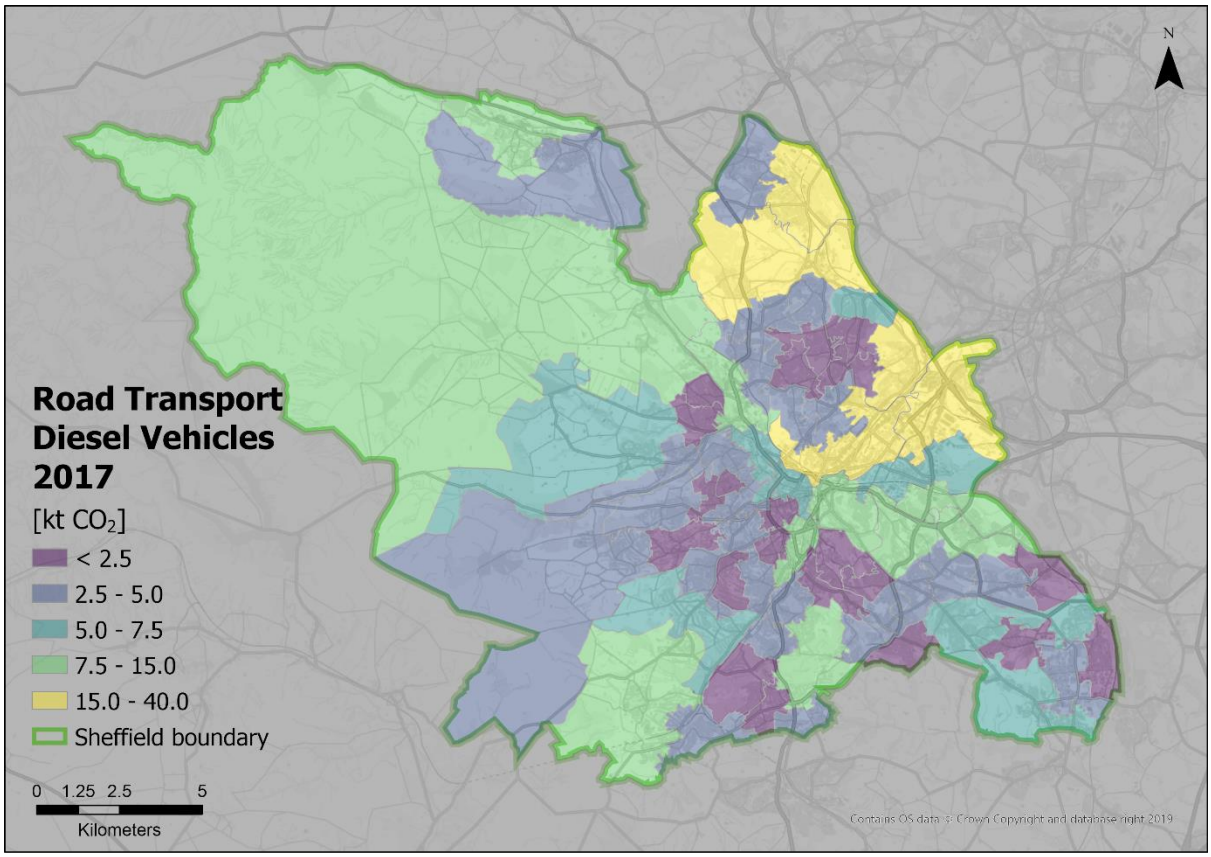


Figure 66 CO_2 emissions from diesel vehicles at road-link level (major roads) in Sheffield.

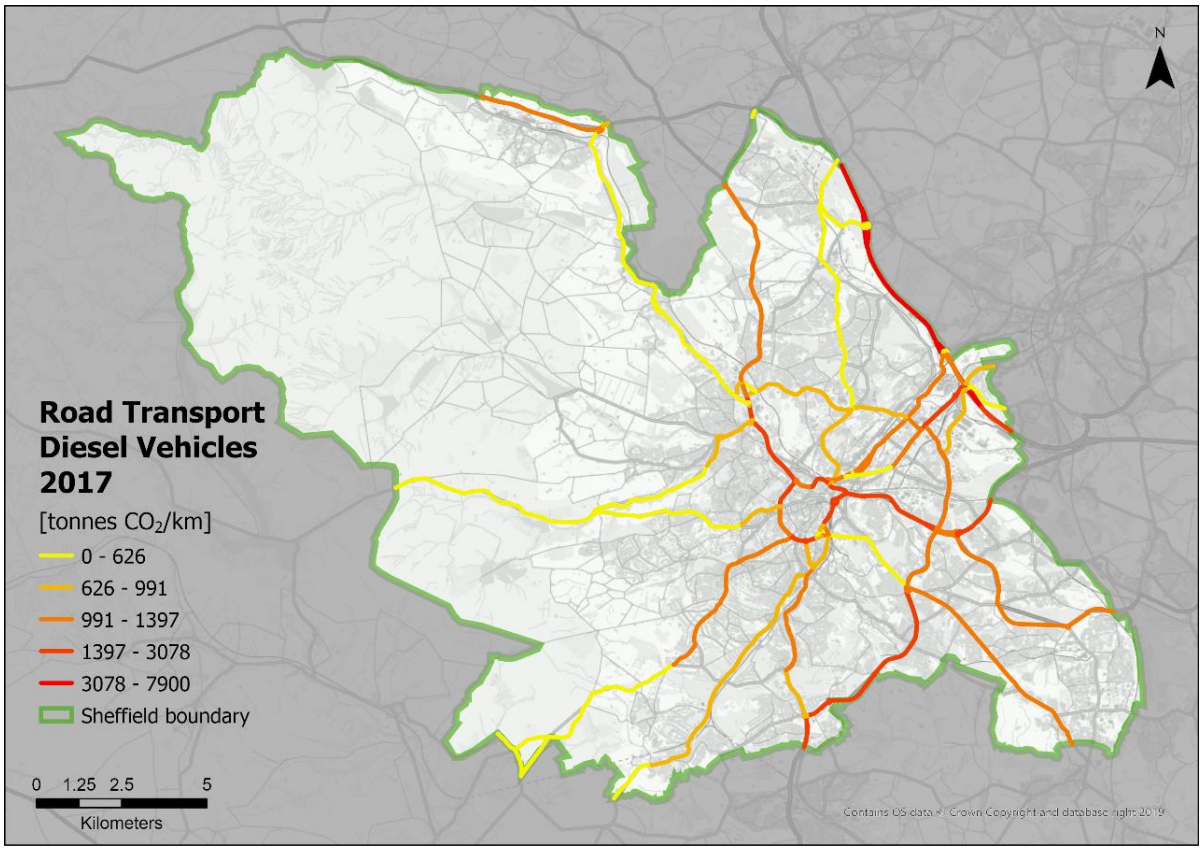


Figure 67 Road transport emissions (kt CO_2) from petrol vehicles in Sheffield at MSOA level.

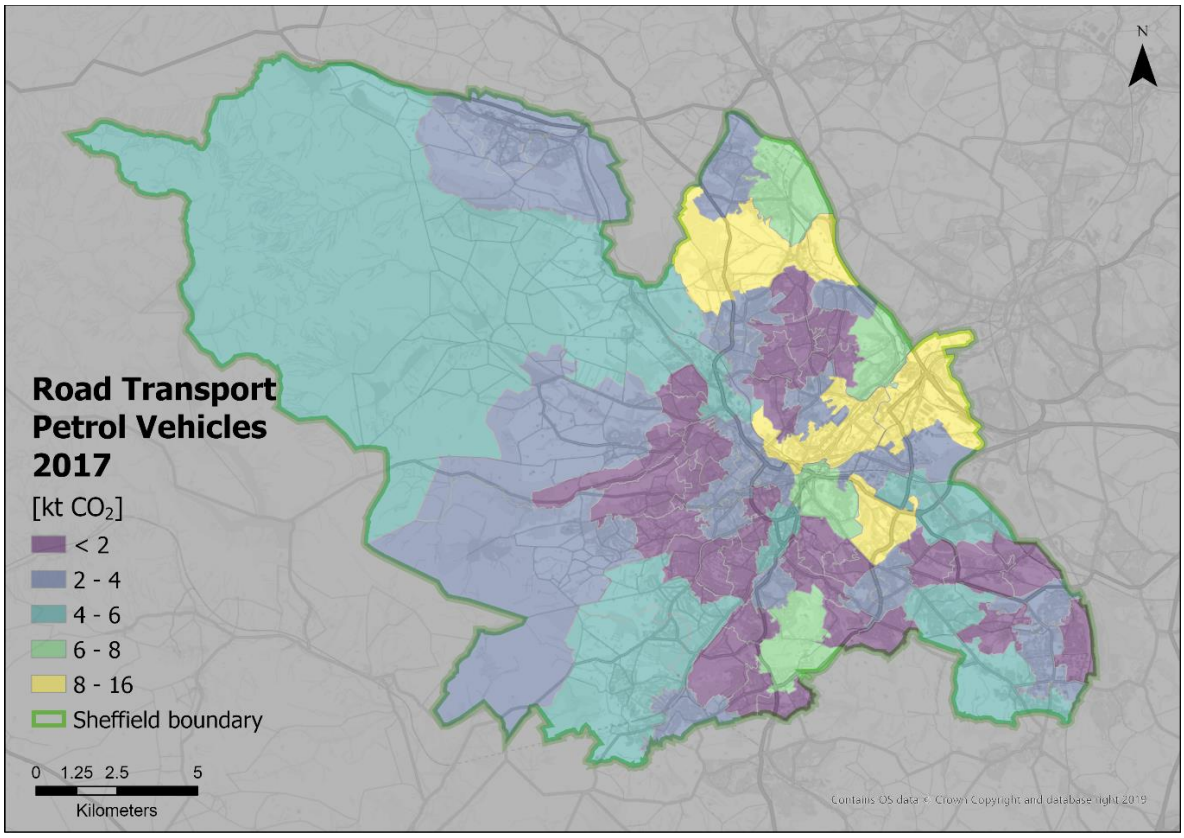
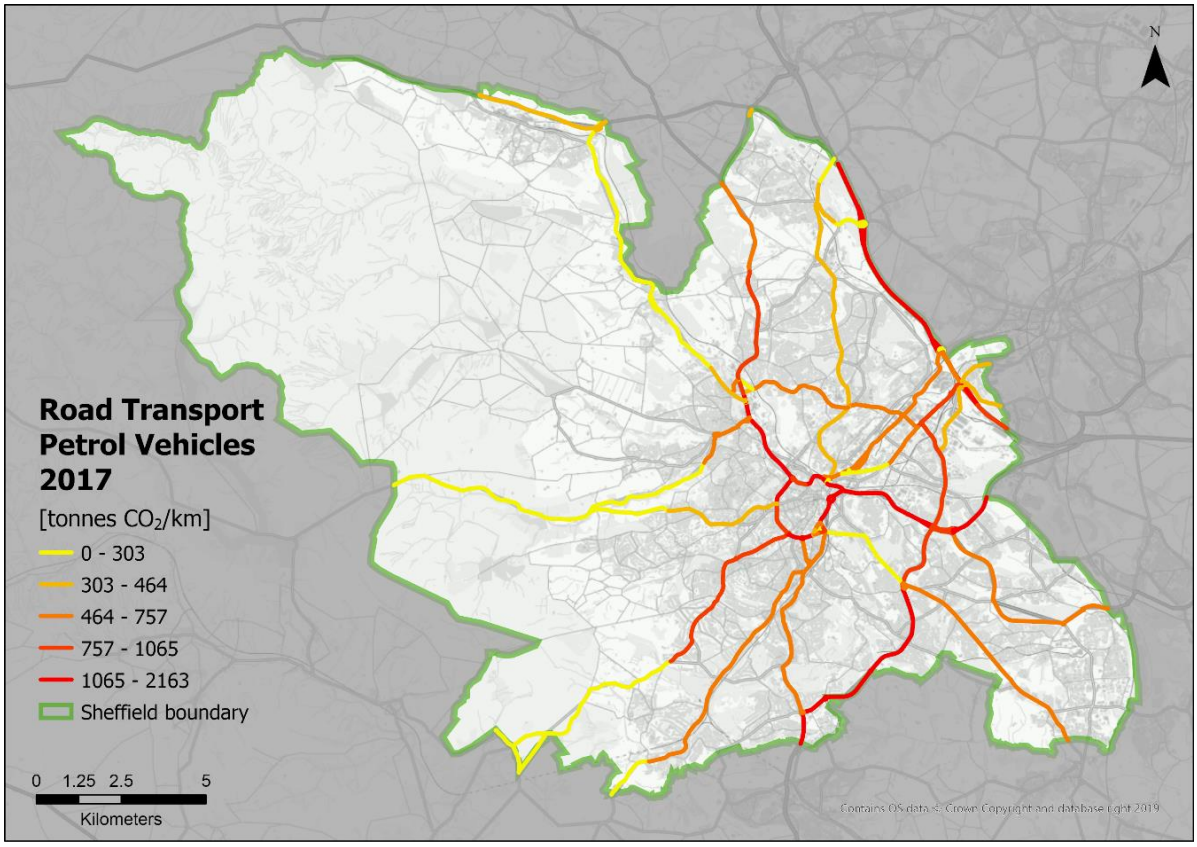


Figure 68 CO_2 emissions from petrol vehicles at road-link level (major roads) in Sheffield.

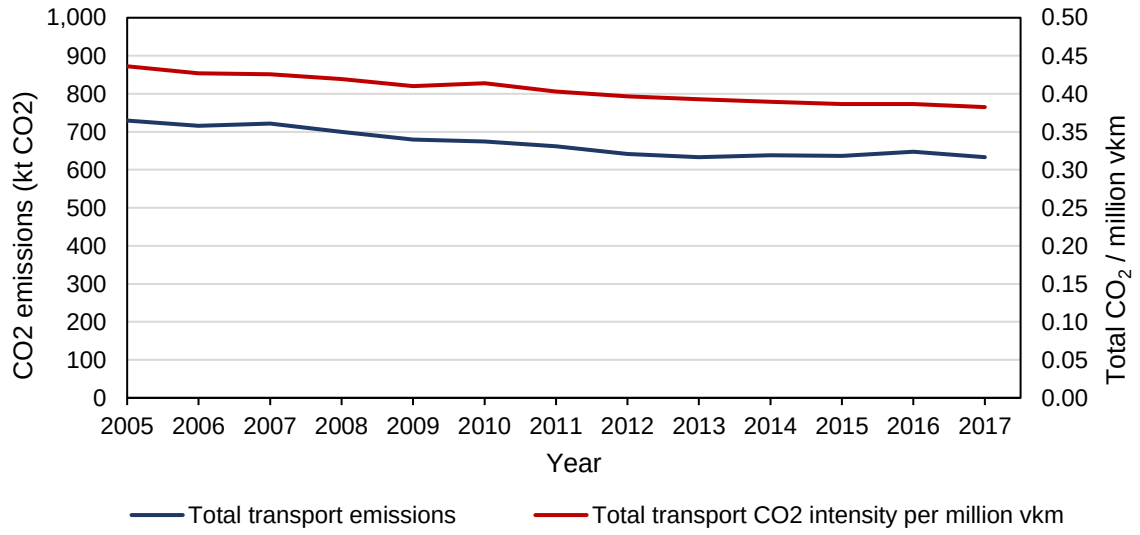


The results present the same patterns for CO_2 emissions from both diesel and petrol vehicles. Specifically, the CO_2 emissions are higher for the MSOAs located near the M1 motorway and between the city centre. Furthermore, the emissions of from diesel vehicles are almost double the equivalent from petrol vehicles at the higher emitting MSOAs.

The link-by-link results present higher emissions for roads leading to/starting from the city centre as well as the M1 motorway. In addition, the higher emitting road links for diesel vehicles are on average three times higher in tonnes of CO_2 compared to petrol vehicles. In this level of spatial analysis, road gradient has not been taken into consideration as research has shown that this factor doesn't impact the emissions.

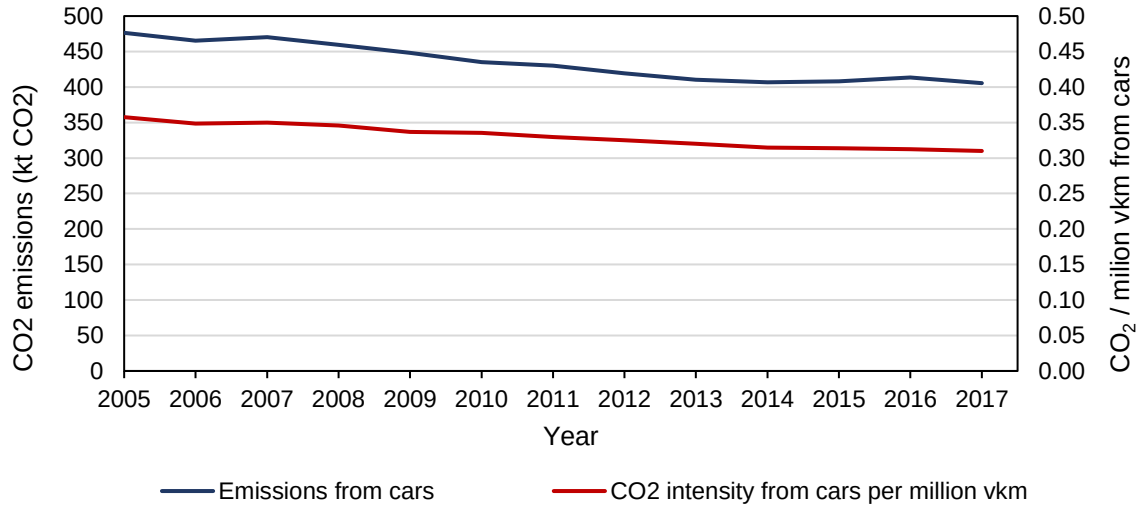
5.3.1 CO_2 Trend Analysis

Figure 69 CO_2 emissions (kt CO_2) from transport against total vehicle traffic (million vkm) in Sheffield[16]



[16] Source: BEIS LA CO_2 statistics and DfT Local authority traffic statistics

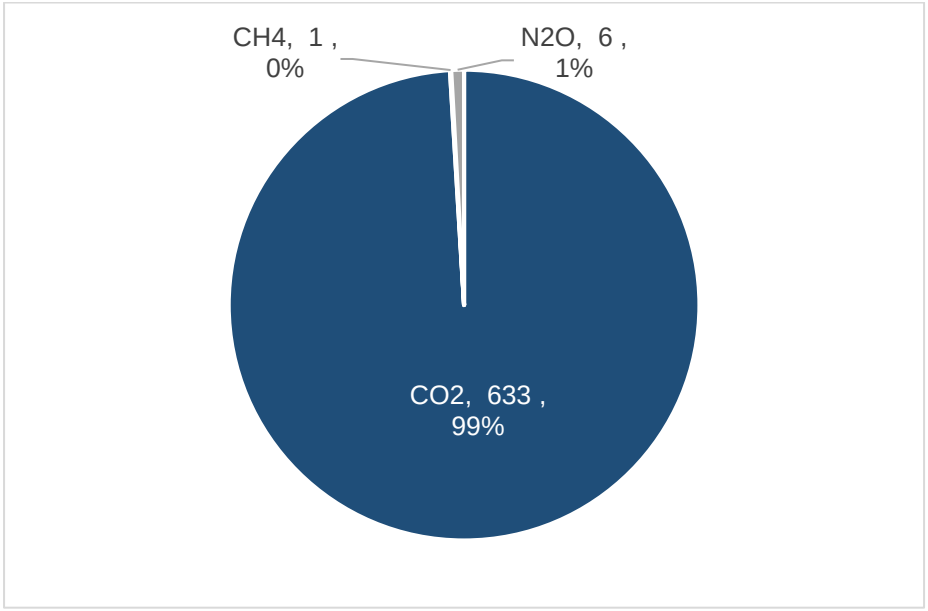
Figure 70 CO_2 emissions (kt CO_2) from cars against vehicle traffic from cars (million vkm) in Sheffield[16]



The trends from Figure 69 and Figure 70 provide more insights on the effect of vehicle kilometres to the total emissions of carbon dioxide from all transport emissions and emissions from cars. Figure 69's trend suggests that total emissions' changes per year and annual emissions per one million vkm follow the same trend. However, in the last two years these two lines start to couple indicating a decreasing vkm is responsible for lower emissions. The trend of Figure 70 presents that the vkm effect on car CO_2 emissions is fairly constant throughout the years despite an overall decrease of car CO_2 emissions. This suggests that for the most recent years that the traffic flow has slightly decreased.

5.4 CH_4 and N_2O data

Figure 71 GHG breakdown from transport (ktCO2e)

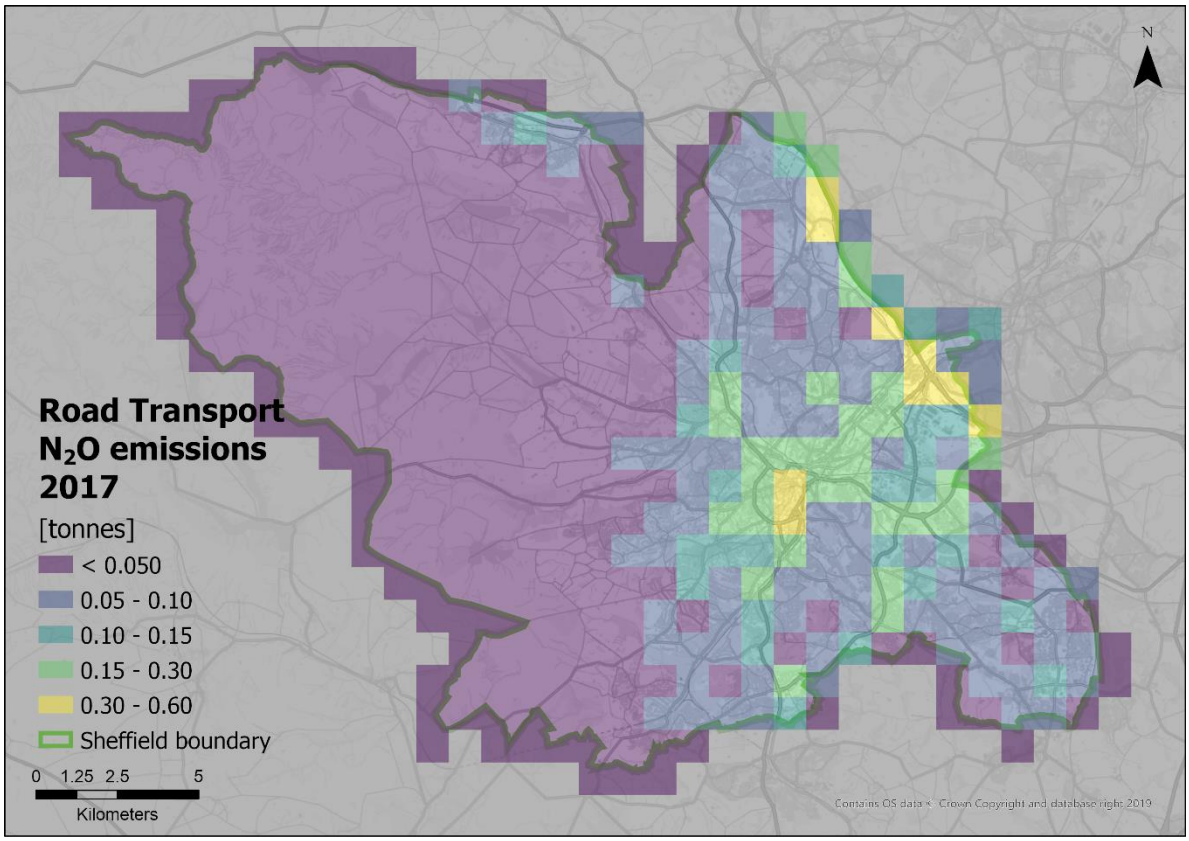


The Road Transport's GHG breakdown indicates a 99% dominance by CO_2 (633 of total 640 ktCO2e). The maps below present the emissions from methane and nitrous oxide from the Road

Transport sector at grid level – the MSOA maps can be found in Appendix A5. The results at grid level present eastern Sheffield boundary and, more specifically, the M1 motorway as the highest region of GHG emissions. Also noticeable is the class range between the 2 GHG – nitrous oxide emissions are one order of magnitude greater than methane.

Figure 72 Methane emissions from transport at 1x1 km grid level in Sheffield

Figure 73 Nitrous oxide emissions from transport at 1x1 km grid level in Sheffield



6 Agriculture, waste and land use

This section concerns emissions in Sheffield from the agricultural, waste and land use sector. The subsections present the historic energy consumption and CO_2 trends including their corresponding data for 2017 (maps) as well as methane and nitrous oxide (GHG) emissions at grid level.

6.1 CO_2 data

Table 20 CO_2 emissions estimates for agriculture, waste and land use in Sheffield 2005-2017 ($ktCO_2$)[17]

Year	Agriculture	Net LULUCF
2005	4.3	-15.3
2006	4.1	-16.6
2007	3.8	-17.2
2008	3.8	-18.0
2009	3.8	-18.2
2010	3.8	-18.8
2011	3.9	-19.4
2012	3.9	-19.4
2013	3.7	-20.4
2014	3.9	-20.4
2015	4.0	-21.1
2016	4.0	-20.9
2017	4.0	-21.4

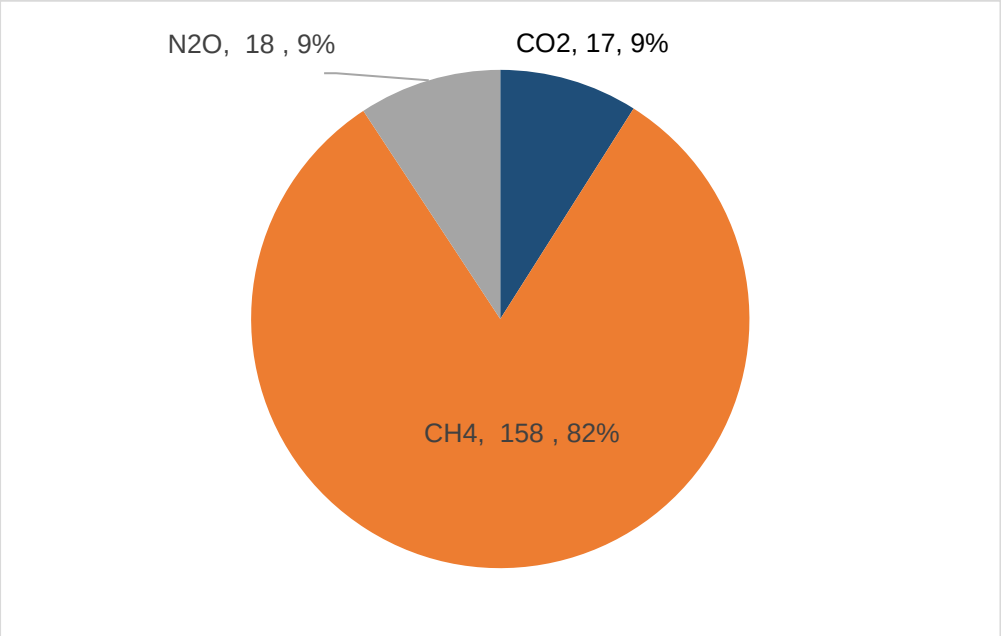
The carbon dioxide emission data and associated trends from Table 20 indicate an overall slight decrease in CO_2 emissions from the agricultural sector in Sheffield over the years (7%) where in the last three years' emissions show no change. In addition, CO_2 emissions attributed to LULUCF, show an increasing net decrease (40%) with an average annual decrease of 2.9%.

The negative figures for land use represent carbon sequestration from natural habitats. The level of sequestration will relate to the type and quality of this habitat. Some local information on the habitats on South Yorkshire is provided by the South Yorkshire Local Nature Partnership website.

[17] Source: BEIS LA CO_2 statistics

6.2 CH_4 and N_2O data

Figure 74 GHG breakdown from agriculture, waste and land use (ktCO2e)



The GHG breakdown from the Agricultural, waste and land use sector indicate an even split between methane (9%) and carbon dioxide (9%) whereas methane emissions dominate the split by contributing to 82% (158 kt CO2e) of the total GHG emissions in Sheffield.

The maps below present the nitrous oxide and methane emissions of this sector at grid level – as with the previous chapters the MSOA maps can be found in the relevant appendix – see Appendix A6. The maps results indicate very high emissions of methane (in accordance to Figure 74) near the M1 motorway, south-east of the city centre and closer to the rural area (near the Peak District National Park) at the west (orange grids from Figure 75). On the contrary the nitrous oxide emissions are relatively low and seem to be higher just west of the city centre. The methane emissions are approximately 3 orders of magnitude higher than nitrous oxides emissions for the highest emitting grids.

Figure 75 Methane emissions from agriculture, waste and land use at 1x1 km grid level in Sheffield

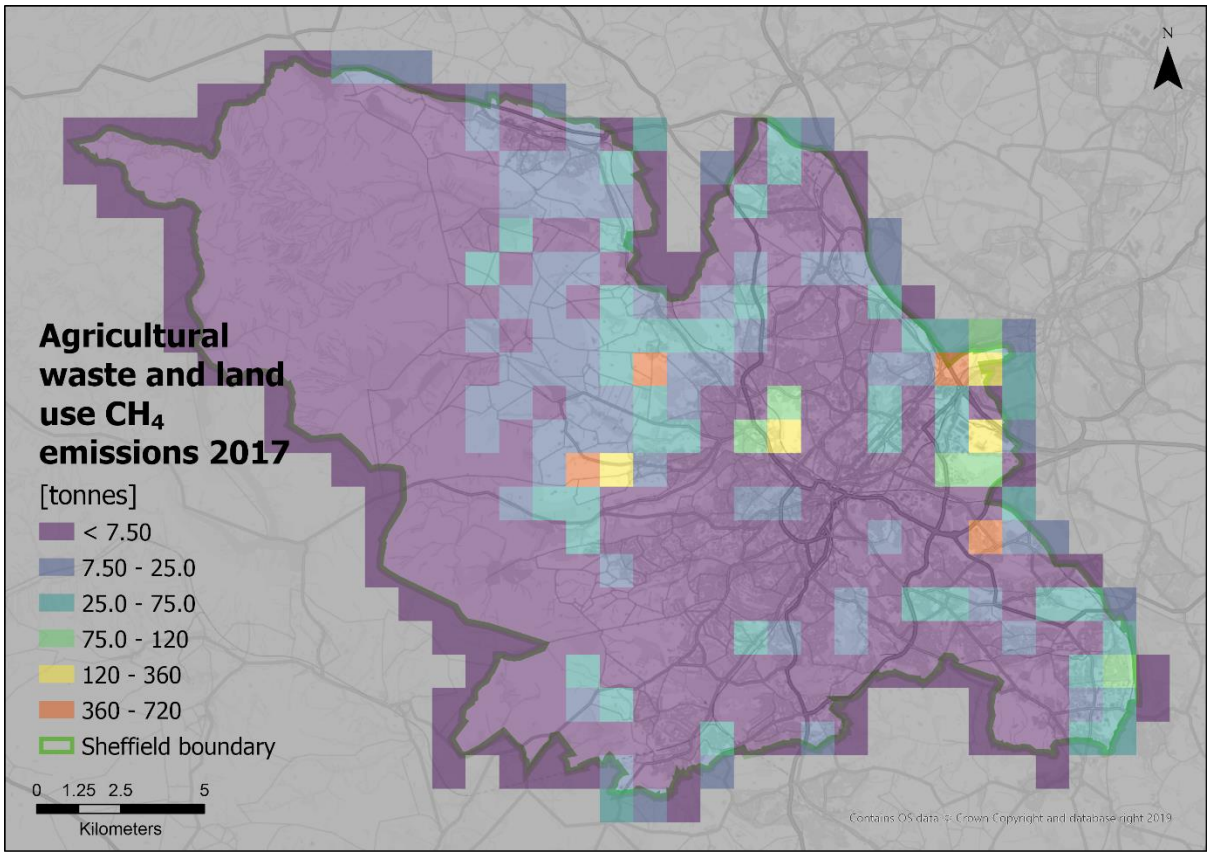
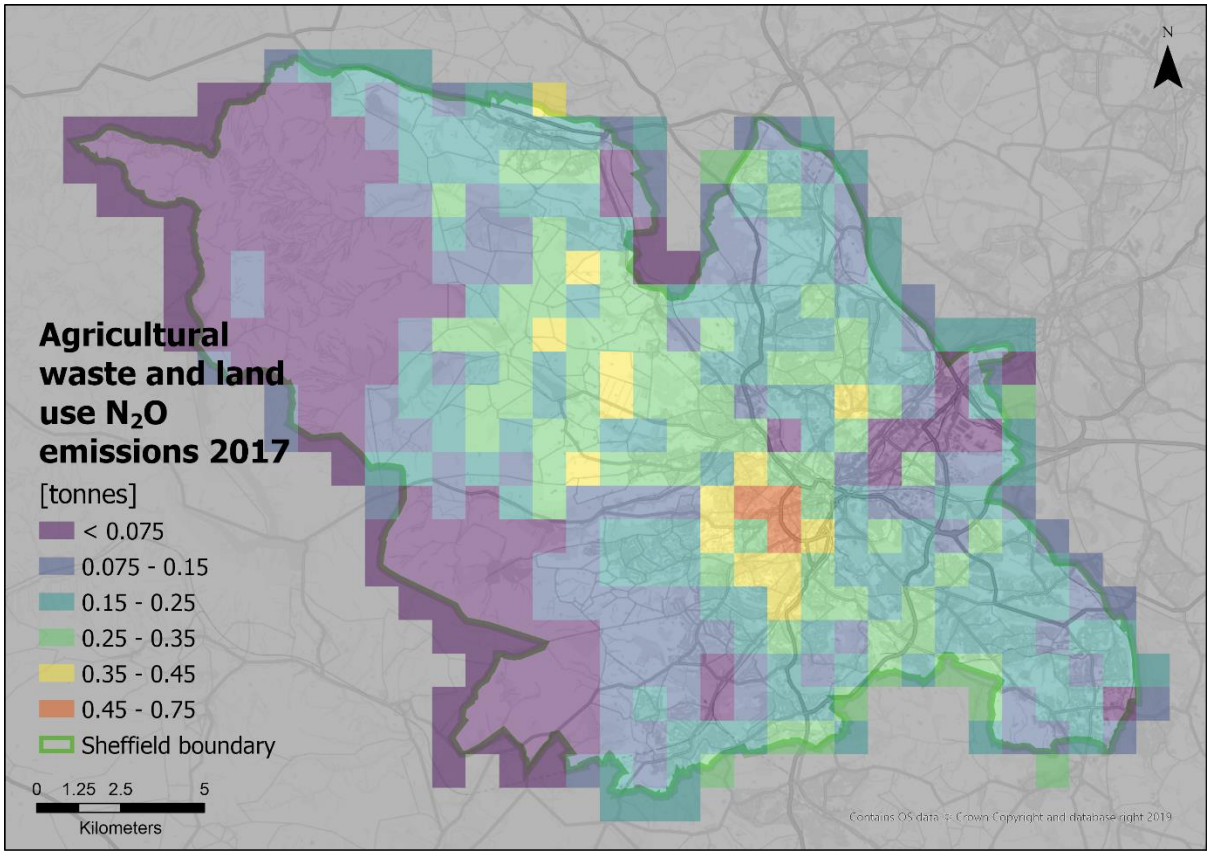


Figure 76 Nitrous oxide emissions from agriculture, waste and land use at 1x1 km grid level in Sheffield



7 Local energy generation and storage

The purpose of this note is to summarise the indigenous energy generation (heat and electricity) in the Sheffield local authority area. This information will form part of the baseline developed within Work Package 1 for Sheffield City Council net zero pathways project.

7.1 Heat

7.1.1 Scope

This assessment focussed on the heat generation in the Sheffield local authority area for heat generated by all sources other than natural gas.

We have used readily available information to estimate:

- Total number of installations
- Total installed capacity (MW)
- Total heat exported from each site (GWh/year)
- Emissions associated with the heat (tCO_2e/year)

There is limited information in the public domain about the generation of heat. Given the highly distributed nature of heating systems, it is difficult to get a full picture without in depth research. We particularly highlight the following exclusions and limitations of this analysis:

- We have not considered any gas-fired boilers or CHP plants. We understand that gas usage is considered elsewhere in the study.
- We have not considered any renewable heating installations which aren't registered under the RHI scheme. We know there are several SCC biomass heating systems which supply community heating systems and pre-dated RHI but these are relatively small in the context of the whole city.
- We have not included domestic wood burning stoves.
- We have not included coal and oil-fired heating systems.

7.1.2 Data sources

The data sources used for this analysis are summarised in the table below.

Data Source	Description	Link
RHI Monthly Deployment Data published by BEIS	UK RHI data from November 2011-March 2020	RHI
Veolia Environmental Services	Information provided direct to the project team in relation to the Sheffield Energy Recovery Facility (ERF) which generates heat and electricity from Sheffield's waste.	

7.1.3 Data summary

The table below summarises the installed capacity and exported heat from sites in Sheffield.

Technology	No of installations	Capacity MW_{th}	Generation GWh/year
Domestic RHI installations	252	3.2[18]	15.1[19]
Non-domestic RHI installations	63	11.0[18]	140.6[19]
Sheffield ERF which supplies heat to the Sheffield District Energy Network	1	Up to 45MW available. Typical peak load is 40-42MW.	97.4[20]
Blackburn Meadows Biomass CHP which supplies heat to a district heating network in the Don Valley area	1	Up to 25MW available. Typical peak load is currently unknown	Currently unknown
Total	**317**	**54.2**	**253.1**

7.2 Electricity

7.2.1 Scope

This assessment focussed on the electricity generation in the Sheffield local authority area for electricity generated by all sources other than natural gas.

We have used publicly available information to estimate:

- Total number of installations
- Total installed capacity (MW)
- Total electricity exported from each site (GWh/year)
- Emissions associated with the electricity (tCO_2e/year)

We have not considered any gas-fired electricity generation or CHP plants. We understand that gas usage is considered elsewhere in the study.

7.2.2 Data sources

The data sources used for this analysis are summarised in the table below.

[18]This was calculated by multiplying the number of institutions by the average capacity and design SPF values for new and legacy installations
[19] This was calculated by applying the proportional representation of technologies in Sheffield to the heat generated and paid for in the UK
[20] Annual average based on total heat consumed during the period 2012-2019

Data Source	Description	Link
BEIS data on renewable electricity generation by local authority	Data covering number of installations, capacity, annual generation and emissions between 2014 and 2018 (latest available dataset)	Renewable electricity by local authority
UK Government GHG Conversion Factors 2019	GHG conversion factors for different fuel types	GHG Factors
Veolia Environmental Services	Annual performance report 2019	Annual Performance Report 2019
E.ON Blackburn Meadows – Renewable Energy Plant Design and Access Statement	A description of the processes used to determine the GHG factor for Blackburn Meadows	Design and Access Statement

7.2.3 Data summary

The table below summarises the installed capacity and electricity generation from sites in Sheffield.

Technology	No of installations	Capacity MW	Generation GWh/year	Emissions tCO_2e/year
Photovoltaics	5,451	22.1	20.8	0
Onshore Wind	9	0.1	0.1	0
Hydro	3	0.6	2.2	0
Sewage Gas	1	2.0	11.1	2.32
Landfill Gas	3	4.9	17.8	3.55
Municipal Solid Waste[21]	1	19.0	105.9[22]	4,335
Plant Biomass[23]	8	62.3	315.9	4,938
Total	**5,476**	**111.0**	**473.8**	**9,279**

There is no electricity generation recorded in Sheffield from anaerobic digestion, offshore wind, wave/tidal, animal biomass or cofiring.

[21] This is the Sheffield Energy Recovery Facility operated by Veolia Environmental Services
[22] From Veolia Annual Performance Report 2019
[23] This includes the Blackburn Meadows biomass-fuelled CHP plant

8 Summary and conclusions

This report provides the baseline data to help Sheffield City Council to work towards achieving zero carbon emissions. The report presents the results of the spatial disaggregation of the CO_2 emissions from the UK Greenhouse Gas Inventory (GHGI) along with the associated energy use data and the structural and activity data for each main sector as follows:

- Industrial and commercial
- Domestic
- Transport
- Agriculture, Waste and Land Use

Top level messages

- **90% of total GHG emissions are CO_2 hence the focus for further analysis should be on this pollutant;**
- **Methane is the dominant non-CO_2 GHG and is largely related to agriculture and waste disposal.**
- **Industry and commercial emissions (35%) and domestic emissions (33%) and the largest sectors and nearly entirely CO_2.**
- **Transport is the 3rd largest sector at 26% of emissions**
- **The remainder are from agricultural, waste and land-use, which form most of the non-CO2 GHG emissions.**
- **All sectors have seen declining emissions with the industrial and commercial sector reducing the most followed by the domestic sector. The transport sector has seen the lest reduction at only about 17% since 2005.**

8.1 Industrial and commercial sector

The industrial and commercial sector is the largest source of GHG emissions in the city at 35% of the total, of which nearly all are CO_2 emissions. Some of the key features of this sector are as follows:

- Energy consumption has dropped by some 33% since 2005, with the largest drop being in solid fuels and then gas.
- Overall energy Intensity has drop by between 40 and 65%, dependant on fuel this will reflect a range of factors from structural change with an increasing service sector, efficiency improvements and some fuel switching.
- Most of the CO_2 emissions related to commercial and light industrial activity, with only about 4% related to large industrial sources
- Overall some 85% of commercial and industrial premises are retail, offices and warehouses - so the focus on mitigation in this sector should be really on energy efficiency and low carbon energy sources for these types of premises, with industry being less significant and harder to change
- The largest industrial sources are the iron and steel sector followed by incineration.
- The geographical focus of the industrial and commercial emissions is the industrial area to the North East of the city along the Don Valley

8.2 Domestic sector

Domestic emissions are the second largest sector of emissions and are almost entirely CO_2 emissions. Key aspects of this sector are:

- Energy use dropped by 25% overall with a 30% reduction for gas, indicating both boiler and fabrics efficiency improvements) and a15% reduction for electricity indicating improvements in appliance efficiency.

- Energy intensity per capita matches the overall patter for energy use fuel use - so indicates all the reduction relates to efficiency rather than structural change.
- Geographically the emissions distribution mirrors that of industrial and commercial sector, with energy use being in the South West of the city (larger, detached housing).
- The EPC data shows a normal distribution around a D rating, so there is significant scope for improvement. A shift from D to B would reduce emissions by about 40%, and a shift to A by about 90%.
- As might expected older houses have worse EPC ratings, however, but even more modern properties built since 2000 have an average rating of C so can be improved.
- In terms of main heating source 81% are gas boilers, 10% are electric and 5% some form of district heating. This indicates a need for a major shift away from gas boilers to zero carbon heating sources.

8.3 Road transport sector

Transport is the 3rd largest sector but only just behind industrial commercial and domestic emissions at some 26% of the total. These emissions are nearly entirely related to road transport, with 84% related to car traffic, and are virtually all CO_2. The key features of this sector are:

- Total emissions dropped by about 17%, which is the smallest reduction of all sectors.
- There is been a significant growth in diesel cars and vans, while petrol cars declined, similar to elsewhere in the country.
- Also, HGVs emissions have remained relatively constant.
- Car mode share has remained around 60% for the last 15 years, but the bus share has declined 24% to 16%.

Overall decarbonising transport will be a significant challenge with a key focus being on mode shift to low carbon modes and generating a rapid uptake of zero emission vehicles.

8.4 Agriculture, waste and land use

The agricultural, waste and land-use sector is the smallest sector at some 6% of GHG emissions. This is also the only sector where methane dominates the GHG emissions (82%; 158 kt CO2e). The results from the Agricultural, waste and land use sector have indicated that CO_2 emissions have slightly decreased between 2005 and 2017 (7% decrease). The CO_2 emissions attributed to LULUCF, show an increasing net decrease (40%) with an average annual decrease of 2.9%. Continuing or enhancing this trend will help the net carbon emissions balance. The spatial analysis has shown that the hotspots of methane emissions are much higher in emissions than the ‘colder’ spots and are located near the eastern region of the Peak District National Park and near the motorway.

8.5 Energy generation and storage

There is a growing amount of locally generated renewable heat and electricity in the city. The current annual heat generation is some 253 GWh per year and electricity is higher at 474 GWh per year. Putting this in context the total gas demand in the city (assumed to be largely heat) is some 5,000 GWh, so the current local heat supply is about 7% of this. Total electric demand is some 2,212 GWh per local generation equates to about 21% of this so significantly higher than for heat.

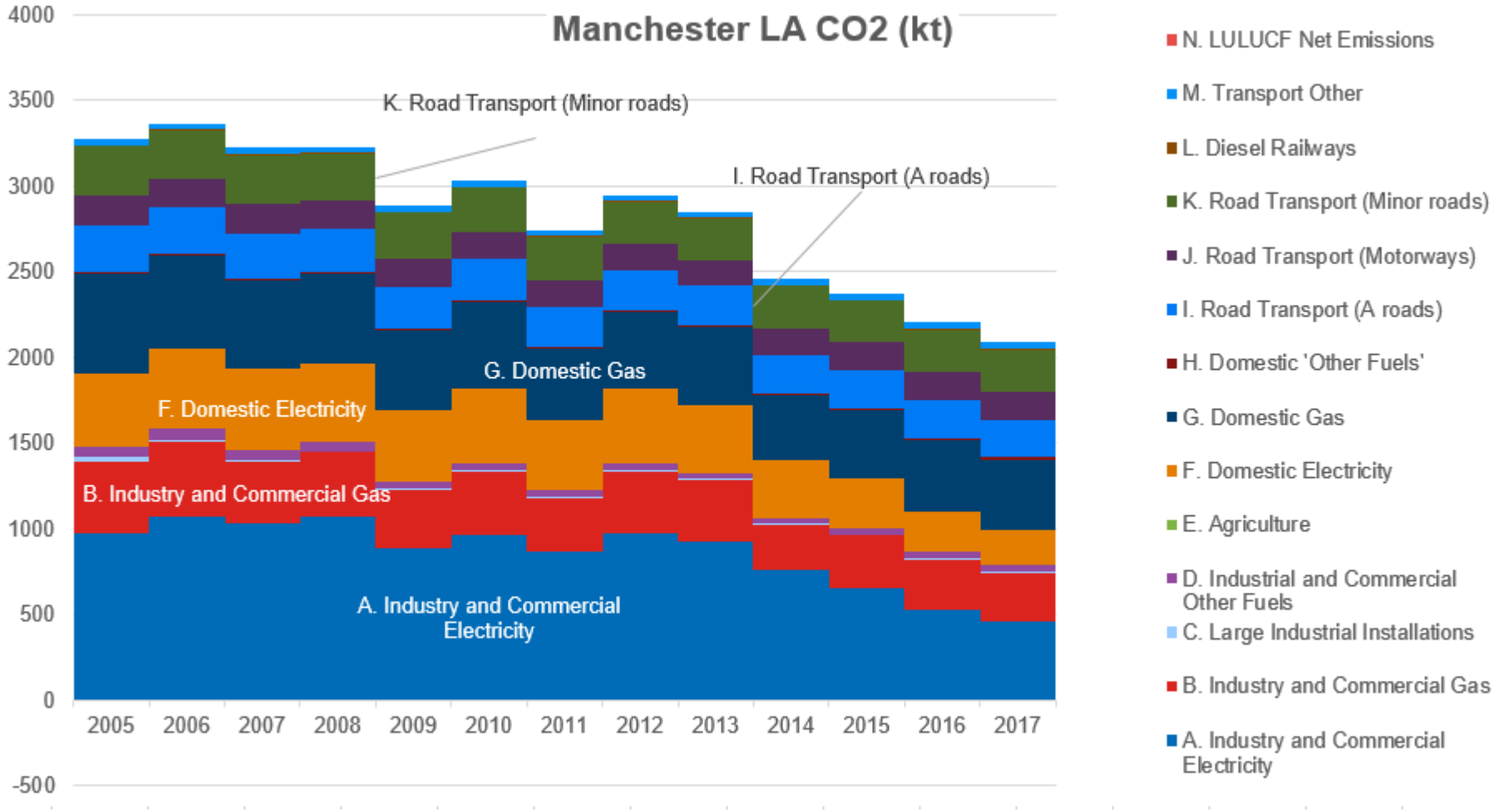
9 References

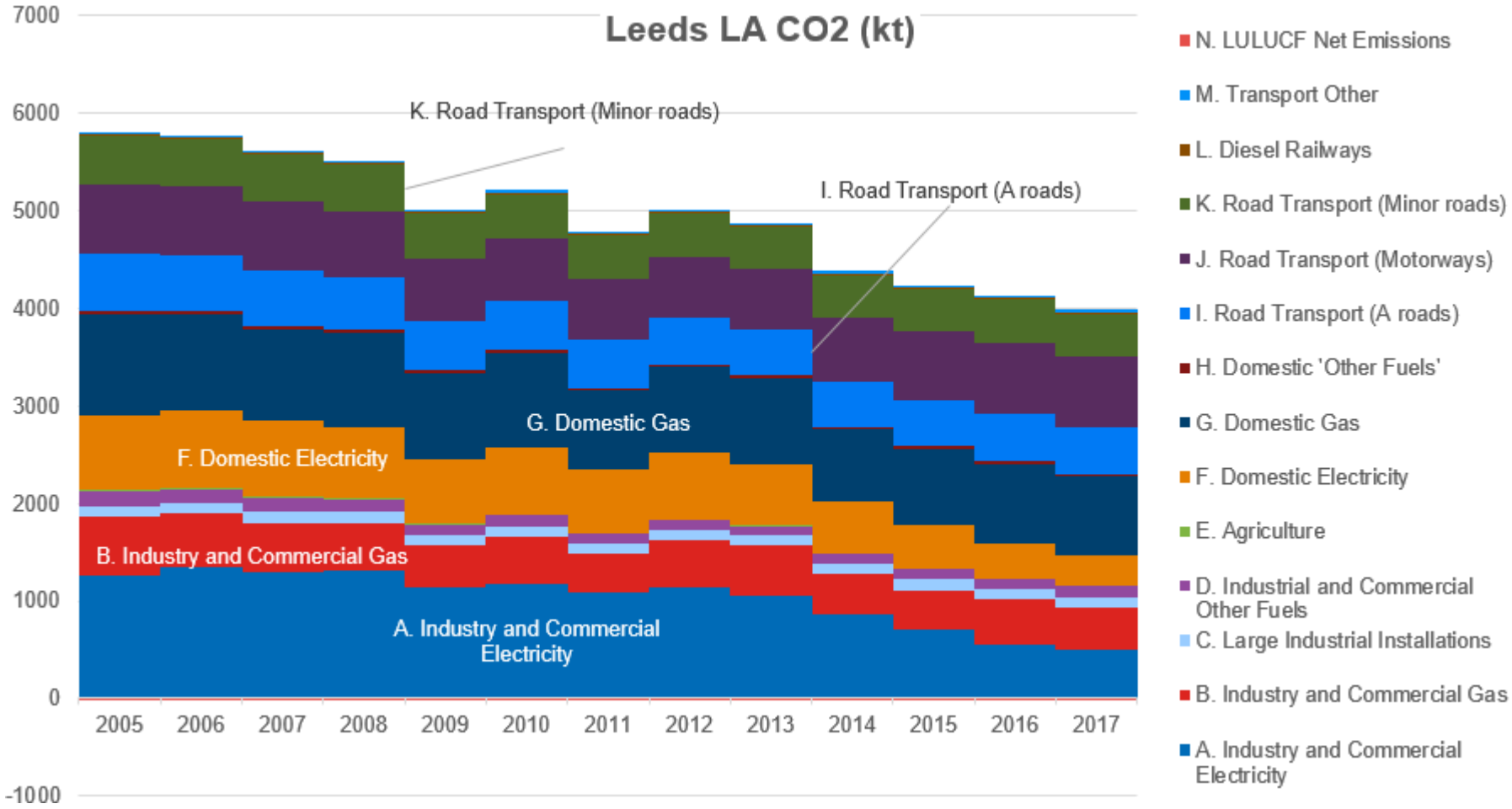
Tsagatakis, I., Ruddy, M., Richardson, J., Otto, A., Pearson, B., & Passant, N. (2019). *UK Emission Mapping Methodology*. Retrieved from National Atmospheric Emissions Inventory: https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1910040848_Mapping_Methodology_for_NAEI_2017_v1.pdf

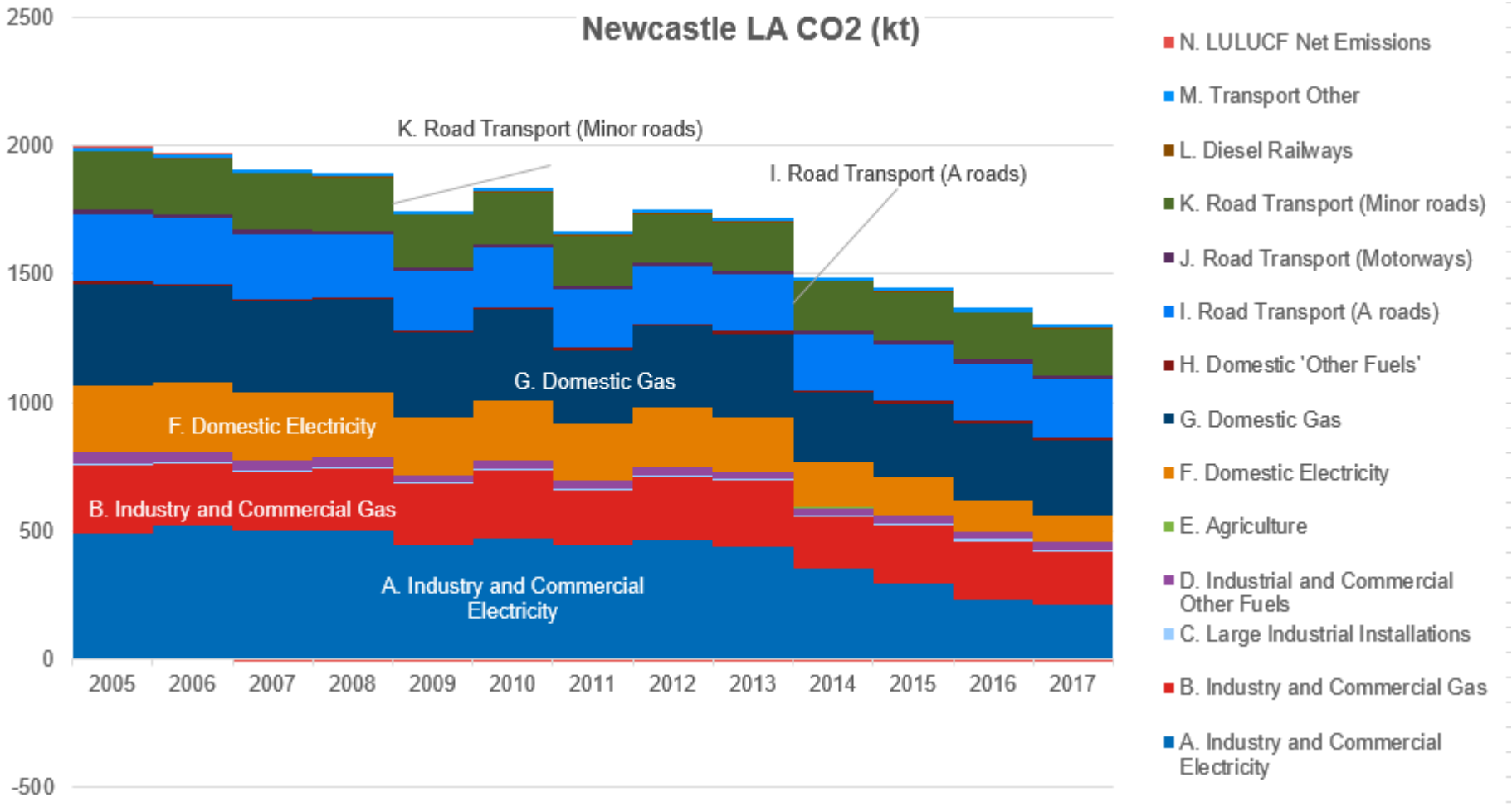
Appendices

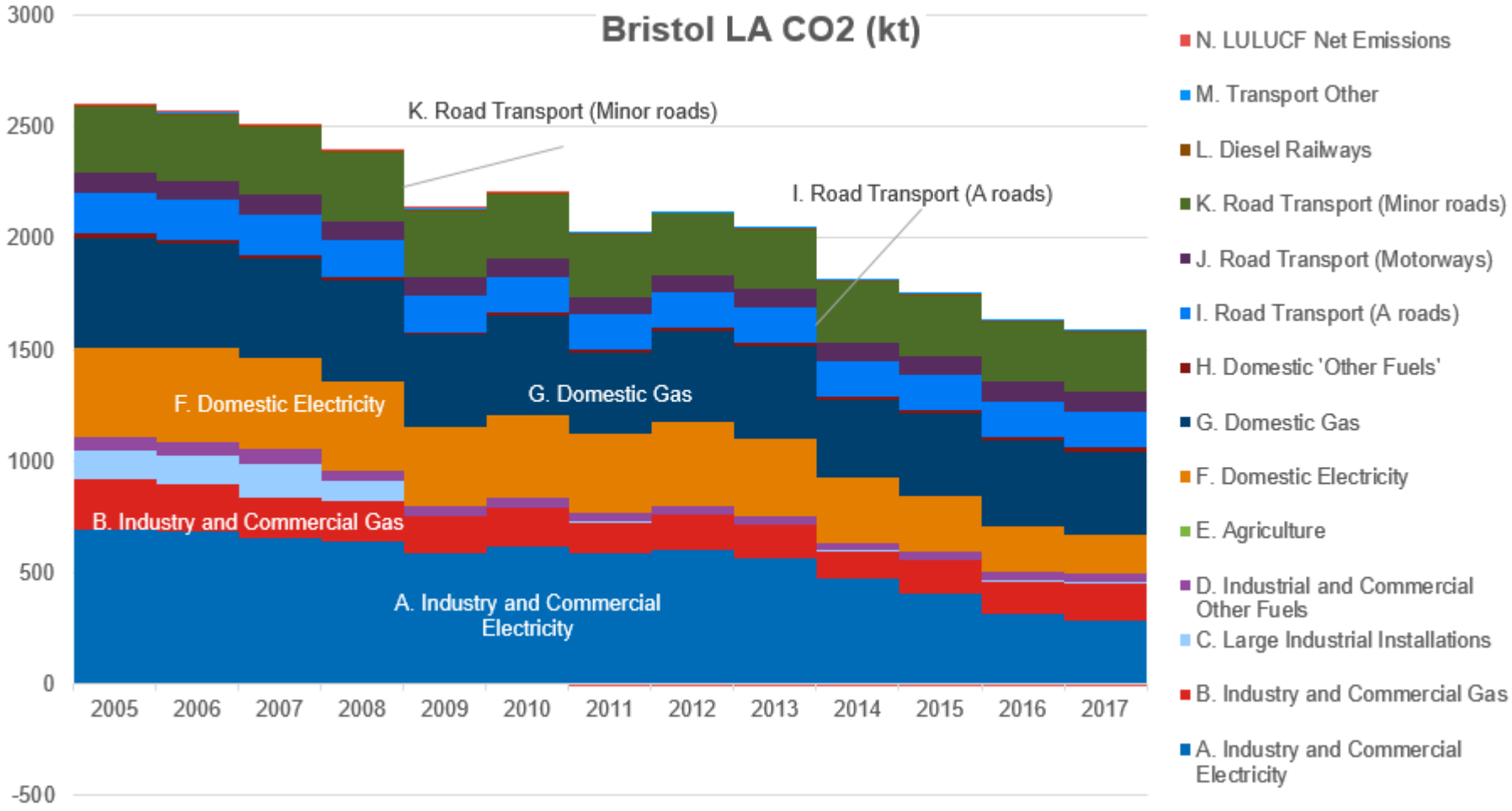
This last chapter of the report contains additional information that supplements the main chapters. It consists of the detailed emissions (tonnes of CO_2) from the Large Industrial Installations in 2017 and the maps at MSOA level – where these have been derived from gridded data (1x1km^2 grids).

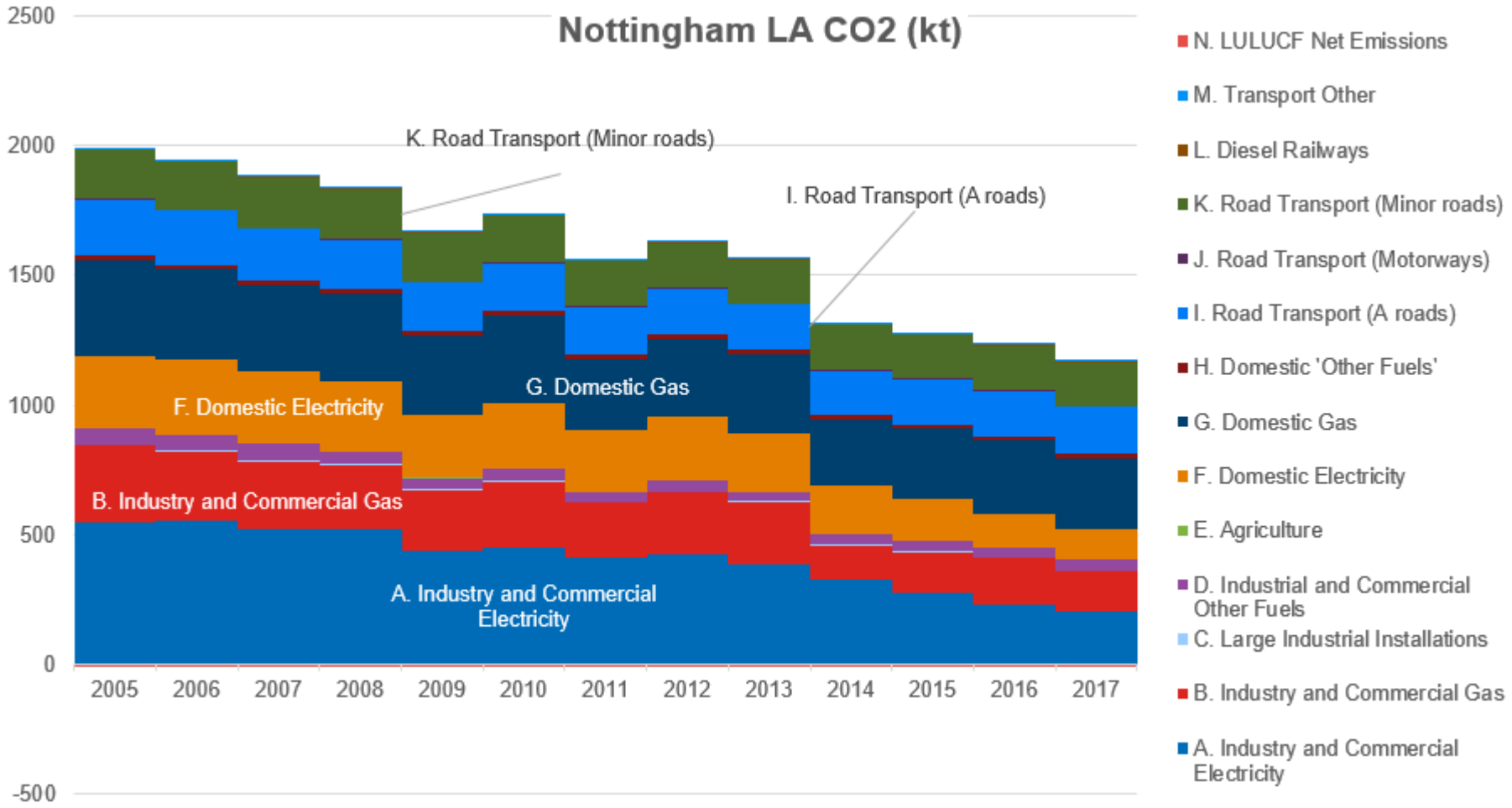
A1 LA CO_2 emissions from other major cities




Leeds LA CO2 (kt)
7000
6000
5000
4000
3000
2000
1000
0
-1000
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
K. Road Transport (Minor roads)
I. Road Transport (A roads)
G. Domestic Gas
F. Domestic Electricity
B. Industry and Commercial Gas
A. Industry and Commercial Electricity
N. LULUCF Net Emissions
M. Transport Other
L. Diesel Railways
K. Road Transport (Minor roads)
J. Road Transport (Motorways)
I. Road Transport (A roads)
H. Domestic 'Other Fuels'
G. Domestic Gas
F. Domestic Electricity
E. Agriculture
D. Industrial and Commercial Other Fuels
C. Large Industrial Installations
B. Industry and Commercial Gas
A. Industry and Commercial Electricity


Newcastle LA CO2 (kt)
2500
2000
1500
1000
500
0
-500
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
K. Road Transport (Minor roads)
I. Road Transport (A roads)
G. Domestic Gas
F. Domestic Electricity
B. Industry and Commercial Gas
A. Industry and Commercial Electricity
N. LULUCF Net Emissions
M. Transport Other
L. Diesel Railways
K. Road Transport (Minor roads)
J. Road Transport (Motorways)
I. Road Transport (A roads)
H. Domestic 'Other Fuels'
G. Domestic Gas
F. Domestic Electricity
E. Agriculture
D. Industrial and Commercial Other Fuels
C. Large Industrial Installations
B. Industry and Commercial Gas
A. Industry and Commercial Electricity


Bristol LA CO2 (kt)
3000
2500
2000
1500
1000
500
0
-500
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
K. Road Transport (Minor roads)
I. Road Transport (A roads)
F. Domestic Electricity
G. Domestic Gas
B. Industry and Commercial Gas
A. Industry and Commercial Electricity
N. LULUCF Net Emissions
M. Transport Other
L. Diesel Railways
K. Road Transport (Minor roads)
J. Road Transport (Motorways)
I. Road Transport (A roads)
H. Domestic 'Other Fuels'
G. Domestic Gas
F. Domestic Electricity
E. Agriculture
D. Industrial and Commercial Other Fuels
C. Large Industrial Installations
B. Industry and Commercial Gas
A. Industry and Commercial Electricity

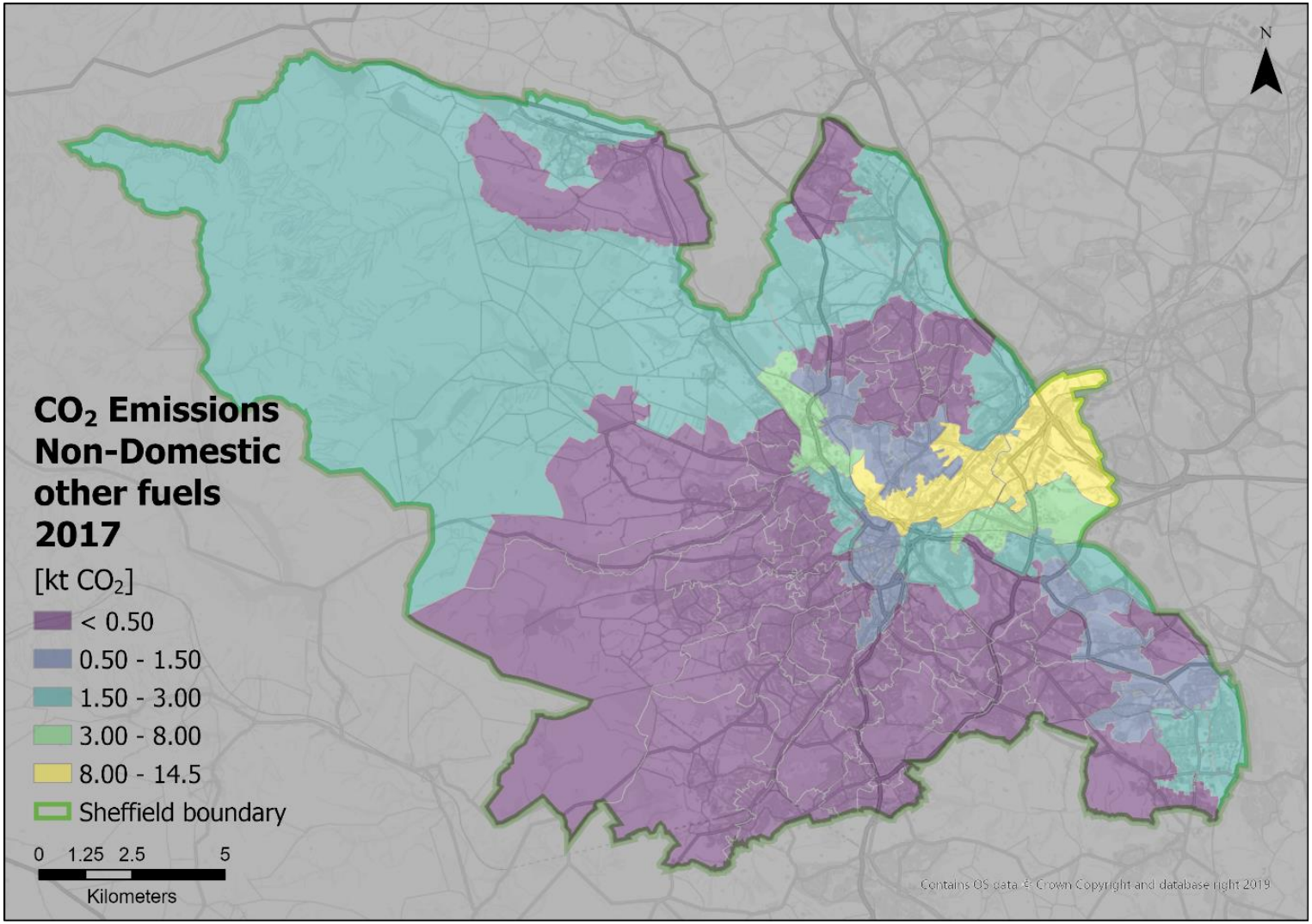

Nottingham LA CO2 (kt)
2500
2000
1500
1000
500
0
-500
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
K. Road Transport (Minor roads)
I. Road Transport (A roads)
G. Domestic Gas
F. Domestic Electricity
B. Industry and Commercial Gas
A. Industry and Commercial Electricity
N. LULUCF Net Emissions
M. Transport Other
L. Diesel Railways
K. Road Transport (Minor roads)
J. Road Transport (Motorways)
I. Road Transport (A roads)
H. Domestic 'Other Fuels'
G. Domestic Gas
F. Domestic Electricity
E. Agriculture
D. Industrial and Commercial Other Fuels
C. Large Industrial Installations
B. Industry and Commercial Gas
A. Industry and Commercial Electricity

A2 Detailed Large Industrial Installations' CO_2 emissions in 2017

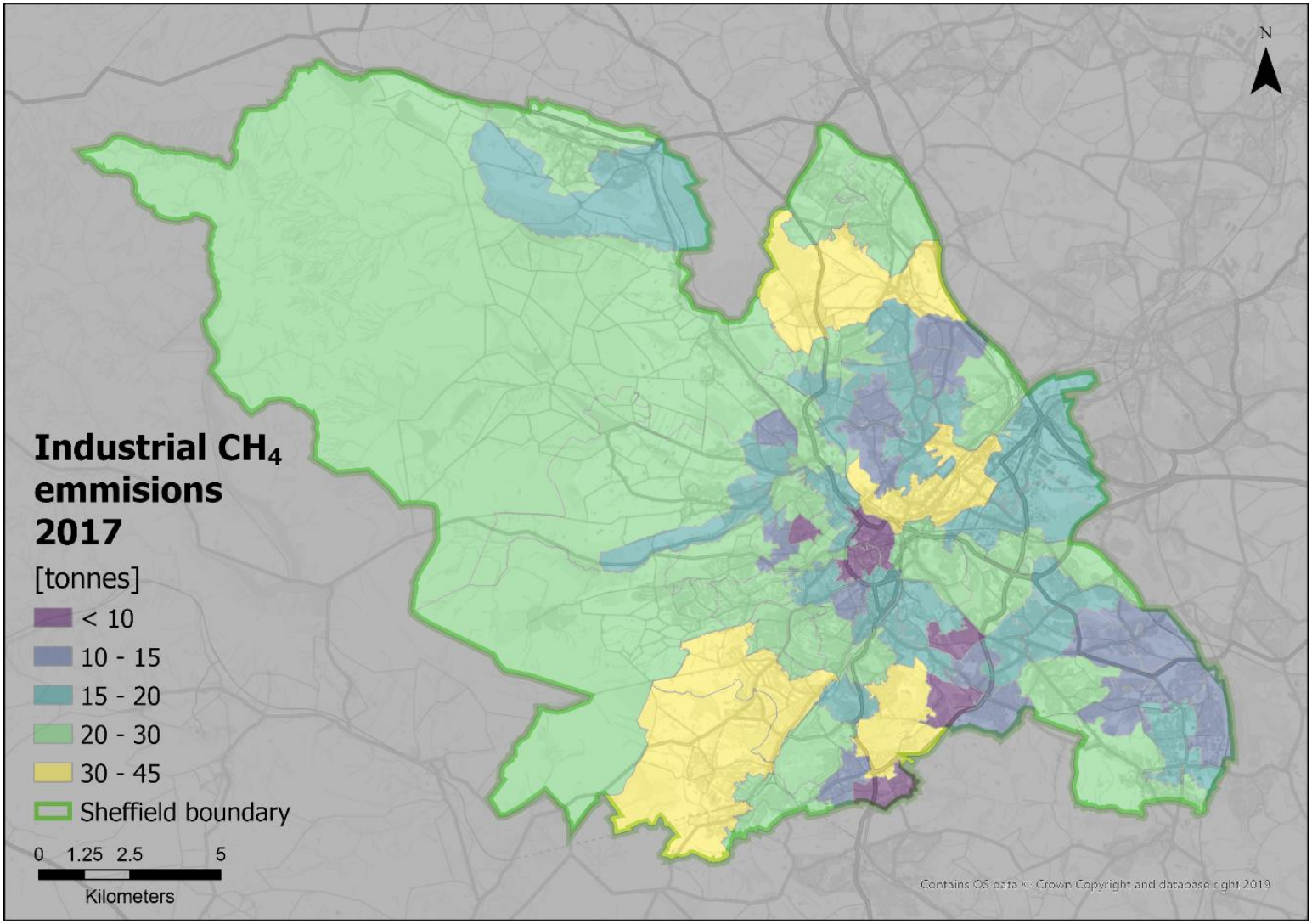
PlantID	Operator	Kt CO_2	OS_GRE	OS_GRN
4384	Georgia Pacific GB Ltd		430200	394050
4390	Outokumpu Stainless Ltd		439500	389800
4408	Sheffield Forgemasters Engineering Ltd		437960	388810
8147	Cadbury Trebor Bassett		433900	390100
8420	Sheffield Forgemasters Engineering Ltd	1.916124	438200	390100
8610	Corus UK Ltd		427000	398700
8714	Outokumpu Stainless Ltd	26.15547	440400	389180
8762	Sheffield Teaching Hospitals NHS Trust	0.035166	436500	390300
8763	Sheffield Teaching Hospitals NHS Trust	0.193482	433800	386900
9627	Veolia ES Sheffield Ltd	0.103752	434820	387420
9628	Veolia ES Sheffield Ltd	0.006292	436770	387900
11963	Cadbury UK Ltd		433855	389434
13070	Kraft Foods UK Ltd	0.000622	433900	390100
13691	ATI Allvac Ltd		436800	388600
13699	Sheffield Forgemasters Engineering Ltd	0.03671	438634	389821
13708	Polestar UK Print Ltd		439900	389700
13756	Tata Steel UK Ltd		427246	398529
14199	Eon Climate and Renewables UK Biomass Ltd	0.710239	439551	391549
8610	Corus UK Ltd		427000	398700
13756	Tata Steel UK Ltd		427246	398529
763	Corus UK Ltd		427240	398510

A3 Industrial and commercial – MSOA maps

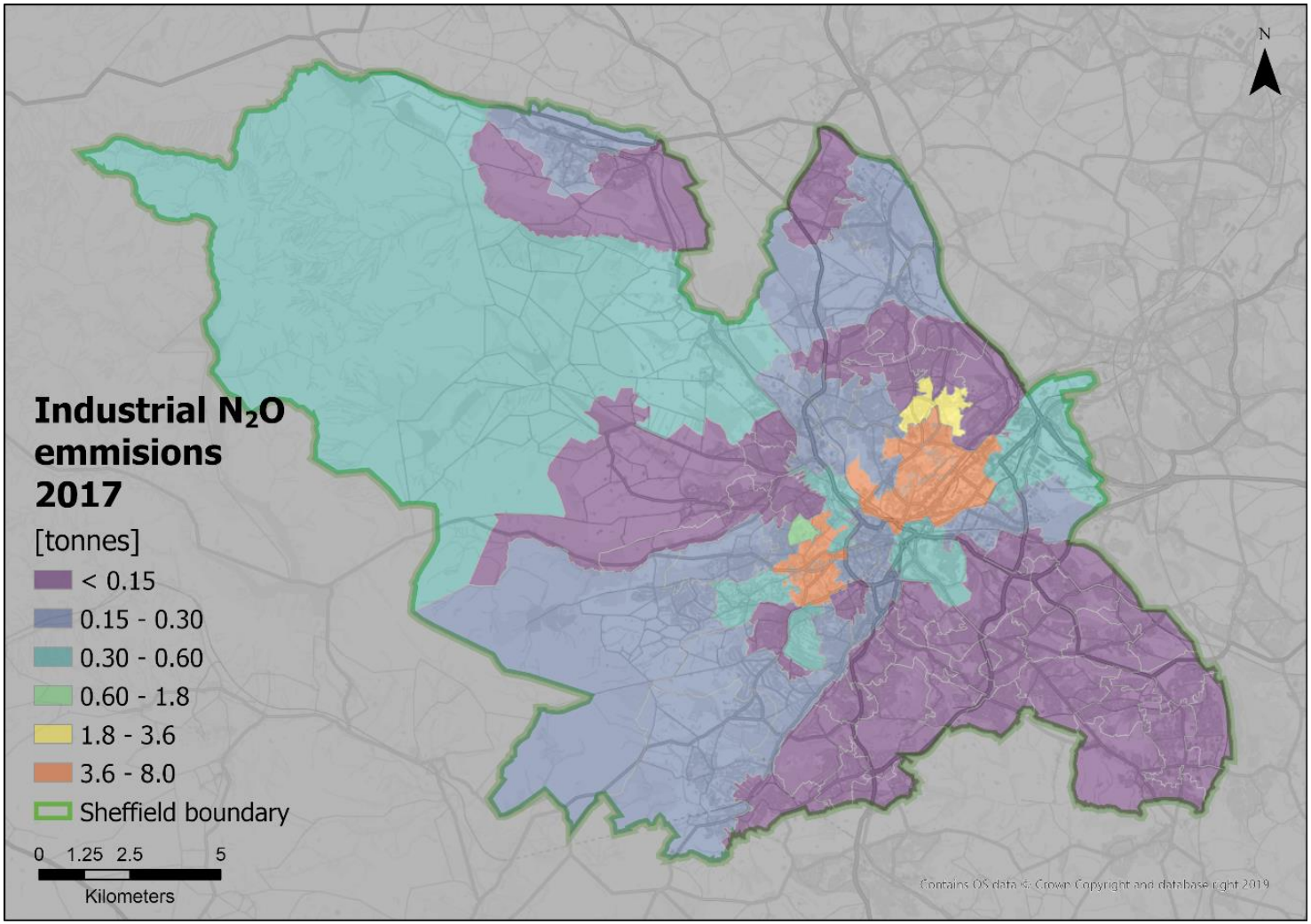
A3.1 CO_2 emissions from industrial and commercial 'other fuels' in Sheffield at MSOA level



A3.2 Methane emissions from industrial and commercial at MSOA level in Sheffield.

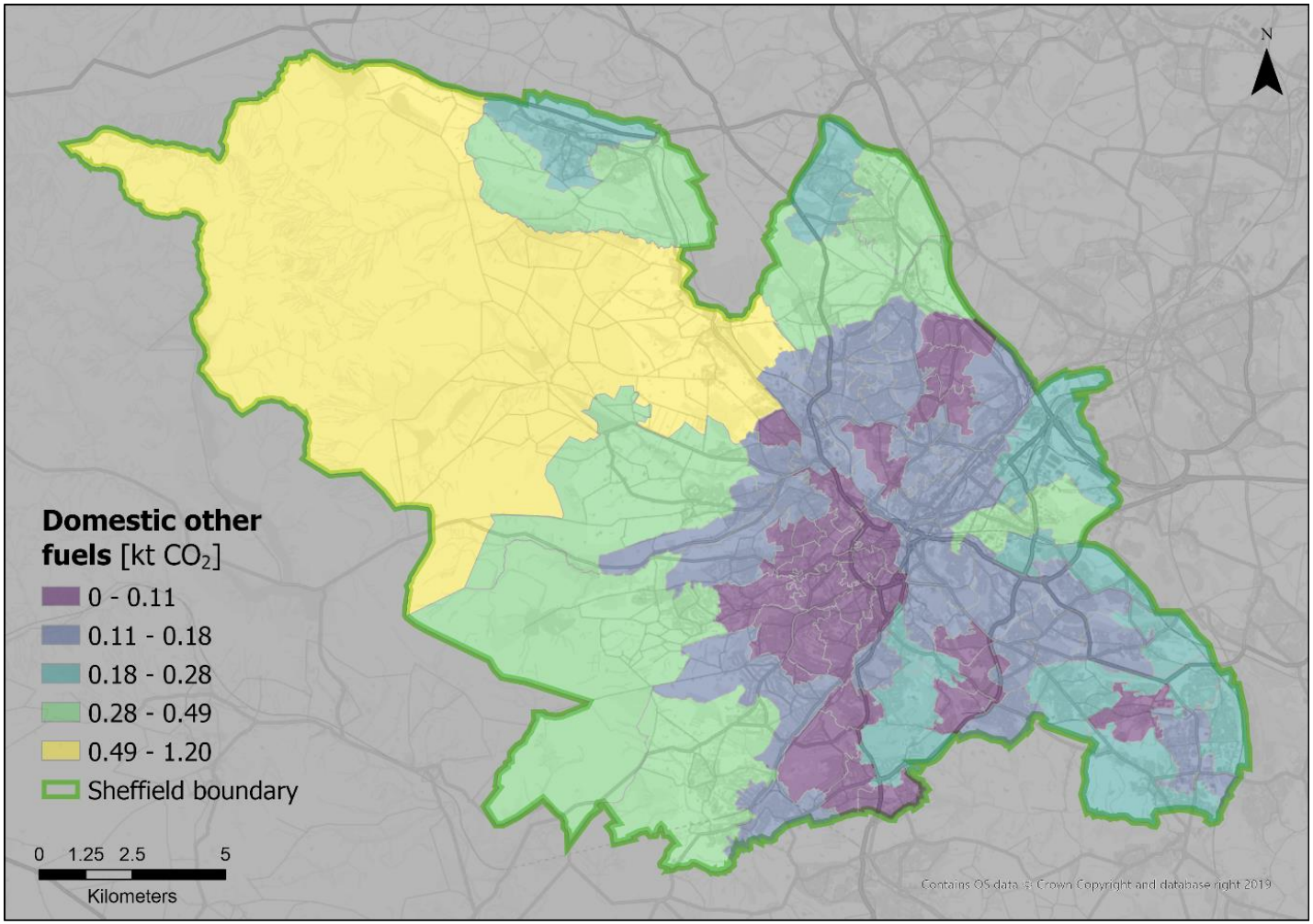


A3.3 Nitrous oxide emissions from industrial and commercial at MSOA level in Sheffield.

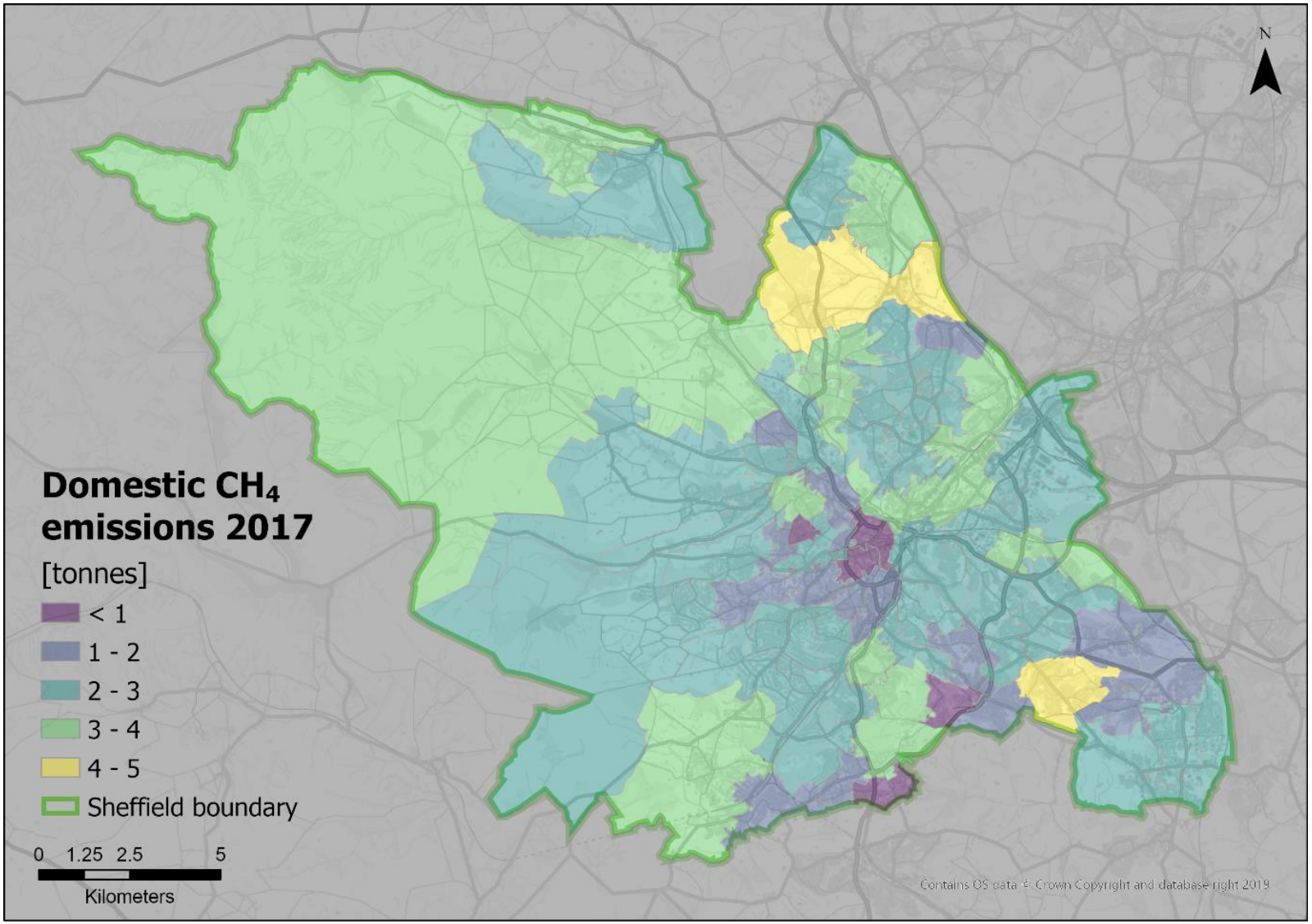


A4 Domestic emissions – MSOA maps

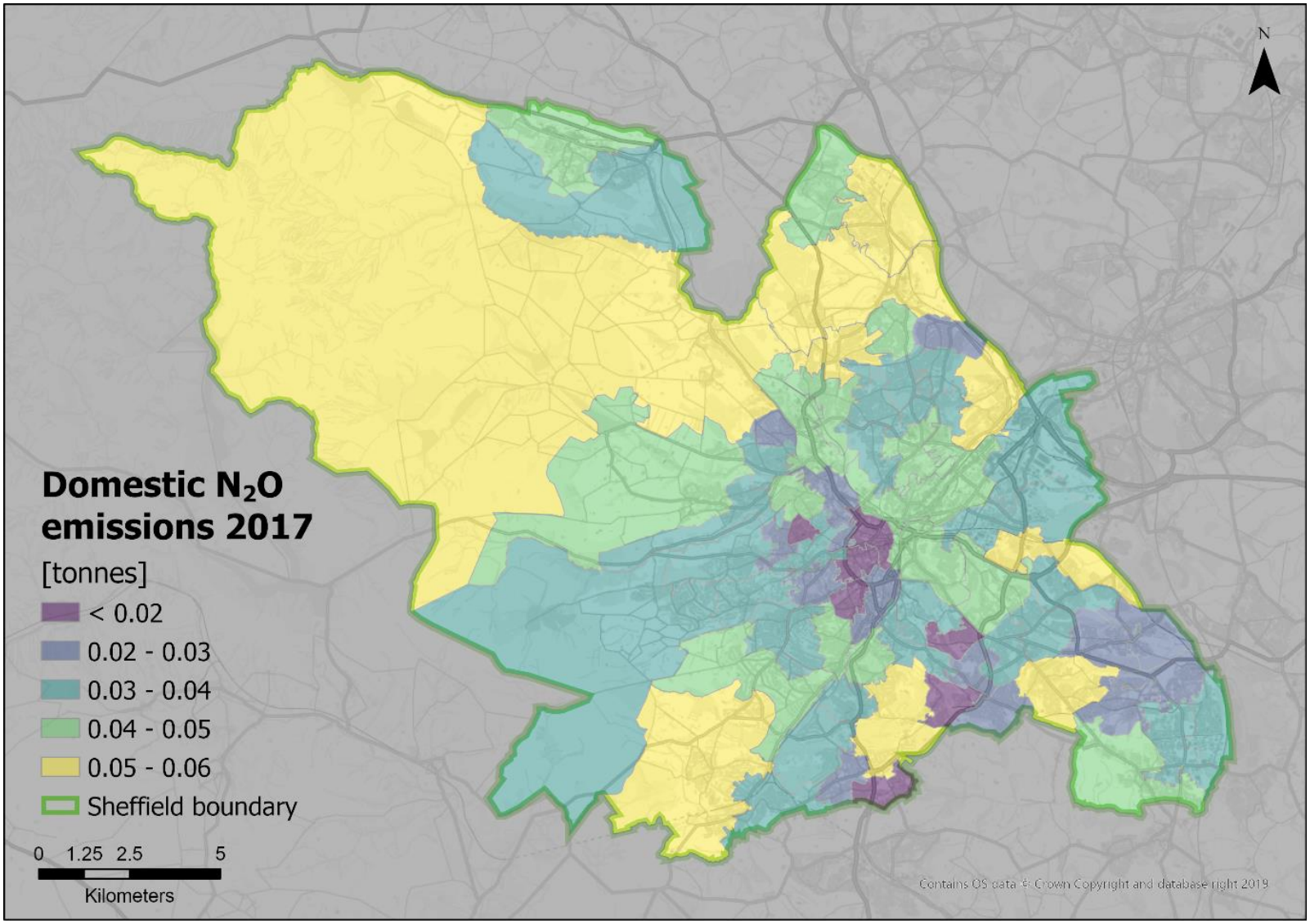
A4.1 CO_2 emissions from domestic 'other fuels' at MSOA level in Sheffield



A4.2 Methane emissions from residential at MSOA level in Sheffield

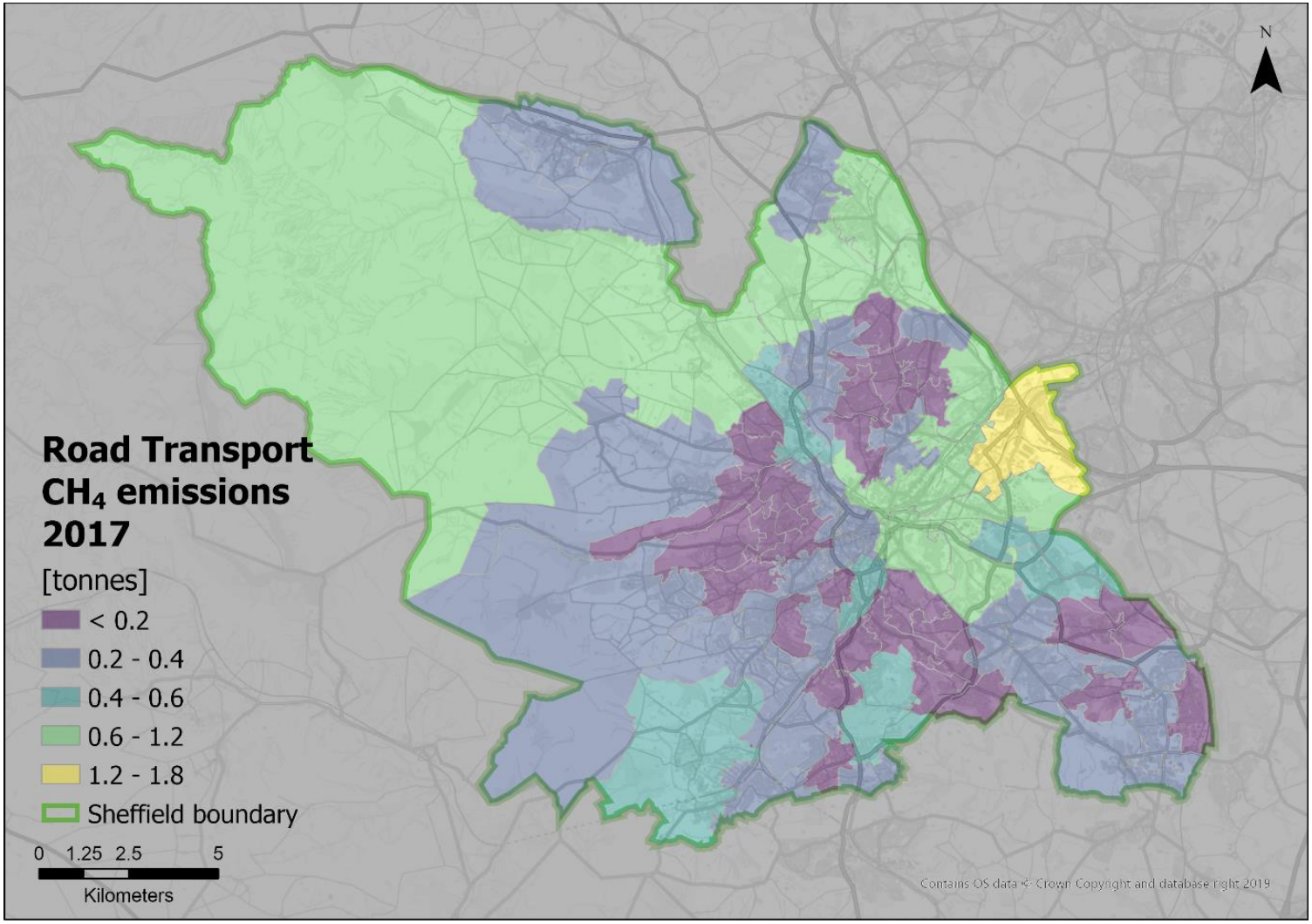


A4.3 Nitrous oxide emissions from residential at MSOA level in Sheffield

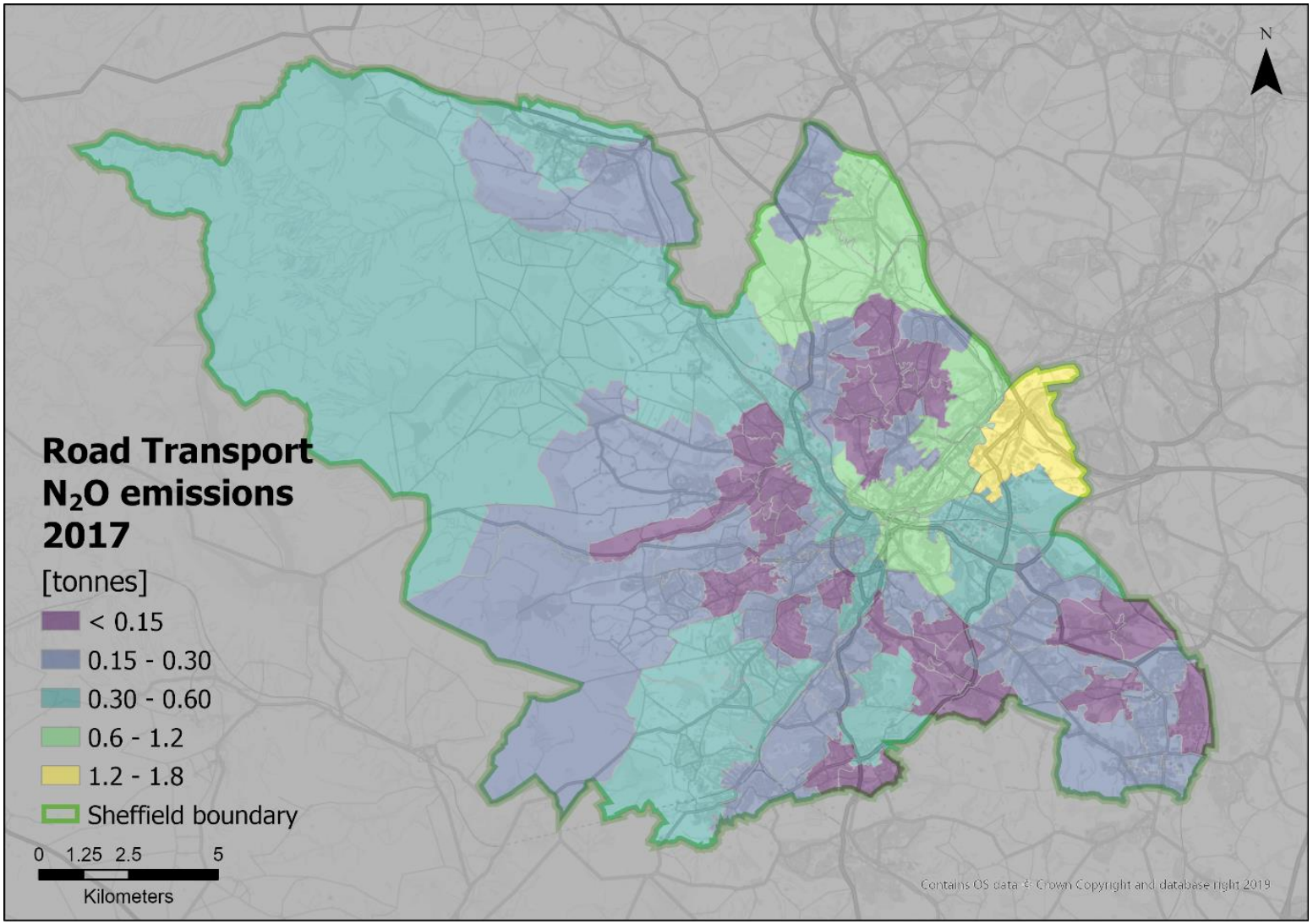


A5 Road transport emissions – MSOA maps

A5.1 Methane emissions from transport at MSOA level in Sheffield

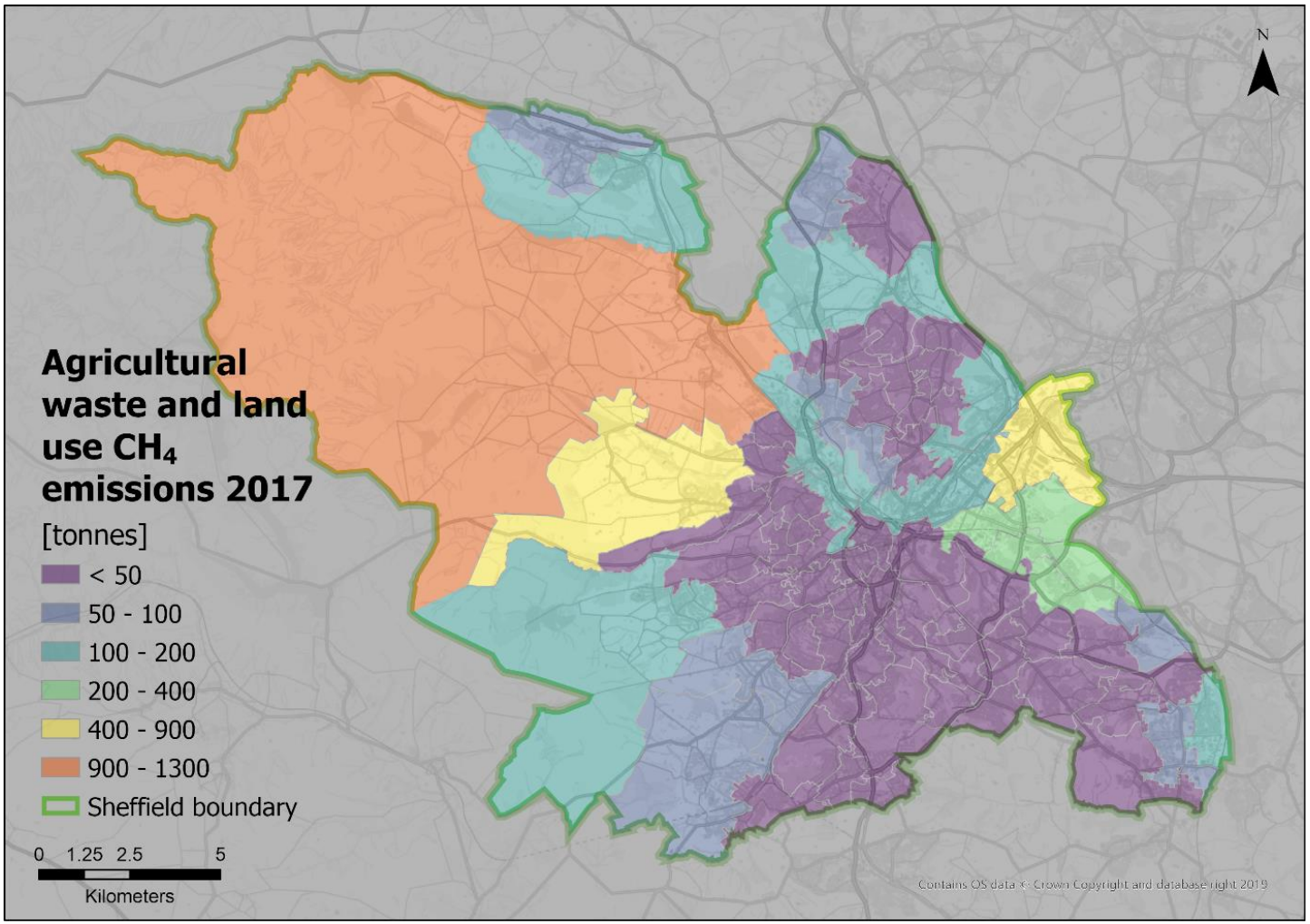


A5.2 Nitrous oxide emissions from transport at MSOA level in Sheffield

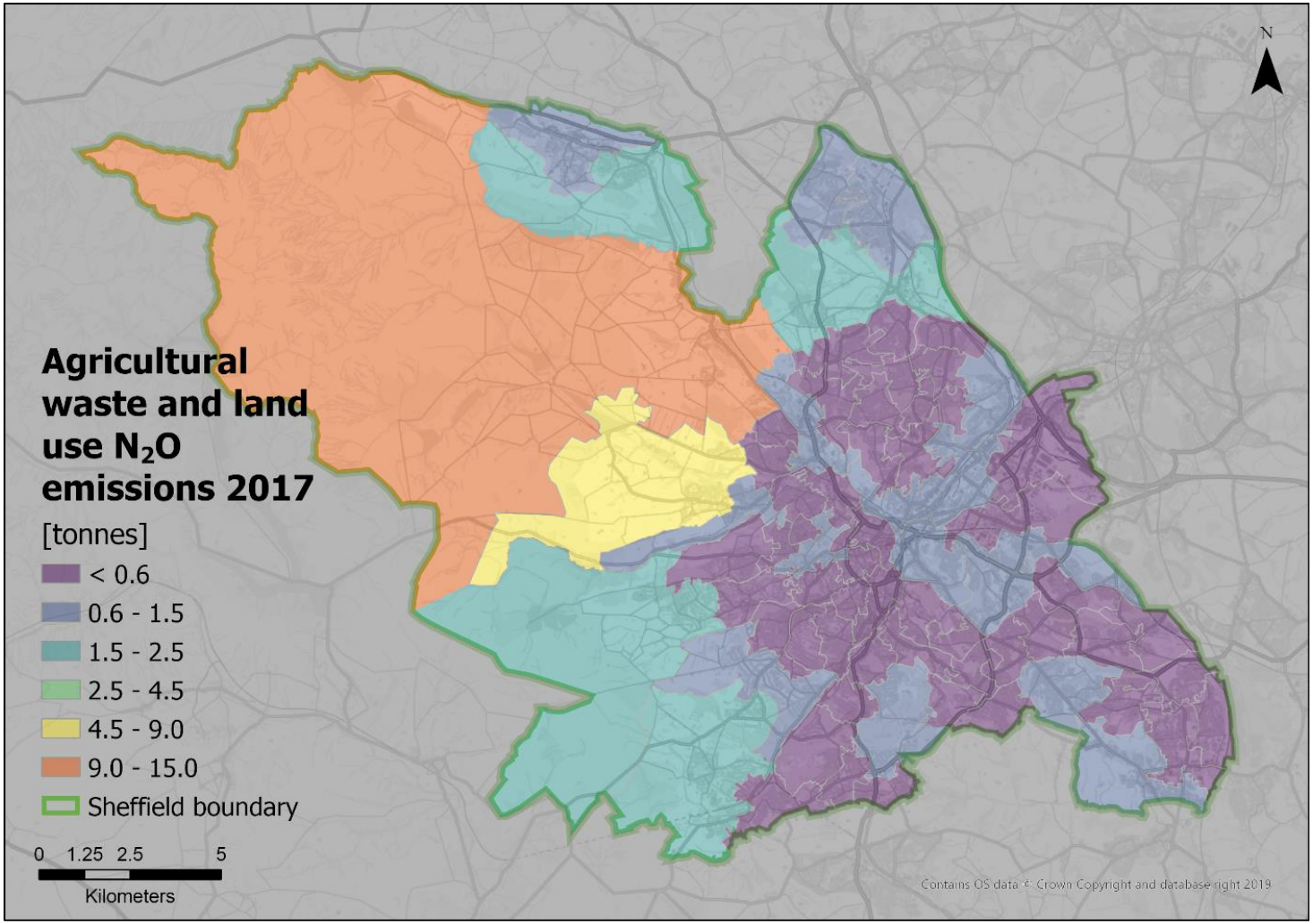


A6 Agriculture, waste and land use emissions – MSOA maps

A6.1 Methane emissions from Agriculture, waste and land use emissions at MSOA level in Sheffield



A6.2 Nitrous oxide emissions from Agriculture, waste and land use emissions at MSOA level in Sheffield



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2030 Net Zero Carbon Sheffield
Business as usual projection

Scope of analysis

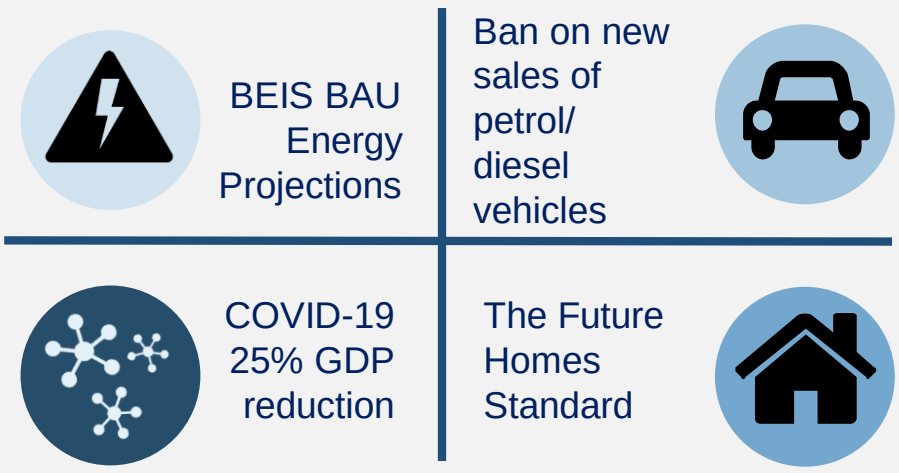
- Projection of WP1 baseline data forward to 2037 under a business as usual (BAU) scenario.
- Assess results against:
  1. Target set by Sheffield City Council for the city to become zero carbon by 2030.
  2. Carbon budgets for Sheffield proposed by the Tyndall Centre – Sheffield's 'appropriate share' of global efforts to reduce GHG emissions under the Paris Agreement.

'BAU' in this project is defined as a scenario where current and expected national and local policies, are implemented and projected into the future.

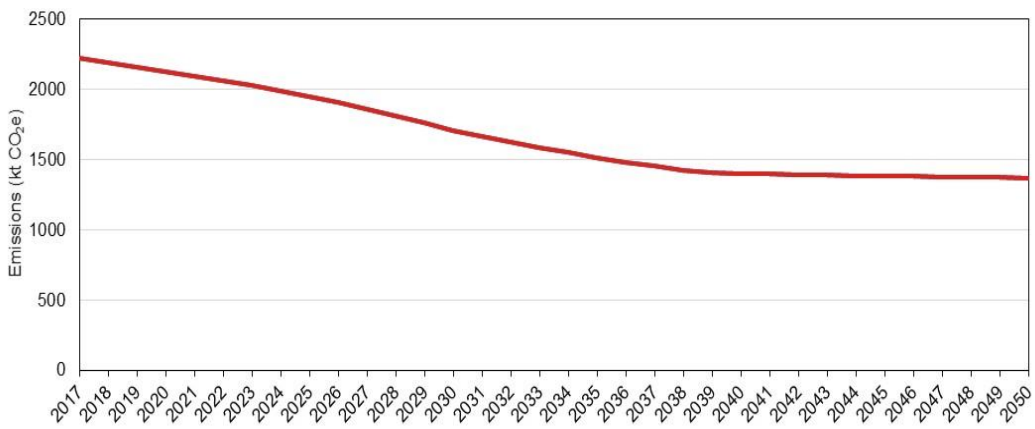
This follows guidance from the UN Framework Convention on Climate Change (UNFCCC) on BAU emissions scenarios.

Central BAU scenario

- Chosen as the scenario that best represents reality.
- Derived by combining the following scenarios:

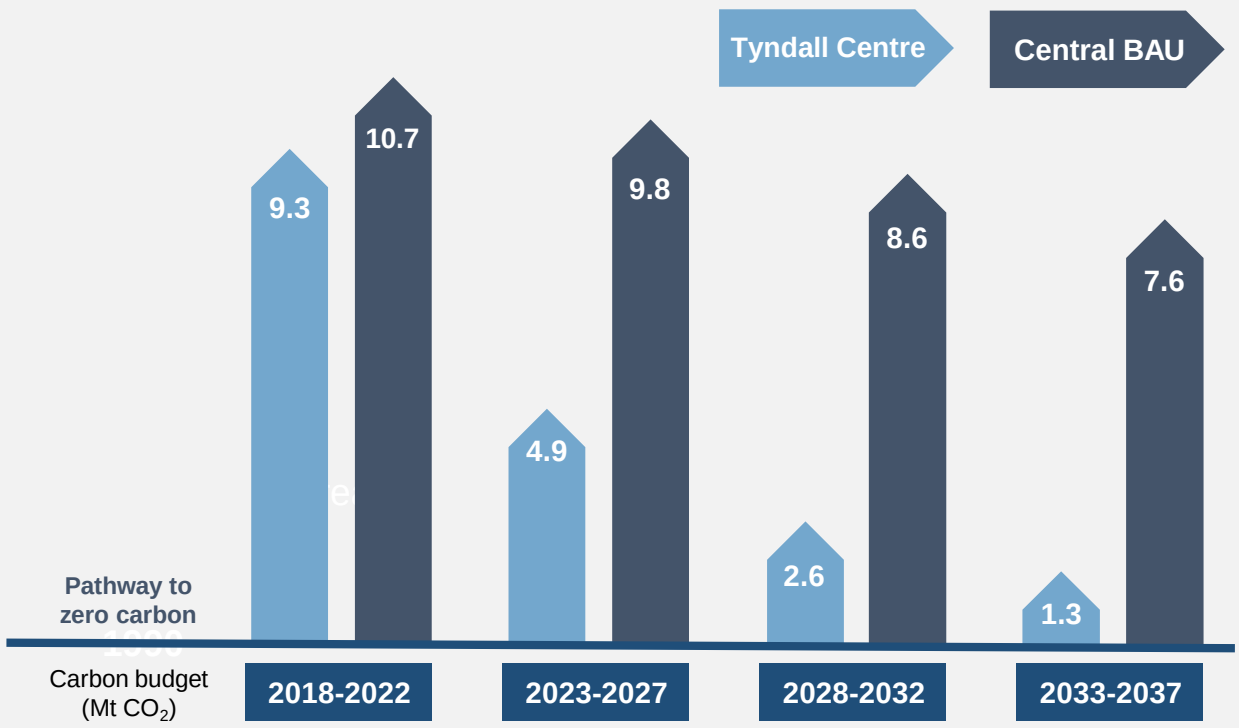


- 23.4% reduction in CO_2 emissions by 2030 (from 2017 levels)
- 34.7% reduction in CO_2 emissions by 2037.
- Tyndall Centre carbon budget for 2018-2027 used up by 2025.
- Net zero unattainable by 2050 under Central BAU scenario.



The 'emissions gap'

- The gap between actual emissions and the Tyndall Centre carbon budgets grows over time.
- At the end of the 2033-37 period, Sheffield will cumulatively be more than 18 Mt CO_2e over the carbon budget for 2018-37.
- To reach zero carbon emissions, CO_2 emissions need to reduce to 0.11 Mt CO_2e in 2030.
- Using the Central BAU scenario, CO_2 emissions in 2030 will be 1.6 Mt CO_2e higher than the zero carbon target.



SUMMARY

- Whilst expected forthcoming policy announcements from the UK Government will have an impact and help in reducing CO_2 emissions in Sheffield, it will still not be enough to ensure that Sheffield reaches net zero within a suitable time frame.

Information based on 2017 data (the latest year for which it is available).

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ARUP

Creating a world fit for the future

RICARDO

Business as usual Projections Report: Work Package 2

Report for Sheffield City Council

Customer:

Sheffield City Council

Customer reference:

Zero Carbon Commission: DN461793

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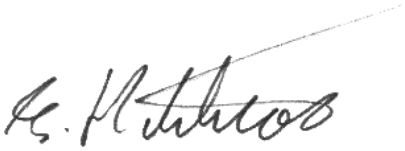

Date:

14th August 2020

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Glossary

Abbreviation/phrase	Definition
BAU	Business as usual
CH_4	Methane
CO_2	Carbon dioxide
FHS	Future homes standard
N_2O	Nitrous oxide
Net zero	Defined as a 95% reduction in net carbon dioxide emissions by 2030
NZP	Net zero projections tool developed by Ricardo Energy & Environment
SCATTER	Setting City Area Targets and Trajectories for Emissions Reduction

1 Introduction and scope of analysis

Sheffield City Council has set a target for the city to be zero carbon by 2030. In addition, in their report of June 2019, the Tyndall Centre recommended that the city should stay within a cumulative CO_2 emissions budget of 16 Mt CO_2 for the period of 2020 to 2100, which would mean achieving near zero carbon emissions by no later than 2038. The City Council has commissioned ARUP and Ricardo to support them in developing a plan to achieve this net zero goal. The work being carried out falls into 4 work packages:

- WP1 Baseline inventory – developing a detailed understanding of current carbon and GHG emissions;
- WP2 Gap Analysis – projecting this baseline inventory forward under business as usual to assess the scale of the challenge required to meet net zero emissions;
- WP3:
    - WP3.1 City level mitigation pathway – developing a set of mitigation options at the city level that can achieve the net zero goal;
    - WP3.2 Council estate mitigation pathway – developing a set of detailed mitigation actions for the councils own buildings and fleet;
- WP4 Governance arrangements – will develop the governance approach to support delivery of the net zero pathway.

This report sets out the results of WP2 where the baseline CO_2 emissions inventory provided in WP1 is projected to 2037 under 'business as usual' (BAU) conditions.

1.1 Scope of analysis

The purpose of WP2 was to take the baseline inventory data for Sheffield from WP1 and project this forward to 2037 under a business as usual (BAU) scenario. BAU is defined as a continuation of existing trends and policies and is therefore used to inform what is likely to happen to future emissions if those trends and policies were to continue. Doing this can then allow for an assessment of the size of the gap to any emissions targets, and is the starting point to then consider what would need to be done to meet those targets.

'BAU' in this report is defined as a scenario where current and expected UK Government policies, including all expired, implemented, adopted and planned policies are implemented and projected into the future for existing fuels and sectors based on demand growth and energy efficiency improvements. This follows guidance from the UN Framework Convention on Climate Change (UNFCCC) on BAU emissions scenarios.

As mentioned briefly in Section 1 above, when carrying out this gap analysis there are two targets against which emissions should be assessed – the 2030 target set by Sheffield City Council for the city to become zero carbon, and the emissions pathway proposed by the Tyndall Centre from an analysis of Sheffield's 'appropriate share' of global efforts to reduce GHG emissions under the Paris Agreement. We now look at each of these in turn.

1.1.1 Sheffield's zero carbon target

In 2019, Sheffield City Council declared a climate emergency and stated its intention to work towards Sheffield becoming a zero-carbon city by the end of this decade, and playing its full part in the Paris Agreement[1].

There are different ways to define carbon targets, for example:

[1] Agreed in 2015, the Paris Agreement has been signed up to by 195 countries and sets a target of limiting global temperature rises to below 2 degrees centigrade above pre-industrial levels, and aiming for 1.5 degrees. The Paris Agreement can be found here - https://unfccc.int/resource/docs/2015/cop21/eng/10a01.pdf

- Whether the target is absolute zero emissions or net zero emissions (accounting for offsets).
- Whether the target (absolute or net) needs to be zero or near zero, as many analyses assume it will not be possible to get to complete zero.
- Whether the target relates just to carbon dioxide or all GHGs.

It was agreed with the client that for the purposes of this analysis, Sheffield's zero carbon ambition would be defined as follows – net zero carbon dioxide, defined as a 95% reduction in net emissions. This follows the approach used by the Tyndall Centre in their analysis (see below), where they only considered energy-related CO_2 emissions (and not other GHGs such as CH_4 or N_2O) and used the 95% definition. This approach makes sense as CO_2 is the dominant GHG, as shown clearly in the WP1 analysis (see Section 1.2) but at the same time it recognises the inherent challenge in reducing net CO_2 emissions to zero in such a short timescale, and the likelihood that, as noted by the Tyndall Centre, the CO_2 emissions reduction pathway is likely to fall rapidly in initial years but then more slowly in later years to reach a plateau.

1.1.2 Tyndall Centre carbon budget

The Tyndall Centre has carried out analysis that takes the Paris Agreement temperature goals outlined above, turns them into a global carbon budget, allocates that global budget between countries and then allocates the UK's share between local authorities. This therefore shows what each local authority should do in terms of reducing CO_2 emissions to be giving their fair contribution under the Paris Agreement.

The Tyndall Centre carried out this analysis in 2019, and proposed a 16 Mt CO_2 carbon budget for the period 2020-2100. This equated to meeting near zero CO_2 emissions (defined as a 95% reduction) by 2038. This analysis was subsequently updated more recently, with some changes to the assumptions used to calculate the carbon budgets, and this resulted in revised figures – a 15.2 Mt CO_2 for the period 2020-2100, or 19.6 Mt CO_2 for the period 2018-2100 (i.e. adding in emissions from 2018 and 2019) (Table 1). This equated to meeting near zero carbon emissions by 2043. The full report can be found at the Tyndall Centre website[2].

Table 1 Tyndall Centre recommended carbon budgets for Sheffield

Carbon budget period	Recommended carbon budget (Mt CO_2)
2018-2022	9.3
2023-2027	4.9
2028-2032	2.6
2033-2037	1.3
2038-2042	0.7
2043-2047	0.4
2048-2100	0.4

Hence the BAU pathway that would be produced in WP2 would be compared both against the 2030 target and the updated Tyndall Centre carbon budget of 19.6 Mt CO_2 from 2020-2100.

[2] https://carbonbudget.manchester.ac.uk/reports/E08000019/print/

1.2 WP1 summary – baseline inventory data

The starting point for the BAU analysis in WP2 was the emissions data produced in WP1. WP1 provides a 2005-2017 baseline inventory for Sheffield City Council, where local and regional carbon dioxide (CO_2) emissions estimates for the UK (LA CO_2)[3] were spatially disaggregated for:

- Industrial and Commercial Gas, Electricity and 'Other fuels[4]'
- Large Industrial Installations[5]
- Domestic Gas, Electricity and 'Other fuels[4]'
- Road Transport (A roads, motorways, minor roads)
- Agriculture, Waste and Land Use

Industry and commercial emissions comprise 35% of Sheffield's emissions, and domestic emissions 33%. These sectors have the largest proportion of emissions and are almost entirely CO_2. Transport is the 3rd largest sector at 26% of emissions and again almost entirely CO_2 (Figure 1). The remainder are from agricultural, waste and land-use, which form most of the non-CO_2 GHG emissions. All sectors have seen declining emissions with the industrial and commercial sector reducing the most followed by the domestic sector. The transport sector has seen the least reduction at only ~17% since 2005. WP1 shows that 90% of total GHG emissions in Sheffield are CO_2 hence the focus for WP2 (Figure 1).

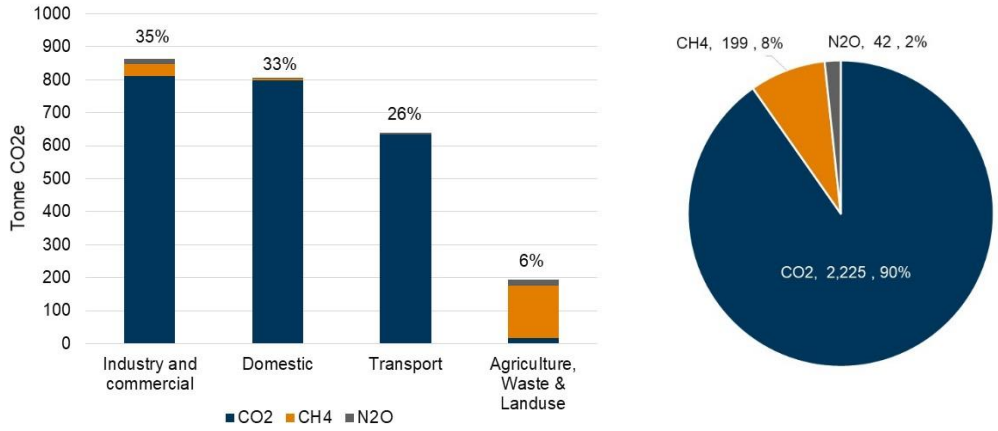

Figure 1: Breakdown of greenhouse gas breakdown by sector (kt CO_2e) and by gas in Sheffield for 2017

[3] Produced by Ricardo Energy & Environment for the Department of Business, Energy & Industrial Strategy (BEIS).

[4] 'Other fuels': equates to petroleum, coal and manufactured solid fuels.

[5] Pulp, paper and print combustion, electric arc furnaces, food, drink and tobacco combustion, iron and steel combustion plant, public sector combustion, other industrial combustion, non-ferrous metal combustion and industrial urea use.

When focusing on CO_2 only, total emissions in Sheffield have dropped by 42% between 2005 and 2017. On a sector level, this breaks down to a 55% reduction in industrial and commercial CO_2 emissions, a 37% reduction in domestic CO_2 emissions and a 13% reduction in CO_2 emissions from transport (Figure 2).

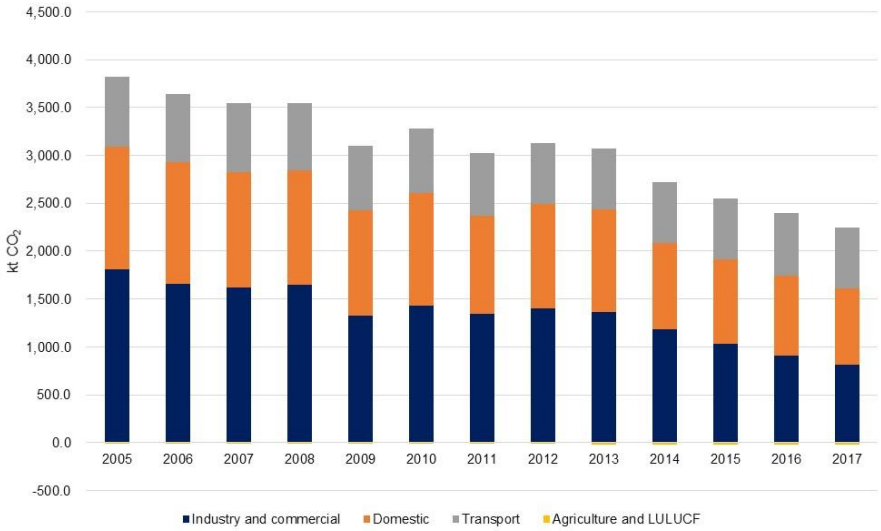

Figure 2: Time series of CO_2 emissions by sector in Sheffield (kt CO_2)[6]

[6] Note that LULUCF is a net sink in most years, so appears below the x-axis.

2 Methodology

2.1 Base year extrapolation

Since the delivery of Work Package 1, an update of the BEIS Local Authority (LA) CO_2 emissions was published, which provides CO_2 emissions for each LA from 2005 to 2018. To understand a simplified projection of Sheffield's CO_2 emissions, this dataset for Sheffield was extrapolated from 2005-2018 into the future to see when Sheffield might reach net zero emissions (Figure 3). This illustrated that Sheffield has already made good progress, but this progress is variable between sectors.

When analysing emissions projections for each sector, it becomes clear that emissions from Transport have shown the lowest rate of decline since 2005 and might therefore take longest to reach zero carbon. In fact in this extrapolation exercise, Transport emissions did not reach net zero until around 2095 (Figure 4). Industry and commercial emissions have shown the greatest rate of decline since 2005, and reach net zero by 2030 when extrapolated. However, this takes into account past trends, for example reductions in gas and electricity consumption, the economic recession, and closures in large industrial installations which would not be applicable to future trends in emissions (Turtle et al., 2020).

These extrapolations are based only on historical trends rather than future policies and assumptions, hence are not realistic BAU pathways. The emissions reductions seen so far are likely to have come from measures which could be considered 'low hanging fruit' – easier and cheaper measures, including ones that save money. Looking ahead, more challenging and costly measures will likely be needed, meaning we would not necessarily expect the same level of emissions reductions without further policy intervention. Furthermore, the emissions reductions realised so far will have come predominantly from decarbonisation of the electricity grid. While likely to continue, the relative gains from this are likely to fall and there will be a need to focus on other measures focused on decarbonisation of heat and transport.

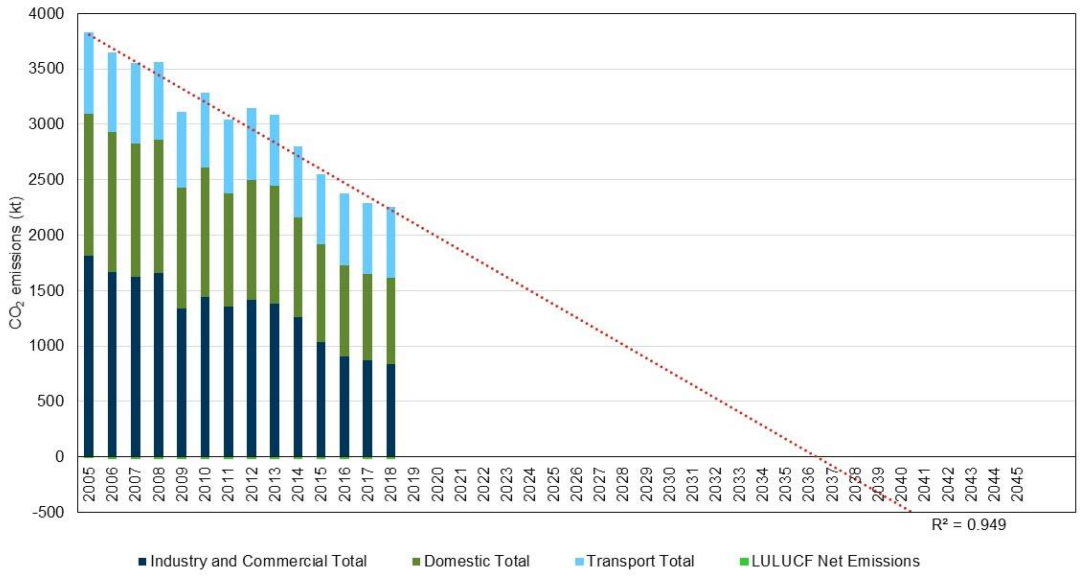

Figure 3: Extrapolation of the BEIS LA CO_2 2005-2018 dataset

Therefore, a more complex model was developed and used to project a more accurate BAU emissions pathway.

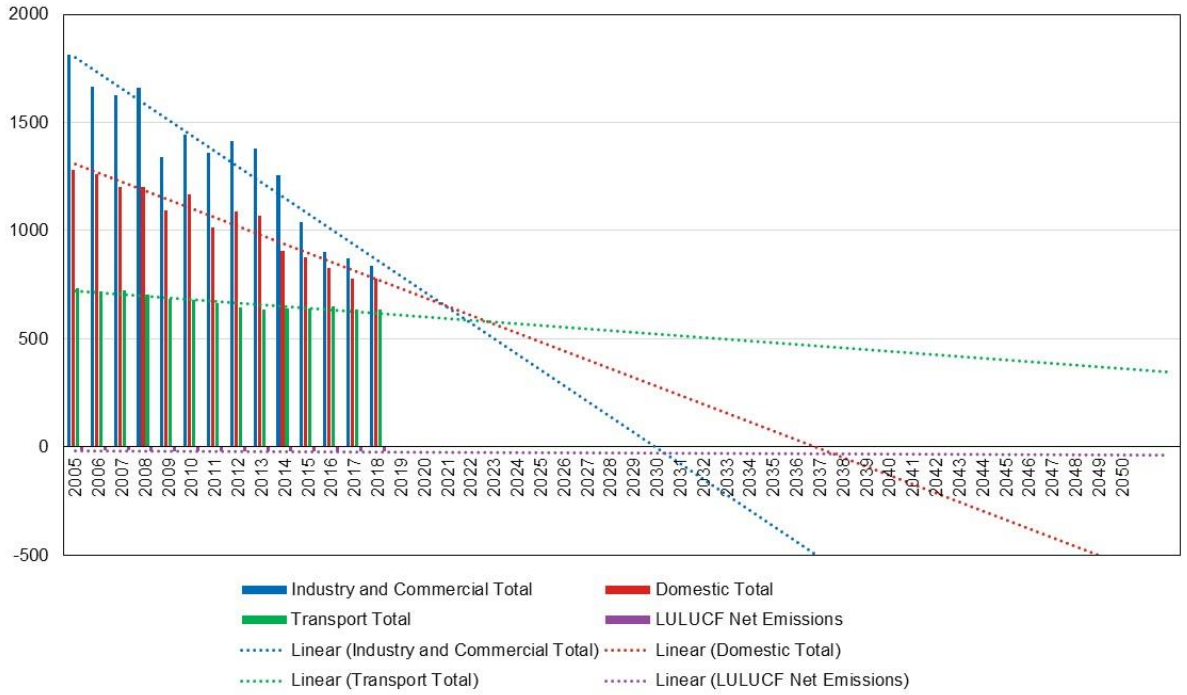

Figure 4: Extrapolation of the BEIS LA CO_2 2005-2018 dataset by sector

2.2 Defining a BAU scenario

To develop a BAU scenario, we used Ricardo's Net Zero Projection (NZP) tool (see Section 2.3 below). We aimed to do this by taking a two-step approach – first reviewing national-level emissions projections that take account of existing trends and policies, such as those from the Department of Business, Energy & Industrial Strategy (BEIS), the Department for Transport (DfT) and the Committee on Climate Change and then adding in the potential impact of local CO_2 reduction programmes and policies (Figure 5).

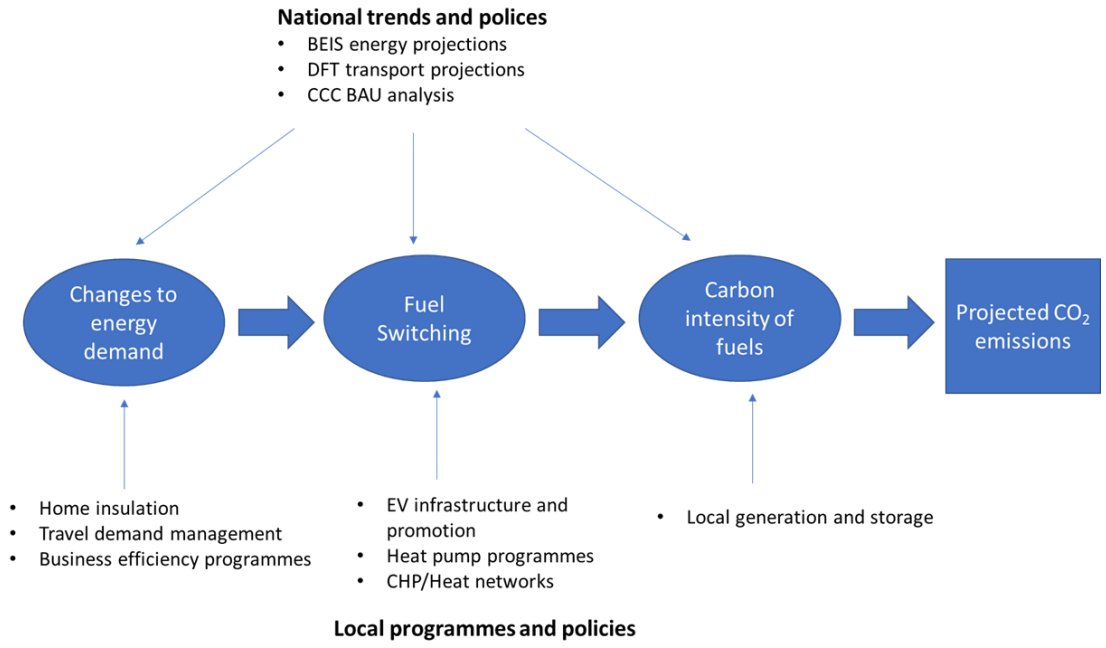

Figure 5: Process for developing projected CO_2 emissions in Sheffield

At the national level, Energy and emissions projections from the Department for Business, Energy & Industrial Strategy (BEIS) and Transport Projections from the Department for Transport (DfT) were used. These data sets provide a central reference case scenario for emissions based on projections of future demand for energy, and traffic respectively by year. The central reference case scenario for the BEIS energy projections is the main projection under current and expected UK Government policies, including all expired, implemented, adopted and planned policies. The emissions estimates are based on future energy demand by year, economic sector and fuel for electricity, natural gas, petroleum products and solid and manufacture fuels (e.g. coal) (BEIS 2019). Similarly, the DfT reference scenario uses central projections of GDP, fuel price and population and assumes that the number and type of trips per capita remains constant over time (DfT 2018).

By applying these reference scenarios to Sheffield's baseline inventory, we can see how CO_2 emissions will react to a BAU scenario, and the different sectors that Sheffield will have to focus on in the coming years to decrease emissions and reach their zero carbon target by 2030. The benefit of taking this approach, and using the BEIS projections of energy demand, is that these projections already take account of existing policies (see Section 2.4 for details on the policies that are included).

2.3 Ricardo Net Zero Projection (NZP) tool

The Net Zero Projection (NZP) tool enables users to model the impact of implementing mitigation measures on CO_2 emissions over time. The tool is designed to enable the development of scenarios for reaching net zero by a given target year, in this case 2037. The tool allows the user to project CO_2 emissions forward for existing fuels and sectors based on assumptions on demand growth and energy efficiency improvements (both %/yr), as well as a consideration of options for fuel switching, for example switching from petrol/diesel cars to electric vehicles, or from gas boilers in buildings to heat pumps.

A BAU scenario was used as a base line projection, and allows the assessment of the likely impact of planned measures. In addition, scenarios were also used to undertake sensitivity testing around the impact of changes in assumptions (see Section 3).

2.4 Assumptions

Having entered the forecasts of changes to energy consumption from BEIS into the NZP tool, we then checked what assumptions sit behind the BEIS forecasts and compared these to the equivalent values for Sheffield. If the values were significantly different, we would then consider making adjustments to the BAU scenario to account for this.

The main assumptions are outlined in Table 2 below.

Table 2 Model inputs to produce a BAU scenario for Sheffield

Assumption	UK-wide growth factor (BEIS)	Sheffield-specific growth factor
GDP growth	2.10 % pa	2.2 % pa
Households	0.85 % pa	0.50 % pa
Uptake of electric vehicles	25% of car and van mileage zero emissions by 2050	Not available
Traffic growth by 2035	1.01 %	0.97 %

It was felt that the values were sufficiently similar to not require a further adjustment to Sheffield's BAU scenario. A few points should be noted, as data was not available in all cases at the Sheffield level:

- For GDP we were not able to find any forecasts for Sheffield. However we used historical data for the South Yorkshire region (available on BEIS website) and used the data from recent years (2012-18) to derive the 2.2% a year value.
- Traffic growth forecasts were used for the Yorks and Humber rather than Sheffield, as provided by DfT (2018).

In terms of policies, the BEIS projections of energy consumption already take account of existing policy measures, as at April 2019 (when the latest forecasts were published). For example they take account of the Renewable Heat Incentive and Buildings Regulations Part L for the domestic, commercial and industry sectors, and for car, van and truck fuel efficiency policies in the transport sector. For a full list of the policies that are included in the BEIS projections, see Appendix A1. As outlined in Section 3 below, to this we added any further policies that have been developed or implemented since the publication of the last BEIS energy and emissions projections.

We then reviewed policies that are specific to Sheffield, to consider whether any of these will have an impact on emissions in the BAU scenario above and beyond the impact of the national-level policies outlined in Appendix A1. The list of local policies that were considered are included in Appendix A2, along with a consideration of whether they would have additional impact. From this, we took the view that none of them are likely to reduce CO_2 emissions additionally to the assumptions already set out in the BEIS energy and emissions projections. The

3 Projections

3.1 Central Sheffield BAU scenario

Figure 6 presents the final outcome of WP2: a central BAU scenario for Sheffield. This was derived by combining inputs from the scenarios that follow in Sections 3.2 to 3.5. This includes:

- BAU scenario – incorporates existing UK policies, and energy and emissions projections from BEIS and transport projections from DfT.
- COVID-19 scenario – where GDP falls by 25% between February and April 2020 and then starts to recover.
- The Future Homes Standard.
- A ban on sales of new petrol and diesel cars and vans.

This results in a reduction in CO_2 emissions from 2017 levels of 23.4% reduction by 2030 and 34.7% by 2037. However, even with these significant reductions in emissions, the Tyndall Centre carbon budget for 2018-2027 would be used up by 2025 and Sheffield does not get close to reaching net zero even by 2050.

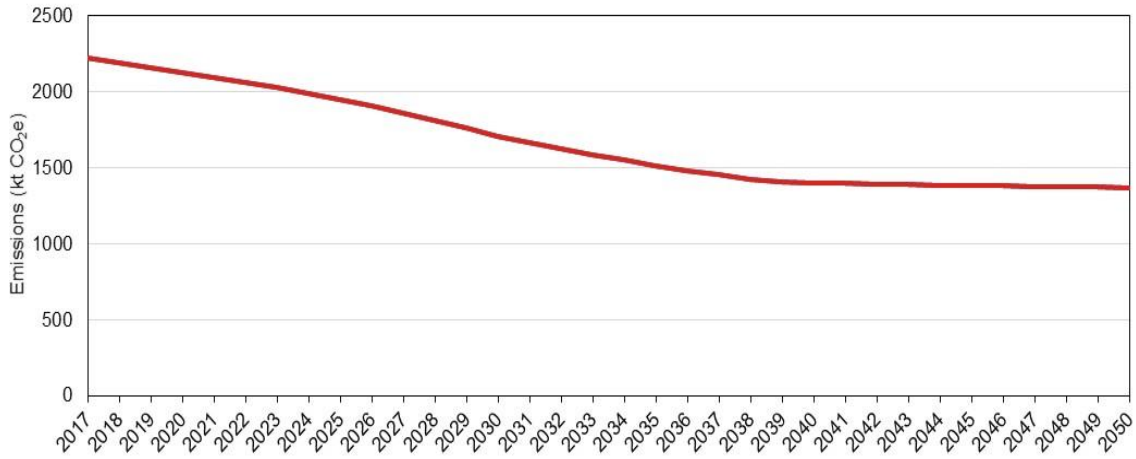

Figure 6 Total CO_2 emissions projection to 2050 for Sheffield under the central Sheffield BAU scenario

3.2 BAU scenario

This scenario was the first scenario developed using the NZP tool, and the scenario in which emissions decrease by the least by 2030 and 2037. Figure 7 illustrates the BAU scenario developed using the assumptions provided in Section 2.4 for all sectors. Here, CO_2 emissions decline by 16.9% by 2030, and 24.1% by 2037 and do not come close to net zero by 2050.

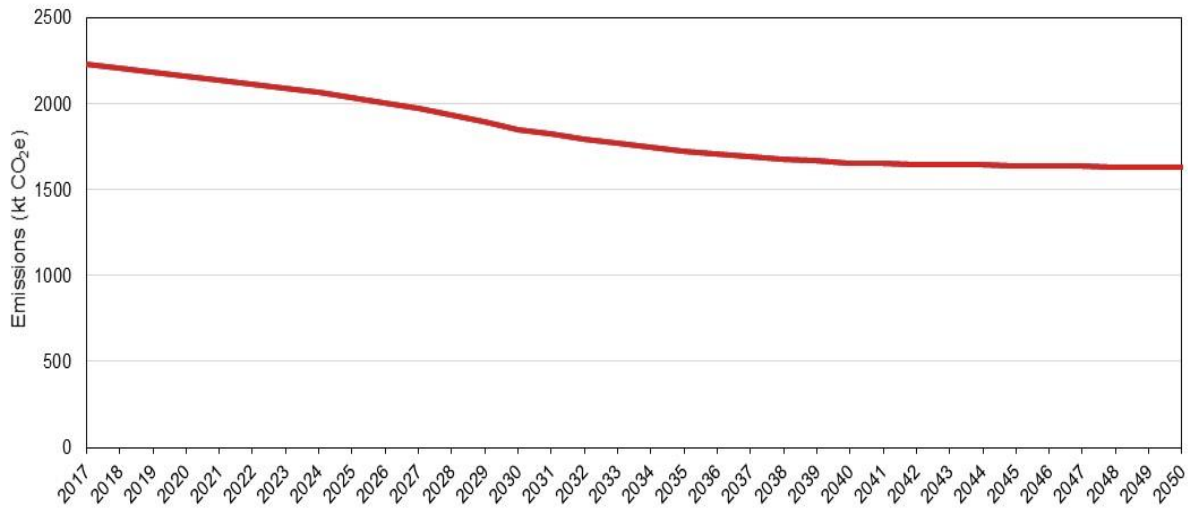

Figure 7 Total CO_2 emissions projection to 2050 for Sheffield under a BAU scenario

As a comparison, an equivalent BAU scenario for Sheffield was produced using the Setting City Area Targets and Trajectories for Emissions Reduction (SCATTER) tool[7] which shows a similar pathway to that from the NZP tool when level 1 is selected for all interventions, which is broadly equivalent to a BAU scenario (Figure 8).

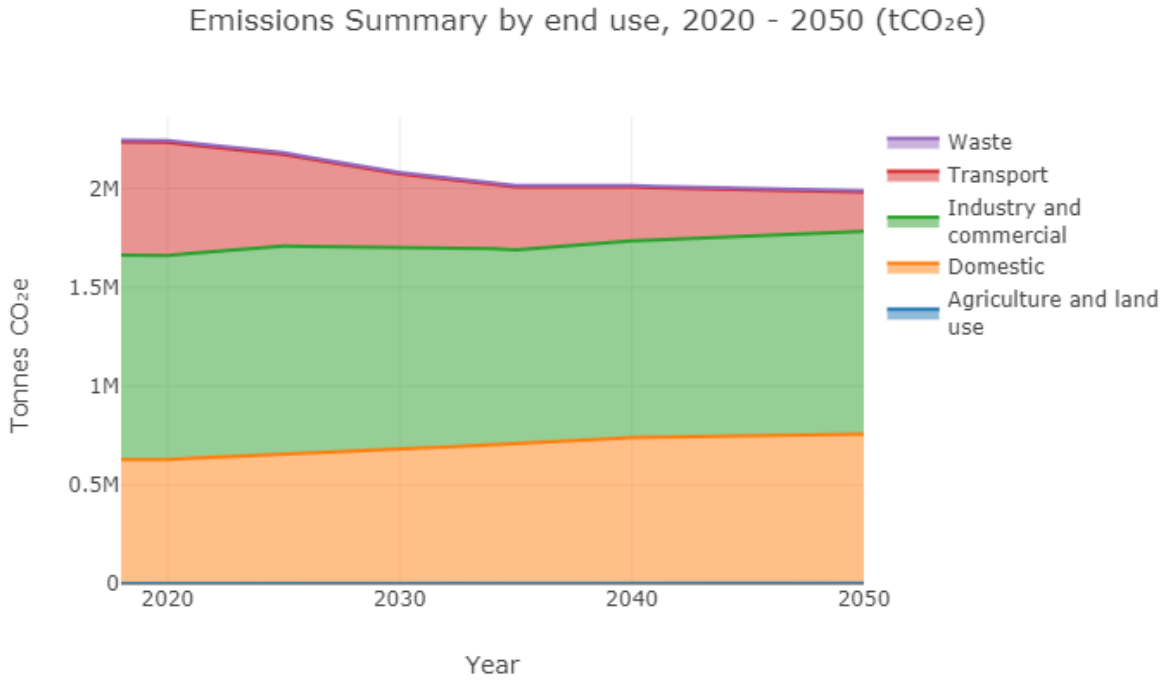

Figure 8 BAU scenario from 2020 to 2050 using the SCATTER tool

3.3 COVID-19 scenario

To create a more realistic BAU scenario with current uncertainty of the UK economy, a COVID-19 scenario for Sheffield was created. According to model results from the Office for Budget

[7] https://scattercities.com/

Responsibility (OBR) Fiscal sustainability report in 2020, GDP fell by 25% between February and April and is now recovering. Their central scenario equates to a 12.4% reduction in GDP in 2020 with GDP down 3% in the long run.

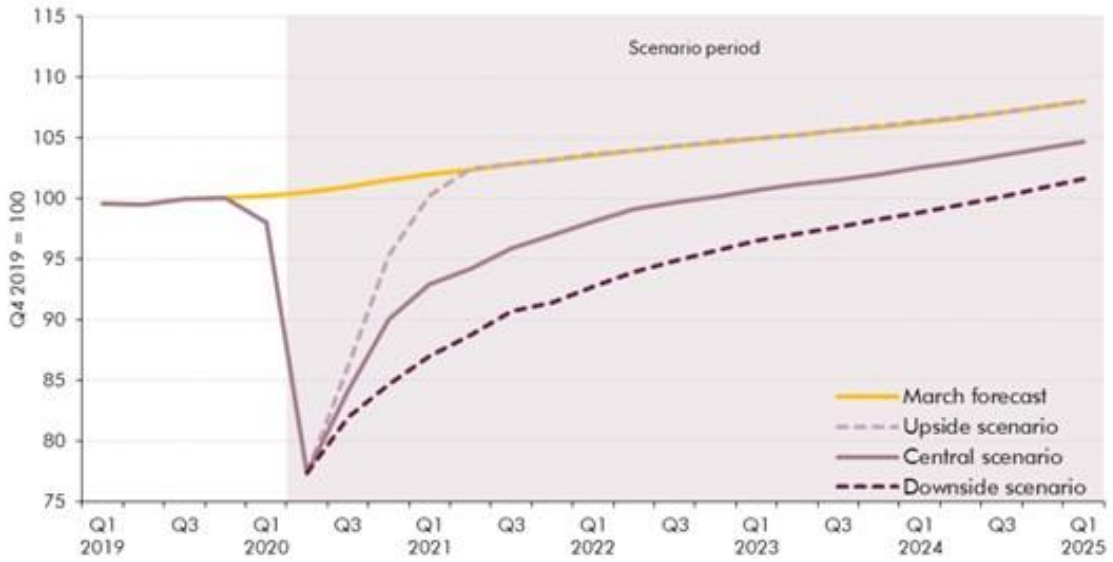

Figure 9 OBR real GDP versus March forecast (OBR 2020)

By taking Figure 9 into account, we calculated the ratio of overall energy demand to GVA growth for each sector, then re-scaled the BEIS growth factors to the different economic growth rates. Results from this can be seen below in Figure 10. In comparison to the initial BAU scenario outlined in Section 3.2, CO_2 emissions for Sheffield are 2.7% lower by 2030 and 4.2% lower by 2037. This means a 19.6% reduction by 2030 and 28.3% reduction by 2037. However again, emissions do not get close to net zero even by 2050.

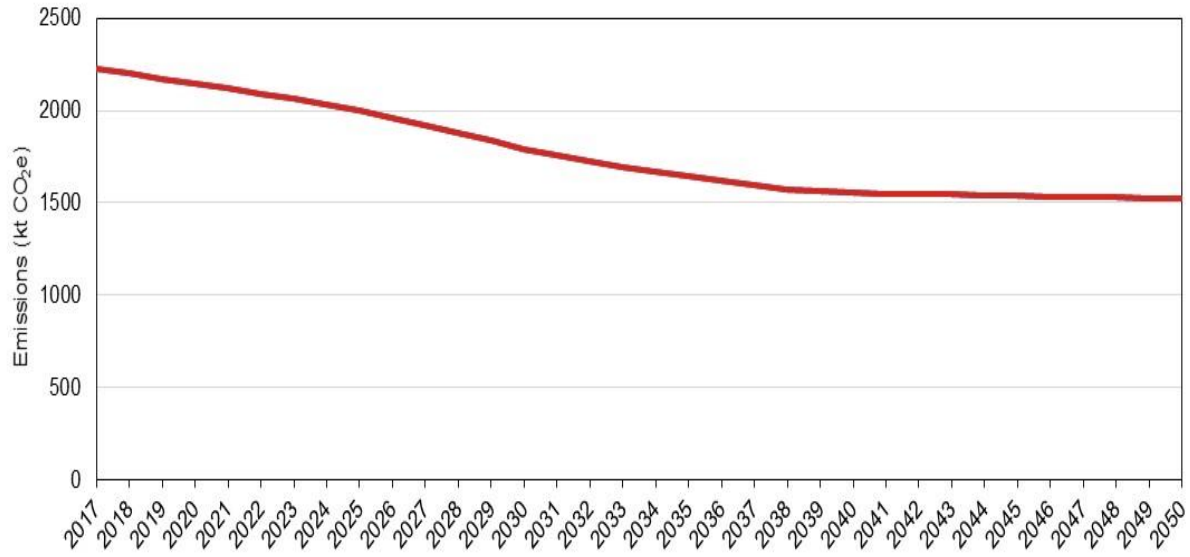

Figure 10 Total CO_2 emissions projection to 2050 for Sheffield under a COVID scenario

3.4 The Future Homes Standard

Another measure that was taken into account was the Future Homes Standard (FHS)[8]. This policy is not taken into account in the BEIS energy and emissions forecasts, hence another scenario was modelled using the NZP tool. The FHS will require an increase in energy efficiency requirements for new homes in 2020, and new build homes to have low carbon heating – to be introduced by 2025.

Under this scenario, the pathway looks very similar to the original BAU projection and COVID-19 scenario. With the FHS in place, emissions decline by 2.1% and 3.3% more than the 2030 and 2037 BAU scenario respectively. This equates to a 19.0% reduction in CO_2 by 2030 and 27.4% by 2037. As most new homes have already been built in Sheffield with the FHS, the policy does not have a notable impact over the time series.

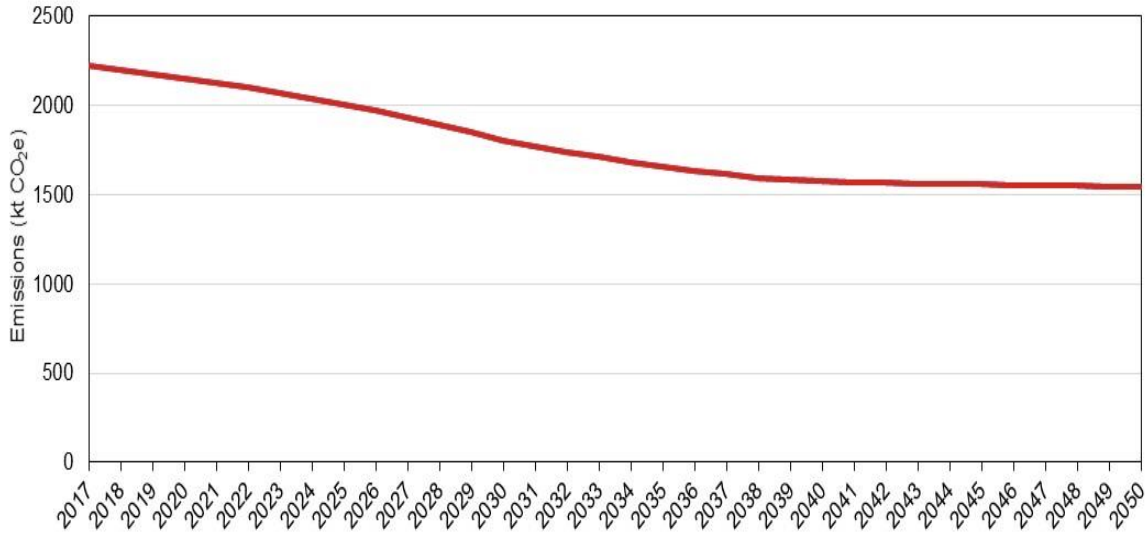

Figure 11 Total CO_2 emissions projection to 2050 for Sheffield under the Future Homes Standard (FHS)

3.5 Ban on new sales of petrol and diesel cars and vans

To incorporate another future policy that is not currently accounted for in the DfT traffic forecasts, a scenario was created to implement a ban on new sales of petrol and diesel cars and vans by 2032. Existing Government policy is that this ban would take effect by 2040, but the Governemnt is currently considering bringing this forward to at least 2035 or possible earlier (e.g. 2032).

Out of all scenarios other than the central Sheffield BAU, this scenario has the biggest impact on CO_2 emissions. In Figure 12, there is a 22% reduction in CO_2 emissions between 2017 and 2030, and a 33.3% decline in emissions between 2017 and 2037. This relatively big impact is to be expected, as it would affect sales of all new vehicles, and bringing the date forward by 8 years would have a significant impact on the average efficiency of the existing UK car parc (i.e. all vehicles on the road, rather than just new vehicles).

[8] https://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings

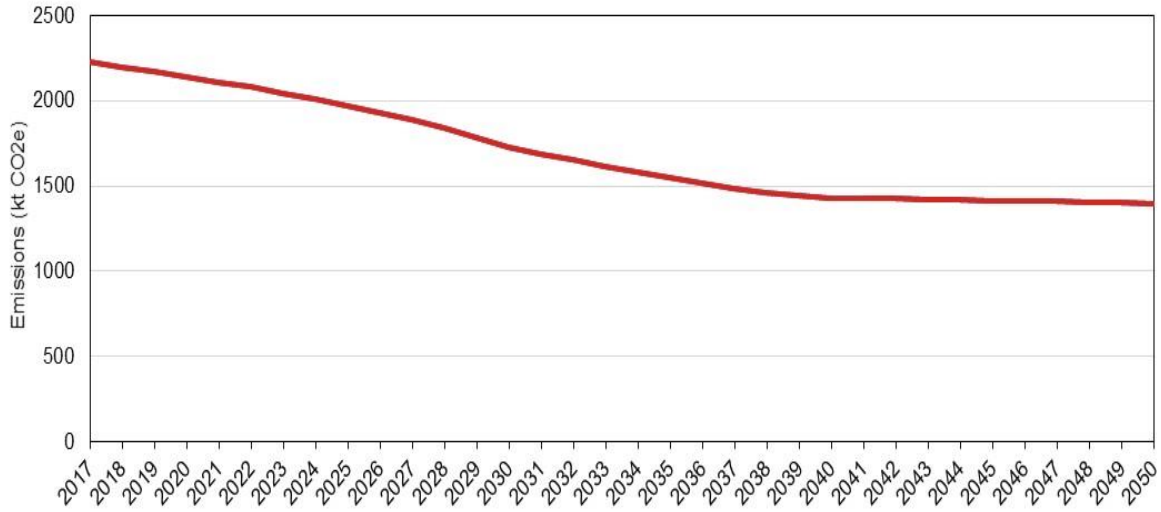

Figure 12 Total CO_2 emissions projection to 2050 for Sheffield under a ban on new sales of petrol and diesel cars and vans by 2032

In Table 3 below, a summary of all model outputs is provided. The details of steps taken to model the additional scenario (COVID-19, FHS and car and van phase out) is provided in Appendix 3.

Table 3 Summary of model outputs from the NZP tool

Scenario	Description	CO_2 reduction 2017-2030 (%)	CO_2 reduction 2017-2037 (%)
Central BAU	BEIS reference, plus impacts of COVID-19, FHS and car/van phase out	23.4	34.7
Basic BAU	Latest (2019) BEIS and DfT projections, central forecast	16.9	24.1
COVID-19	Taking account of COVID-19 OBR forecasts	19.6	28.3
FHS	Taking account of Future Homes Standard	19.0	27.4
Car and van phase out	Phasing out sales of new petrol/diesel cars and vans by 2032	22.2	33.3

4 Conclusions and observations

Overall, Sheffield has already made some good progress in reducing emissions between 2005 and 2017, with the rate of emissions reductions being higher than the national average so far. This report has highlighted that the current policy landscape is not sufficient to meet net zero by 2030, or even to continue this level of emissions reductions into the future. This reflects the picture at the national level, where the current policy landscape is not sufficient to meet the fourth and fifth carbon budgets (**Error! Reference source not found.**), nor net zero by 2050. This is consistent with other sources, such as the projections produced using the SCATTER tool.

Table 4 Comparison between Tyndall Centre recommended carbon budgets for Sheffield, and Central BAU NZP tool output

Carbon budget period	Carbon budget (Mt CO_2)	Central BAU scenario (Mt CO_2)
2018-2022	9.3	10.65
2023-2027	4.9	9.75
2028-2032	2.6	8.57
2033-2037	1.3	7.59
Total	18.1	36.56

Much of the progress in reducing CO_2 emissions in recent years has been from grid decarbonisation, which has progressed at a rapid pace. The additional gains from this are lower than previously anticipated, and more focus will need to be turned to tricky areas such as decarbonisation of heat and transport.

In terms of the 'emissions gap', it can be seen from the table above that the gap between actual emissions and the Tyndall Centre carbon budgets grows over time such that by the end of the 2033-37 carbon budget period, Sheffield will cumulatively be over 18 Mt CO_2e over the carbon budget for the period 2018-37.

To reach zero carbon emissions, defined as a 95% reduction in net CO_2 emissions by 2030, CO_2 emissions in Sheffield would have to reduce from 2.23 Mt CO_2e in 2017 to 0.11 Mt CO_2e in 2030. According to our Central BAU scenario, in 2030, CO_2 emissions will be 1.71 Mt CO_2e, which is 1.6 Mt CO_2e higher than the zero carbon target as defined in this project.

Whilst expected forthcoming policy announcements from the UK Government will have an impact and help in reducing emissions, it will still not be enough to ensure that Sheffield reaches net zero within a suitable time frame.

The next steps of this project will be WP3, where we will consider mitigation options to provide guidance to Sheffield City Council on how to reach net zero emissions and close the current gap that exists in doing so.

- WP3.1 City level mitigation pathway – developing a set of mitigation options at the city level that can achieve the net zero goal;
- WP3.2 Council estate mitigation pathway – developing a set of detailed mitigation actions for the councils own buildings and fleet;

5 References

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Appendices

These appendices contain additional information that supplements the main chapters.

A1 Policy assumptions for a BAU scenario

Table A1.1 Policy assumptions made to project a BAU scenario for Sheffield

Domestic	Commercial	Industry	Transport
Building regs Part L	Building regs Part L	Building regs Part L	Renewable Transport Fuel Obligation (RTFO)
Products policy	Products policy	Products policy	Car fuel efficiency policies
Smart metering	Smart metering	CRC-ees	LGV fuel efficiency policies
Heat Networks Investment Project	Heat Networks Investment Project	ESOS	HGV fuel efficiency policies
Renewable Heat Incentive	Renewable Heat Incentive	Renewable Heat Incentive	Local sustainable transport fund
Private Rented Sector (PRS) Energy Efficiency Regulations	PRS Energy Efficiency Regulations	PRS Energy Efficiency Regulations	PSV fuel efficiency policies
F-gas regulation	F-gas regulation	F-gas regulation	SECR
Boiler Plus	Energy Performance of Buildings Directive (EPBD)	Industrial Heat Recovery Support (IHRS)	
Energy Company Obligation	CRC-ees	CRC-ees	
	ESOS	ESOS	
	Streamlined energy and carbon reporting framework for business (SECR)	SECR	

Source: adapted from Annex D of the BEIS updated energy and emissions projections 2018 (https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018)

A2 Local policies

Table A2.1 Sheffield local policy review

Document	Policy/strategy name	Target	Impact category	Comments
Sheffield Development Framework Core Strategy, Adopted March 2009	CS 22 – Scale of the Requirement for New Housing	Trajectory targets from Fig 8.1 achieved in each year in the period 2004 to 2026. 1,425 net requirement per year for dwellings 2020/21 to 2025/26	Housing	To be included in projections
Sheffield Development Framework Core Strategy, Adopted March 2009	CS 64 – Climate Changes, Resources and Sustainable Design of Developments	All developments over the size thresholds in the period to 2026 to achieve the required standards of sustainability (Code for Sustainable Homes Level 3 for residential developments or BREEAM very good for non-residential developments)	Buildings	Not included in projections as standards do not effectively drive a reduction in emissions
Sheffield Development Framework Core Strategy, Adopted March 2009	CS 65 – Renewable Energy and Carbon Reduction	12MW of renewable energy capacity provided by 2010 and 60MW by 2021	Energy	Not included in projections as should have already been achieved
Sheffield City Region Transport Strategy	-	By 2040, Increase trips by 18% bus, 100% rail , 47% tram, 21% walking and 350% cycling and manage the increase in private car/van/goods trips to 8%. Reduce tailpipe carbon emissions in line with targets for the UK and have a zero carbon public transport network by 2040.	Transport	Not included in projections as in line with national policy
Sheffield Transport Strategy, March 2019	-	We will intervene to enable shift away from carbon intensive modes of transport to less carbon intensive modes where these are suitable. We will aim to achieve a zero carbon public transport network. We will improve our offer for walking, for cycling and for public transport, to ensure improved access to jobs and skills is not limited to those who have access to a car.	Transport	Not included in projections as in line with national policy
SCR Municipal Waste Strategy 2016-2021	Strategic Priority 1 - Educate and Inspire	Increase recycling by 10kg per household by 2021. Reduce household waste by 2kg per household each year – year on year until 2021. Deliver a targeted reduce, re-use, recycle campaign to at least 100,000 households across South Yorkshire each year, by 2021	Waste	Not included in projections as waste won't be modelled as it's a minor point.

Document	Policy/strategy name	Target	Impact category	Comments
Green City Strategy	-	By 2025, The Council and its partners will have increased the level of low carbon and renewable energy generation in the city. By 2030 A significant level of the city's energy will be supplied, from locally generated low carbon and renewable technologies. We will develop an approach to decarbonise our existing heat networks, exploring further approaches to decarbonise domestic heating across the city.	Energy	Not included in projections as no clear policy or target that impacts on carbon
Green City Strategy	-	New homes built in the city will be very low or zero carbon – Our Local Plan includes policies which promote the development of low carbon homes; constructed to high standards of energy efficiency, which will generate their own heat or power. These homes will use significantly less energy and as a result have lower running costs for residents, as well as reducing the city's overall carbon emissions. Our council home building programmes will create very low or zero carbon, energy efficient homes. Where funding allows homes will also generate their own heat or power.	Housing	Not included in projections as no clear policy or target that impacts on carbon
Green City Strategy	-	Buses - work in partnership with the bus companies to improve the bus fleet and reduce emissions through replacement low-emission buses or retrofitting vehicles with cleaner engine technology. Cars - consider specific schemes to support people on lower incomes to change to lower emission vehicles, particularly where their job or responsibilities require unavoidable and frequent use. Freight/HGVs - support the Eco Stars scheme, which helps commercial vehicle operators to reduce their emissions; promote the use of lower emission vehicles across our fleet. Promoting clean travel - encourage more walking, cycling and active commuting in the city.	Transport	Not included in projections as no clear policy or target that impacts on carbon
Sheffield City Region Integrated Infrastructure Plan	Housing increase by Growth Area and Urban Centre: 2014 - 2024	12,469 new homes in Sheffield City Centre 2014 – 2024. 19,627 new homes in Sheffield Local Authority 2014 - 2024	Housing	Using CS22 in projections as takes into account net homes
Sheffield City Region Integrated Infrastructure Plan	Renewable energy capacity	Planned schemes account for 276MW planned renewable energy capacity. 1no. advanced conversion technologies, 2no. Anaerobic digestion, 5no. Biomass, 1no. EFW incineration, 18no. Solar photovoltaics, 5no. Wind onshore.	Energy	Not included in projections as impacts on carbon are not clear
Our City Centre Plan 2018-28	3 City Centre and the economy	Currently 277,600 jobs in Sheffield City centre (2018), forecasting an additional 20,500 jobs until 2024.	Buildings	Not included in projections as impacts on carbon are not clear
Our City Centre Plan 2018-28	Street lighting	Replace all street lighting with low energy (LED), smart, directional street lighting as part of the Streets Ahead programme by 2020	Buildings	Not included in projections as assuming initiative has been completed

Document	Policy/strategy name	Target	Impact category	Comments
Housing Strategy 2013-2023	-	-	-	Not included in projections as no clear policy or target that impacts on carbon
New Homes Delivery Plan 2018-2023	-	-	-	Using CS22 in projections as takes into account net homes
Lower Don Valley Masterplan Study	-	-	-	Not included in projections as no clear policy or target that impacts on carbon
SCR Active Travel Implementation Plan	-	-	-	Not included in projections as no clear policy or target that impacts on carbon
SCR Integrated Rail Plan	-	-	-	Not included in projections as no clear policy or target that impacts on carbon
Sheffield Parking Strategy	-	-	-	Not included in projections as no clear policy or target that impacts on carbon
SCR Strategic Economic Plan	-	-	-	Not included in projections as no clear policy or target that impacts on carbon
Housing Infrastructure Fund	-	-	-	Not included in projections as no clear policy or target that impacts on carbon

A3 Modelling steps of COVID-19, FHS and diesel & petrol car phase out

Covid-19

1. Starting with BEIS's Unified Energy & Emissions Projects (UEP), reference scenario
2. Calculate the growth in GDP modelled under the low and high growth projections (GDP index=100 in 2005)
3. Subtract the low growth from the high growth projections, and derive the % change in each line in the energy projection per unit change in GDP.
4. Use the Bank of England's July 2020 forecast change in GDP growth due to Covid-19 to modify the GDP growth index for the reference scenario
5. Use the % change per unit change in GDP (step 3) to produce a customised energy projection under the GDP growth index (step 4).

Future Home Standard

1. Derive a projection of new home completions based on ONS Table 401: Household projections, United Kingdom, 1961-2039
2. Use the Future Homes Standard 2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings: Impact Assessment to derive the number of FHS homes built per year over a 10 year period, and use stated assumptions for option 2 to back calculate the carbon savings to energy savings per year per home.
3. Extrapolate impact of FHS to 2038, and derive reduction in Domestic Gas and Electricity consumption due to introduction of Future Home Standard.

Diesel & Petrol Car & Van Ban Phase out

1. Use DfT Table ENV0101 (TSGB0301) : Petroleum consumption by transport mode and fuel type: United Kingdom, 1990-2018 to the proportion of the UEP forecast of petrol and diesel transport fuel use attributable to cars and vans.
2. Calculate the reduction in diesel and petrol use that will result of sales of new diesel and petrol cars and vans being banned from 2032, assuming 10% retirement of existing stock of cars & light vans per year. The 10% is based on an assumption that the average age of cars & vans on the road will reach c. 10 years by 2032 after examining trends in average age of vehicles VEH0211/VEH0411 (8.3 year) – and allowing for reduced scrappage rate - that is expected to occur in 2nd hand market.

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Tyndall Centre
for Climate Change Research

Setting Climate Commitments for the City of Sheffield:

Quantifying the implications of the United Nations Paris Agreement for Sheffield

Client:	Sheffield City Council
Document Reference:	SHEF
Version:	2.1
Date:	July 2019
Prepared by:	Dr Jaise Kuriakose, Dr Chris Jones, Prof Kevin Anderson, Dr John Broderick & Prof Carly McLachlan

NB: All views contained with this report are attributable solely to the authors and do not necessarily reflect those of researchers within the wider Tyndall Centre.

Key Messages

This report presents climate change targets for Sheffield[1] that are derived from the commitments enshrined in the Paris Agreement [1], informed by the latest science on climate change [2] and defined in terms of science based carbon budget setting [3]. The report provides Sheffield with budgets for carbon dioxide (CO_2) emissions from the energy system for 2020 to 2100.

The carbon budgets in this report are based on translating the "well below 2°C and pursuing 1.5°C" global temperature target and equity principles in the United Nations Paris Agreement to a national UK carbon budget [1].[2] The UK budget is then split between sub-national areas using different allocation regimes [4]. Aviation and shipping emissions remain within the national UK carbon budget and are not scaled down to sub-national budgets. Land Use, Land Use Change and Forestry (LULUCF) and non-CO_2 emissions are considered separately to the energy CO_2 budget in this report.

Based on our analysis, for Sheffield to make its 'fair' contribution towards the Paris Climate Change Agreement, the following recommendations should be adopted:

1) Stay within a maximum cumulative carbon dioxide emissions budget of 16 million tonnes ($MtCO_2$) for the period of 2020 to 2100. At 2017 CO_2 emission levels[3], Sheffield would use this entire budget within 6 years from 2020.

2) Initiate an immediate programme of CO_2 mitigation to deliver cuts in emissions averaging 14% per year to deliver a Paris aligned carbon budget. These annual reductions in emissions require national and local action, and could be part of a wider collaboration with other local authorities.

3) Reach zero or near zero carbon no later than 2038. This report provides two CO_2 reduction pathways which both stay within the recommended maximum carbon budget of 16 $MtCO_2$; 1) with a long term decay in residual emissions at a consistent percentage reduction rate over time, 2) emissions dropping to zero following the point at which 95% of the budget has been used.

[1] Defined in terms of the administrative boundary of the Sheffield Local Authority area.
[2] We base our global carbon budget on the latest IPCC Special Report on 1.5ºC (IPCC SR1.5) findings on how carbon emissions relate to global temperatures. The budget value we have selected provides a 'likely' chance of staying below 2°C and offers an outside chance at holding temperatures to 1.5ºC. As IPCC SR1.5, notes there are no emissions pathways for limiting warming to 1.5ºC that do not rely upon significant carbon dioxide removal technology deployment [2].
[3] Based on Sheffield's 2016 CO_2 emissions (excluding aviation, shipping, process CO_2 emissions from cement production and those from LULUCF).

1. Introduction

This report presents advisory climate change targets for Sheffield to make its fair contribution to meeting the objectives of the United Nations Paris Agreement on Climate Change. The latest scientific consensus on climate change in the Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5°C [2] is used as the starting point for setting sub-national carbon budgets [3, 4] that quantify the maximum carbon dioxide (CO_2) associated with energy use in Sheffield that can be emitted to meet this commitment. This report translates this commitment into; 1) a long-term carbon budget for Sheffield; 2) a sequence of recommended five-year carbon budgets; 3) a date of 'near zero'/zero carbon for the city.

The United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement commits the global community to take action to "*hold the increase in global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C*" [1]. Cumulative emissions of CO_2 from human activity are the principle driver of long-term global warming.[4] It is the relationship between CO_2 and global temperatures which means that staying within a given temperature threshold requires that only a certain total quantity of CO_2 is released to the atmosphere. This is the global carbon budget.

In addition to setting global average temperature targets, the UNFCCC process also includes foundational principles of common but differentiated responsibility [1]. This informs the fair (equitable) distribution of global emissions between nations at different stages of economic development. Industrialised nations are expected to show leadership towards a low carbon future, while it is acknowledged that a greater total share of future emissions will be associated with other countries as they develop (though their emissions per capita will remain comparatively low). Any sub-division of the global carbon budget must therefore account for the development needs of what the Paris Agreement refers to as "developing country Parties" in setting a fair/equitable national or sub-national carbon budget.

The carbon budgets presented here apply to CO_2 emissions from the energy system only. Although all greenhouse gas (GHG) emissions, such as methane and other forcing agents, such as aircraft contrails, affect the rate of climate change, long term warming is mainly driven by CO_2 emissions [5]. Furthermore the physical or chemical properties of each GHG vary, with different life-times causing warming in different ways, and with subsequent, and often large, uncertainties in their accounting [6]. As such the global carbon budgets in the Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5°C (SR1.5) [2], relate to CO_2-only emissions. In this report we have discussed non-CO_2 emissions and CO_2 emissions associated with land use, land use change and forestry separately.

Ultimately staying within a global temperature threshold (e.g. "well below 2°C") requires limiting cumulative CO_2 emissions over the coming decades. Carbon budgets can be an effective way to understand the amount of CO_2 emissions that can be released into the atmosphere in order to do this. End point targets such as 'net zero' by 2050, with very clear assumptions, can be useful

[4] This is due to the near-linear relationship between cumulative CO_2 emissions and temperature is the result of various feedback processes and logarithmic relationship between atmospheric CO_2 concentrations and radiative forcing, as well as the changes in the airborne fraction of CO_2 emissions [20].

indicators of ambition, but it is ultimately the cumulative CO_2 released on the way to that target that is of primary significance to achieving climate change goals. Whereas end point focused targets can be met with varying levels of CO_2 emissions (and therefore varying global temperature with consequent climate impacts) depending on their reduction pathways, carbon budgets specify the limits to CO_2 emissions within the period of the commitment. This is a reason why the UK Climate Change Act has legislated 5-year carbon budget periods, as well as a long term target, to keep CO_2 emissions consistent with the framing goal of the climate change commitment. It is also the reason why we recommend a carbon budget based approach.

1.2 Wider UK Policy Context

The UK Climate Change Act now legislates for a commitment to net zero greenhouse gas emissions by 2050[5], with five yearly carbon budgets to set actions and review progress [7]. The carbon budgets for this target were not available at the time of our analysis for direct comparison, however the recommended budget in this report will most likely be more stringent. This is primarily due to two key differences between our approach and the current recommendations of the UK Government's advisory body the Committee on Climate Change (CCC) that inform the revised UK net zero target:

a) The equity principles of the Paris Agreement and wider UNFCCC process are explicitly and quantitatively applied: Our approach allocates a smaller share of the global carbon budget to the 'developed country Parties', such as the UK, relative to 'developing country Parties'. Moreover the approach is also distinct in including global 'overheads' for land use, land use change and forests (LULUCF) and cement process emissions related to development.

b) Carbon dioxide removals via negative emissions technologies (NETs) and carbon offsets[6] are not included: The UK Climate Change Act's 'net zero' framing means that the commitment is met when greenhouse gas emissions and removals from the UK's carbon 'account' balance at zero. Hence the 2050 target can be met using carbon dioxide removal technologies, including land use sequestrations, and potentially carbon offsetting. The CCC include a significant role for NETs such as bioenergy carbon capture and storage and direct air capture in their analysis supporting the net zero target. Doing so theoretically increases the size of a carbon budget, but also increases the risk of failing to deliver on the Paris global temperature target. The UK Government has also rejected the CCC's advice to explicitly exclude international carbon offsetting as an approach to meeting the net zero target. Allowing for future carbon dioxide removal technologies and international carbon offsetting ostensibly increase the size of the UK's carbon budget. However carbon removal technologies are at a very early stage of development and whether they can be successfully deployed at sufficient scale is highly uncertain. While they are an important technology to develop, it is a major risk to prematurely adopt a carbon budget that allows for additional CO_2 on the basis that future generations will be in

[5] The 2019 amended UK Climate Change Act commits the UK to at least a 100% reduction in greenhouse gas emissions by 2050 from 1990 levels on the basis that the UK's 'carbon account' is 'net zero' by this point. This is not the same as zero greenhouse gas emissions by 2050. In this framing residual greenhouse gas emissions are net zero on the provision that they are balanced by greenhouse gas removals in the UK's carbon account.
[6] Carbon offsetting refers to the purchase of a tradeable unit, representing emissions rights or emissions reductions, to balance the climate impact of an organisation, activity or individual.

a position to deploy planetary-scale NETs. Similarly, as the CCC note in their advice, the efficacy of carbon offsetting credits as a contribution to meeting global climate change commitments is not robust enough to incorporate into recommended carbon budgets.

We regard our UK carbon budget to be at the upper end of the range that is aligned with the Paris Agreement's objectives. Early results from the latest Earth system models suggest that the climate may be more sensitive to greenhouse gases than previously thought implying a smaller global carbon budget is required [8]. In addition, assuming that developing countries will, on aggregate, implement rapid emissions reduction measures in line with a 2025 peak year is far from certain. ***Therefore, we recommend that these budgets are taken as reflective of the minimum commitment required to deliver on the Paris Agreement.***

2. Method

The Setting City Area Targets and Trajectories for Emissions Reduction (SCATTER) project [4] funded by the Department for Business Energy and Industrial Strategy (BEIS) developed a methodology for Local Authorities to set carbon emissions targets that are consistent with United Nations Paris Climate Agreement. This report uses the SCATTER methodology with revised global carbon budgets, based on the latest IPCC Special Report on 1.5°C and updated CO_2 emissions datasets, to downscale global carbon budgets to Sheffield. This methodology has been successfully piloted with Greater Manchester Combined Authority and is being made available nationally to support all local authorities and groupings of local authorities.

Step 1: A global carbon budget of 900 $GtCO_2$ is taken from the Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5ºC [2]. This global carbon budget represents the latest IPCC estimate of the quantity of CO_2 that can be emitted and still be consistent with keeping global temperatures well below 2ºC with an outside chance of stabilising at 1.5 ºC. This budget assumes no reliance on carbon removal technologies.

Step 2: A 'global overhead' deduction is made for process emissions arising from cement production (60 $GtCO_2$) [9][7]. Cement is assumed to be a necessity for development [5]. We also assume that there is no *net* deforestation at a global level (2020 to 2100) so none of the global carbon budget is allocated to this sector. This will require a significant global effort to rapidly reduce deforestation and significantly improve forestry management as well as increase rates of reforestation and potentially afforestation.

Step 3: A share of the global carbon budget is allocated to "developing country parties" assuming a trajectory for those countries from current emissions to a peak in 2025 then increasing mitigation towards zero emissions by around 2050. The remaining budget is allocated to "developed country parties" which includes the UK [10]. This approach of considering developing countries first, is guided by the stipulation of equity within the Paris Agreement (and its earlier forebears, from Kyoto onwards)[10].

Step 4: The UK is apportioned a share of the 'developed country Parties' budget after Step 3 to provide a national carbon budget. The apportionment is made according to "grandfathering"[8] of emissions for the most recent period up to the Paris Agreement (2011 to 2016).

Step 5: Aviation and shipping emissions are deducted. Assumptions and estimates are made about the level of future emissions from aviation, shipping and military transport for the UK. These emissions are then deducted from the national budgets as a 'national overhead' to derive final UK energy only carbon budgets. Emissions from aviation including military aircraft are assumed to be static out to 2030, followed by a linear reduction to complete decarbonisation by 2075. The total CO_2 emissions of this path are >25% lower than Department for Transport central forecast followed by reduction to zero by 2075. Shipping emissions are based on Walsh et al [11] 'big world' scenario out to 2050 followed by full decarbonisation from this sector by 2075. These aviation and shipping emissions (1,518 $MtCO_2$) are then deducted as a 'national overhead' from the UK budget to derive the final carbon budgets for the UK, from which local authority budgets are subsequently derived [4]. The budgets provided are therefore aligned with

[7] Based on IEA's ambitious 2 degree scenario on process CO_2 for the period 2020-2050, subsequently extrapolating to zero by 2075

[8] Grandfathering is based on the average proportion of CO_2 emissions from each Party in recent years.

"well below 2°C and pursuing 1.5°C" provided that aviation and shipping emissions do not exceed the pathway assumed in our analysis [4]. Failure to hold aviation and shipping emissions within the outlined allocation will reduce the carbon budget for UK regions, including for Sheffield.

Step 6: Sheffield is apportioned a part of the remaining UK carbon budget. Our recommended budget is based on sub-national allocation through 'grandfathering'. A grandfathering approach allocates carbon budgets on the basis of recent emissions data. Data for recent annual CO_2 emissions for Sheffield [12] (2011-2016) is averaged and compared to averaged data for the whole UK [13] over the same period. The carbon budget (2020-2100) for Sheffield is then apportioned based on Sheffield's average proportion of UK CO_2 emissions for the 2011-2016 period. CO_2 emissions in the carbon budget include emissions from fossil combustion within the region and a share of the emissions from national electricity generation (relative to the Sheffield area end-use electricity demand).

Step 7: Carbon emission pathways. The carbon budgets for Sheffield are related to a set of illustrative emission pathways. These pathways show projected annual CO_2 emissions from energy use in Sheffield and how these emissions reduce over time to stay within the budget. The energy-only CO_2 emissions for 5-yearly interim carbon budget periods are calculated in line with the framework set out in the UK Climate Change Act (2018). It is the cumulative carbon budget and the 5 year interim budgets that are of primary importance as opposed to a long term target date. The combination of a Paris Agreement based carbon budget and the projected emissions pathways can however be used to derive a definition for a zero carbon year for Sheffield. The zero carbon year of 2038 is defined here as the point at which on the consistent reduction rate curve only 5% of Sheffield's recommended budget remains. Annual CO_2 emissions at this point fall below 0.1 $MtCO_2$ (>96% lower than 2015 CO_2 levels). Two illustrative emissions pathways can be derived in relation to this; 1) the residual 5% carbon budget pathway continues at the consistent reduction rate, diminishing until the end of the century; 2) emissions fall to zero in this year and the recommended budget pathway is revised to account for this. Both pathways are consistent with the Paris Agreement if CO_2 emissions stay within the cumulative CO_2 budget and 5-year interim budgets.

3. Results

3.1 Energy Only CO_2 Budgets for Sheffield

Following the Method the recommended maximum energy only CO_2 carbon budget for the Sheffield area for the period of 2020 to 2100 is 16 $MtCO_2$. To translate this into near to long term commitments two CO_2 reduction pathways that are within the 16 $MtCO_2$ are proposed here:

1) End of Century Run: A consistent emissions reduction rate of 14.2% out to the end of the century is applied. In 2038 95% of the recommended carbon budget is emitted and low level CO_2 emissions continue at a diminishing level to 2100.

2) Informed by the end of the century pathway (1), 2038 is identified as a 'stop year' at which CO_2 emissions drop to zero. A pathway that distributes the 16 $MtCO_2$ budget from 2020 to 2038 is calculated. The annual emissions reduction rate for this pathway is 13.2%.

Both of these pathways are consistent with the recommended budget for a minimum commitment to meeting the objectives of the Paris Agreement.

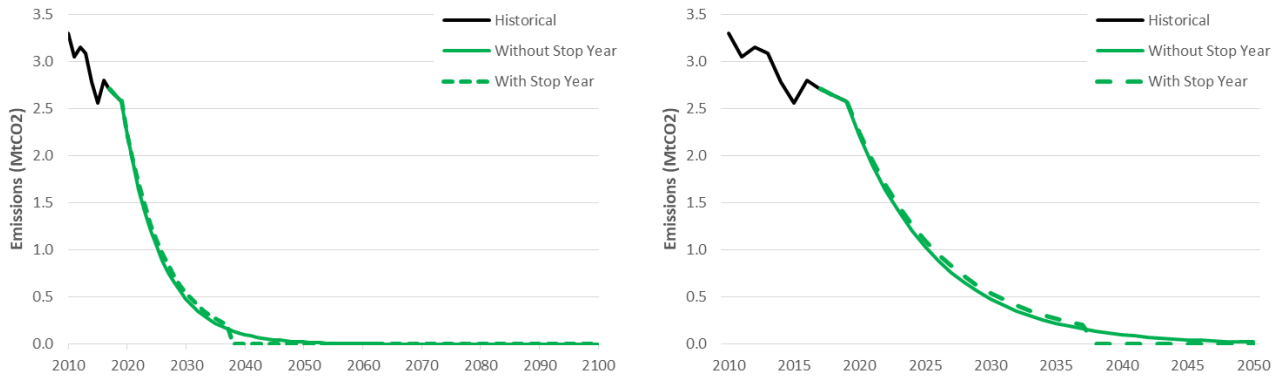

***Figure 1a (left)**: Energy related CO_2 only emissions pathways (**2010-2100**) for Sheffield premised on the recommended carbon budget. **Figure 1b (right)**: Energy CO_2 only emissions pathways (**2010-2050**) for Sheffield premised on the recommended carbon budget.*

Table 1 presents the Sheffield energy CO_2 only budget in the format of the 5-year carbon budget periods in the UK Climate Change Act. To align the 2020 to 2100 carbon budget with the budget periods in the Climate Change Act we have included estimated CO_2 emissions for Sheffield for 2018 and 2019, based on BEIS provisional national emissions data for 2018 [14] and assuming the same year on year reduction rate applied to 2019. The combined carbon budget for 2018 to 2100 is therefore 20.8 $MtCO_2$.

***Table 1**: Periodic carbon budgets from 2018 under various regimes for* Sheffield. *Includes budgets for different allocation regimes.*

		Recommended Budget (End of Century Run)	**Recommended Budget (Stop Year at 95% of**

			budget)
Carbon Budget Period	2018-2022	11.0	11.1
	2023-2027	5.3	5.6
	2028-2032	2.5	2.8
	2033-2037	1.1	1.4
	2038-2042	0.5	0.0
	2043-2047	0.2	0.0
	2048-2100	0.2	0.0

As shown in Figure 2, opting for a nearer term 'zero'/stop year allocates more of the overall carbon budget to the pre-2038 budget periods. This slightly reduces the emissions reduction rate over this period (from 14.2% to 13.2%), but it means that there is no residual emissions budget for the post-2038 budget periods. As with any emissions projection, using more of the available carbon budget within the next decade reduces the emissions 'space' for future Sheffield residents and this should be considered carefully. It is for this reason also that we do not recommend any zero carbon/stop dates earlier than this for the Sheffield recommended budget. The recommended budgets here are the minimum requirement for meeting the Paris Agreement. Therefore adopting a smaller cumulative CO_2 budget than the one presented here, with accelerated reduction rates leading to an earlier zero carbon year, is compatible with this approach - assuming that cumulative CO_2 emissions within the 5 year budget periods are the same or lower that those specified in Table 1.

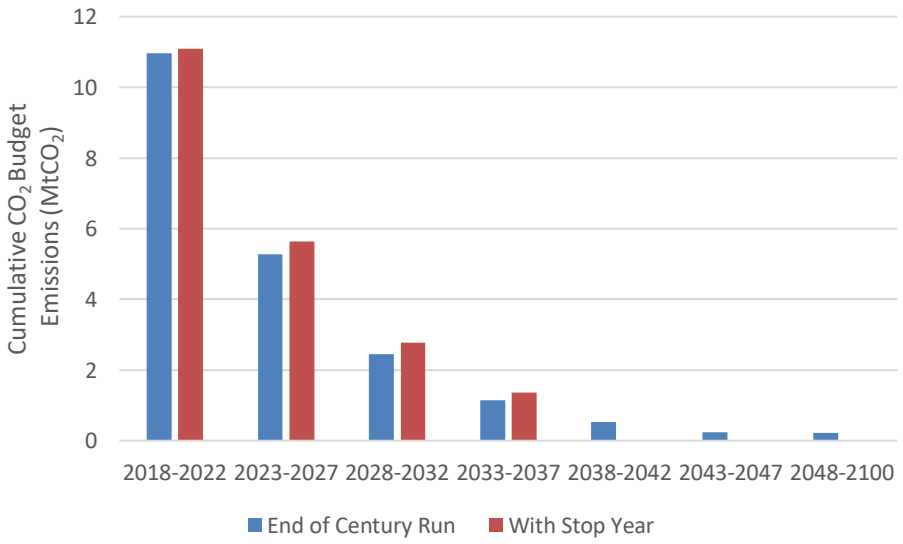

Figure 2: *Cumulative CO_2 emissions per budget period for End of Century and Stop Year projections (based on Table 1)*

3.2 Recommended Allocation Regime for Carbon Budget

The recommended carbon budget is based on a grandfathering allocation regime for sub-dividing the UK sub-national energy only carbon budget. There are three distinct allocation regimes that can be applied to determine sub-national budgets. We have opted to recommend one common approach for allocating carbon budgets that can be applied to all Local Authority areas. This enables straightforward compatibility between carbon budgets set at different administrative scales. For example this makes it easier for individual Local Authorities to calculate their own carbon budgets that are compatible with a budget set at Combined Authority scale. It also means that under the recommended carbon budgets, all Authorities are contributing to a common total UK carbon budget. If for example all Authorities selected the allocation regime that offered them largest carbon budget the UK the combined UK budget would not comply with the objectives of the Paris Agreement. The common approach to allocation we recommend therefore further assures that the carbon budget adopted is Paris Agreement compatible.

We have chosen a grandfathering as our common allocation approach because, based on our analysis, it is the most appropriate and widely applicable regime within the UK.

Population and Gross Value Added[9] (GVA) are alternative allocation regimes. Population shares the carbon budget equally across the UK on a per capita basis. In this allocation regime the UK population [15] is compared to that of Sheffield [16] from 2011 to 2016. The carbon budget (2020-2100) for Sheffield is then apportioned based on its average proportion of the UK population for the period 2011-2016. For regions where per capita energy demand deviates significantly from the average (e.g. a large energy intensive industry is currently located there) the budget allocated may not be equitable for all regions, therefore it is not recommended as the preferred allocation. GVA is used as an economic metric to apportion carbon budgets. For example, the UK total GVA [17] is compared to that of Sheffield [17] from 2011 to 2016. The carbon budget (2020-2100) for Sheffield is then apportioned based on Sheffield's average proportion of UK GVA for the period 2011-2016. GVA can be useful as a proxy for allocation on economic value, however without an adjustment for the type of economic activity undertaken, areas with high economic 'value' relative to energy use can get a relatively large budget, while the inverse it true for areas with energy intensive industries, and/or lower relative economic productivity. We would therefore not recommend GVA as an appropriate allocation regime for all regions.

Table 2 presents the result outcomes for alterative allocation regimes – population and gross value added (GVA). For Sheffield the variation in carbon budget between allocation regimes is +/- 11% of the median value.

***Table 2**: Energy only CO_2 budgets and annual mitigation rates for Sheffield (2020-2100) by allocation regime*

Allocation regime (% of UK budget allocated to Sheffield)	UK budget[10] ($MtCO_2$)	Sheffield budget ($MtCO_2$)	Average annual mitigation rate (%)

[9] Balanced approach at current basic prices
[10] After deducting an emissions budget for aviation, shipping and military transport of 1,518 $MtCO_2$.

Grandfathering to Sheffield from UK (0.7%)	2,239	15.6	14.2%
Population split to Sheffield from UK (0.9%)	2,239	19.6	11.6%
GVA split to Sheffield from UK (0.7%)	2,239	15.6	14.2%
Midpoint value of the allocation regimes		16.9	13.4%

Pathway projections for the change in annual energy-only CO_2 emissions pathways for Sheffield based on the carbon budgets under the different allocation approaches in Table 2 are illustrated in Figure 3a & 3b and in Table 2.

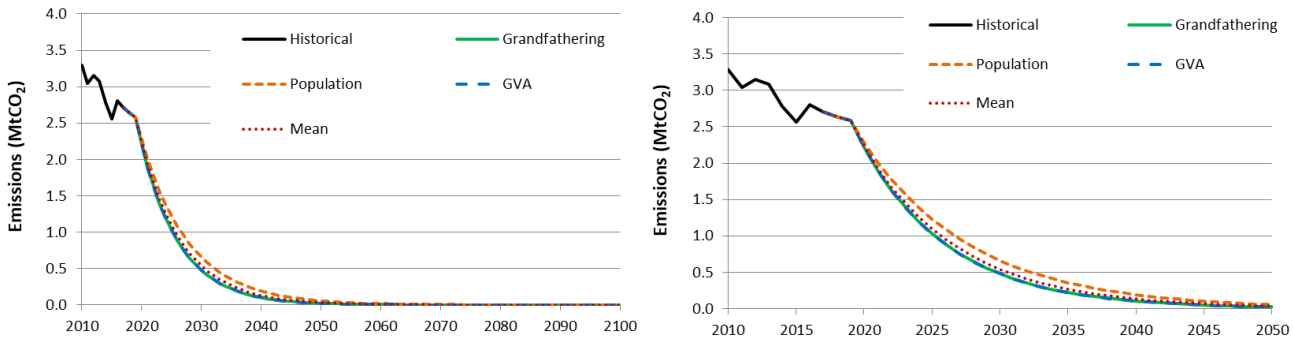

Figure 3a (left): *Energy related CO_2 only emissions pathways (**2010-2100**) for Sheffield premised on carbon budgets shown in Table 2.* ***Figure 3b (right):*** *Energy CO_2 only emissions pathways (**2010-2050**) for Sheffield premised on carbon budgets shown in Table 2.*

3.2 Land Use, Land Use Change and Forestry emissions for Sheffield

Land Use, Land Use Change and Forestry (LULUCF) consist of both emissions and removals of CO_2 from land and forests. Sheffield's CO_2-only emissions from LULUCF in 2016 were net negative (as were those of England as a whole) and estimated at around -251 $ktCO_2$ per year (i.e. equivalent to 0.9% of Sheffield's total annual CO_2 emissions) [18]. We recommend that CO_2 emissions and sequestration from LULUCF are monitored separately from the energy-only carbon budgets provided in this report. Sheffield should continue increasing the sequestration of CO_2 through LULUCF in the future aligned with Committee on Climate Change's high level ambition of tree planting, forestry yield improvements and forestry management [19]. Where LULUCF is considered, we recommend it compensate for the effects of non-CO_2 greenhouse gas emissions (within the geographical area) that cannot be reduced to zero, such as non-CO_2 emissions from agriculture.

3.3 Non-CO_2 Emissions

The IPCC SR1.5 report identifies the importance of non-CO_2 climate forcers (for instance methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), sulphur dioxide (SO_2) and black carbon) in

influencing the rate of climate change. However, a cumulative emission budget approach is not appropriate for all non-CO_2 greenhouse gases, as the physical and chemical properties of each leads to differing atmospheric lifetimes and warming effects [20]. There are also substantial relative uncertainties in the scale, timing and location of their effects.

We do not provide further analysis or a non-CO_2 emissions reduction pathway in this report. However the global carbon budget in the IPCC Special Report on 1.5ºC, that our analysis is based on, assumes a significant reduction in rate of methane and other non-CO_2 emissions over time. Therefore to be consistent with carbon budgets Sheffield should continue to take action to reduce these emissions.

The Department of Business Energy and Industrial Strategy's Local Authority emissions statistics do not provide non-CO_2 emissions data at the regional level. Given the absence of robust non-CO_2 emissions data, any non-CO_2 emissions inventory by other organisations at scope 1 and 2 for Sheffield may form the basis of monitoring and planning for these emissions. ***We recommend considering the adoption of a LULUCF pathway that includes CO_2 sequestration sufficient to help compensate for non-CO_2 emissions within the Sheffield area.***

4. Conclusions

The results in this report show that for Sheffield to make its fair contribution to delivering the Paris Agreement's commitment to staying well below 2°C and pursuing 1.5°C" global temperature rise, then an immediate and rapid programme of decarbonisation is needed. At 2017 CO_2 emission levels[11], Sheffield will exceed the largest budget available (based on grandfathering allocation) within 6 years from 2020. ***To stay within the recommended carbon budget Sheffield will, from 2020 onwards, need to achieve average mitigation rates of CO_2 from energy of around 14% per year*** (depending on reduction pathway selected). This will require that Sheffield rapidly transitions away from unabated fossil fuel use. For context the relative change in CO_2 emissions from energy compared to a 2015 Paris Agreement reference year are shown in Table 3.

***Table 3**: Percentage reduction of annual emissions for the recommended CO_2-only scenarios out to 2050 in relation to 2015*

	Recommended Budget – End of Century	Recommended Budget – Stop Year
2020	14%	13%
2025	60%	57%
2030	81%	79%
2035	91%	90%
2040	96%	100%
2045	98%	100%
2050	99%	100%

The carbon budgets recommended should be reviewed regularly to reflect the most up-to-date science, any changes in global agreements on climate mitigation and progress on the successful deployment at scale of negative emissions technologies.

These budgets do not downscale aviation and shipping emissions from the UK national level. However if these emissions continue to increase as currently envisaged by Government, aviation and shipping will take an increasing share of the UK carbon budget, reducing the available budgets for combined and local authorities. ***We recommend therefore that Sheffield seriously consider strategies for significantly limiting emissions growth from aviation and shipping.*** This could include interactions with the UK Government or other local authority and local enterprise partnership discussions on aviation that reflect the need of the carbon budget to limit aviation and shipping emissions growth.

CO_2 emissions in the carbon budget related to electricity use from the National Grid in Sheffield are largely dependent upon national government policy and changes to power generation across the country. ***It is recommended however that Sheffield promote the deployment of low carbon electricity generation within the region and where possible influence national policy on this issue.***

[11] Based on Sheffield's 2016 CO_2 emissions (excluding aviation, shipping, process CO_2 emissions from cement production and those from LULUCF).

We also recommend that the LULUCF sector should be managed to ensure that high levels of CO_2 sequestration should continue through reforestation, forestry yield improvements and forestry management. The management of LULUCF could also include action to increase wider social and environmental benefits.

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Green City Partnership Board

NAME	ORGANISATION	ROLE
Liz Ballard (LB)	Sheffield and Rotherham Wildlife Trust	Chief Executive
Emma Bridge (EB)	Community Energy England	Chief Executive
Cllr Mike Chaplin (MC)	Sheffield City Council	Councillor - Cabinet Adviser for Environment, Streetscene and Climate Change
Cllr Simon Clement-Jones (SC-J)	Sheffield City Council	Councillor (Lib Dem)
Greg Fell (GF)	Sheffield City Council	Director of Public Health,
Cllr Peter Garbutt (PG)	Sheffield City Council	Councillor (Green)
John Grant (JG)	Sheffield Hallam University	Senior Lecturer in Sustainable Construction and Climate Change
Fiona Griffiths (FG)	Sheffield Hallam University	Facilities Manager
Rachael Hand (RH)	Sheffield Climate Alliance	Worker
Edward Highfield (EH)	Sheffield City Council	Director of City Growth
Cllr Tim Huggan (TH)	Sheffield City Council	Councillor (Lib Dem), Shadow Cabinet Member for Environment, Streetscene and Climate Change
Cllr Mark Jones (MJ) (Chair)	Sheffield City Council	Councillor - Cabinet Member for Environment, Streetscene and Climate Change
Prof Lenny Koh (LK)	University of Sheffield	Director of Advanced Resource Efficiency Centre and Head of Communications, Partnership and Internationalisation, Energy Institute
Laraine Manley (LM)	Sheffield City Council	Exec. Director Place
Zak McMurray (ZM)	Sheffield CCG	Medical Director
Andy Sheppard (AS)	Arup	UKIMEA Region Sustainable Development Manager
Thomas Sutton (TS)	Sheffield Chamber of Commerce and Industry	Head of Policy & Representation
Cllr Alison Teale (AT)	Sheffield City Council	Councillor (Green)
Martin Toland (MT)	Amey	Investment Manager
Nigel Wilson (NW)	Veolia	Director
Mark Whitworth (MW)	Sheffield City Council	Climate Change and Sustainability Manager

Appendix 7: Existing projects impacting on emission reduction and climate change adaptation

Sheffield City Council has already committed £43 million from its capital budget to address climate issues in the city over the next five years, as well as accessing more funding from Government. Investments that will help us on our path to net zero carbon include:

Sustainable Travel

- Over £100 million of investment from the city and successfully raised from government is going towards making travelling in Sheffield greener and cleaner and making it safer and easier for people to travel by bike. This includes the new Connecting Sheffield project which is key to our work transforming the city's mobility infrastructure to enable people to get around the city more easily using low carbon, sustainable and inclusive ways of travelling including walking, cycling and public transport.
- Previous work to further active travel includes:
    - Accessing emergency funding for active travel made available as a consequence of Covid, and trialling low traffic neighbourhoods, road closures and new cycle lanes.
    - Investing £1.5m from DfT to deliver high quality cycle networks linking the city centre to Broomhall and providing segregated and direct links across the Inner Ring Road.
    - Promoting active travel with more walking routes, segregated cycle lanes and bus lanes.
    - Funding cycle loans, invested in a fleet of bikes and ebikes that people can loan for free; provided cycle training to people and Bikeability training to school pupils in Sheffield.
- £896,000 funding has been made available for electric vans which businesses can hire to try before buying and 32 electric cargo bikes for small businesses.
- The Council is making its own vehicle fleet cleaner and greener. The Streets Ahead team will run another 15 electric vehicles to replace its current diesel vehicles. It is also taking a major eco-friendly step by trialling two vans that use a hydrogen fuel cell to extend the range of power the battery gives to approximately 200 miles. The Council also runs an extra five hydrogen vehicles.
- 22 ultra-low taxi charge points are to be installed in the city centre.
- Working with Bus companies and government £4.9 million will be invested in to Cleaner Bus Technology Fund to retrofit up to 277 buses to the Euro VI standard.
- Investing £1.25m to increase access to rapid-charge points for electric cars, with many more charging points planned for the city.

Renewable and Sustainable Energy

- Council electricity is now generated from 100% renewable sources, an increase of 81% on last year.
- Energy Surgeries have been established to provide advice on sustainable energy in the home and Smart Energy Meters have been installed for Council tenants – creating a 40% saving for tenants as well as a substantial reduction in wasted energy.
- The Council is leading on a funding bid with three other local authorities in the city region to develop a project to support small to medium sized enterprises (SME's) to implement low carbon improvements within the business.

Waste, recycling and energy recovery

- We have improved recycling facilities for shared properties such as flats, high density housing, and student accommodation.
- Sheffield is trialling electric bin lorries powered by the very waste they have collected. The re-powered lorries have zero carbon emissions and produce no air pollution.
- We are working with the city's schools to see a reduction in plastic, including huge reductions in the amount of single use plastics used at school meal times.
- General household waste is taken to the city's Energy Recovery Facility (ERF), which generates electricity for the National Grid and heat for the city's award winning District Energy Network. As well as reducing landfill waste the ERF reduces greenhouse gas emissions because it avoids the need to burn fossil fuels to produce energy. This prevents around 21,000 tonnes of carbon emissions from being released every year, as well generating energy for the city's schools, council owned buildings and thousands of homes.

Trees, Woodlands and Green Spaces

- Over the next 10 years the Council will plant 100,000 trees as part of its Trees and Woodland Strategy.

Climate adaptation

- Work is ongoing and more than £18 million is being spent to protect Sheffield from the expected increased flood risk resulting from climate change. Work has already been completed on some schemes and further resilience projects are being progressed.
- The award-winning Grey to Green sustainable urban drainage system contributes both to climate emission reduction and also to adaptation. It has replaced roads with cycle paths and drought-friendly, pollen rich planting which is designed to capture water to prevent flooding.
- Flood resilience work to protect the Lower Don Valley completed in 2017 and during the recent flood event in November 2019 these defences prevented significant damage and disruption.

- Plans are now moving forward for the £9 million Upper Don Valley flood protection scheme and phase 1 (Lower Loxley defences) started in August. This scheme will protect parts of Hillsborough and Owlerton that flooded last year.
- A £3m citywide culvert scheme is being developed to improve water flow throughout the city, diverting excess water away from the city's roads and highways.

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Overview and Scrutiny Management Committee Thursday 26th November 2020

Report of: Policy and Improvement Officer

Subject: Draft Work Programme 2020/21: Overview and Scrutiny Management Committee

Author of Report: Alice Nicholson, Policy and Improvement Officer
alice.nicholson@sheffield.gov.uk

This report aims to assist the Committee in determining a programme of work for the remainder of municipal year 2020/21. Covid-19 has disrupted usual pattern of meetings, and meetings are being held virtually. This Committee met in June to consider a Call-In and in September for an Update on the Council's 2020-21 Revenue Budget. Four more meetings of this Committee are scheduled - December 2020, January, February, and March 2021. The February meeting is earmarked for consideration of budget 2021-22.

Section 2.0 of this report is a list of items already suggested for OSMC draft work programme 2020/21. It is for the Committee to consider and agree a work programme, including identify further suggestions and to prioritise items. Scrutiny work programmes are live documents, so are subject to change, and on occasion other appropriate items may have to be swapped into the schedule. Section 3.0 is a guide to assist in determining a work programme.

Type of item: The report author should tick the appropriate box

Reviewing of existing policy	
Informing the development of new policy	
Statutory consultation	
Performance / budget monitoring report	
Cabinet request for scrutiny	
Full Council request for scrutiny	
Call-in of Cabinet decision	
Briefing paper for the Scrutiny Committee	
Other	**X**

The Scrutiny Committee is being asked to:

- Consider, identify, and agree topics for draft work programme 2020/21, and prioritise items for remaining meetings

Background Papers: Sheffield Council Constitution
Category of Report: OPEN

Draft Work Programme 2020/21: Overview and Scrutiny Management Committee - Thursday 26th November 2020

1.0 What is the role of Scrutiny?

1.1 Scrutiny Committees exist to hold decision makers to account, investigate issues of local concern, and make recommendations for improvement. The Centre for Governance and Scrutiny (formerly the Centre for Public Scrutiny) has identified that effective scrutiny:

- Provides 'Critical Friend' challenge to executive policy makers and decision makers
- Enables the voice and concern of the public and its communities
- Is carried out by independent minded governors who lead and own the scrutiny process
- Drives improvement in public services and finds efficiencies and new ways of delivering services

1.2 The Centre for Governance and Scrutiny has updated its activity with several blogs and handy advice for scrutiny in Covid-19, and the Coronavirus Act. These can be found on their web pages - https://www.cfgs.org.uk/ .

1.3 Scrutiny Committees can operate in several ways – through formal meetings with several agenda items, single item 'select committee' style meetings, task and finish groups, and informal visits and meetings to gather evidence to inform scrutiny work. Committees can hear from Council Officers, Cabinet Members, partner organisations, expert witnesses, members of the public. Scrutiny Committees are not decision making bodies, but they can make recommendations to decision makers.

2.0 Current list of suggested items for OSMC Work Programme 2020/21

2.1

Suggested work programme topics 2020/21 for prioritisation and/or addition
• Sheffield City Region – Devolution Deal update and going forward
• Annual Equality Report
• Sheffield Equalities Partnership update
• Revenue Budget 2021/22 and Capital Programme 2021/22
• City partnerships overview

3.0 Determining the work programme

3.1 It is important the work programme reflects the principles of effective scrutiny, outlined above at 1.1, and so the Committee has a vital role in ensuring that the work programme is looking at issues that concern local people, and looking at issues where scrutiny can influence decision makers. The work

programme remains a live document, and there will be an opportunity for the Committee to discuss it at every Committee meeting, this might include:

- Prioritising issues for inclusion on a meeting agenda
- Identifying new issues for scrutiny
- Determining the appropriate approach for an issue – e.g. select committee style single item agenda vs task and finish group
- Identifying appropriate witnesses and sources of evidence to inform scrutiny discussions
- Identifying key lines of enquiry and specific issues that should be addressed through scrutiny of any given issue.

3.2 Members of the Committee can also raise any issues for the work programme via the Chair or Policy and Improvement Officer at any time.

4.0 Meeting Dates 2020/21

4.1 Remaining meetings are scheduled for Thursdays 10am-12pm on the following dates:

- 17th December 2020
- 28th January 2021
- 11th or Friday 12th February 2021 - TBC
- 25th March 2021

5.0 Recommendations

5.1 The Scrutiny Committee is being asked to:

- Consider, identify, and agree topics for draft work programme 2020/21, and prioritise items for remaining meetings

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