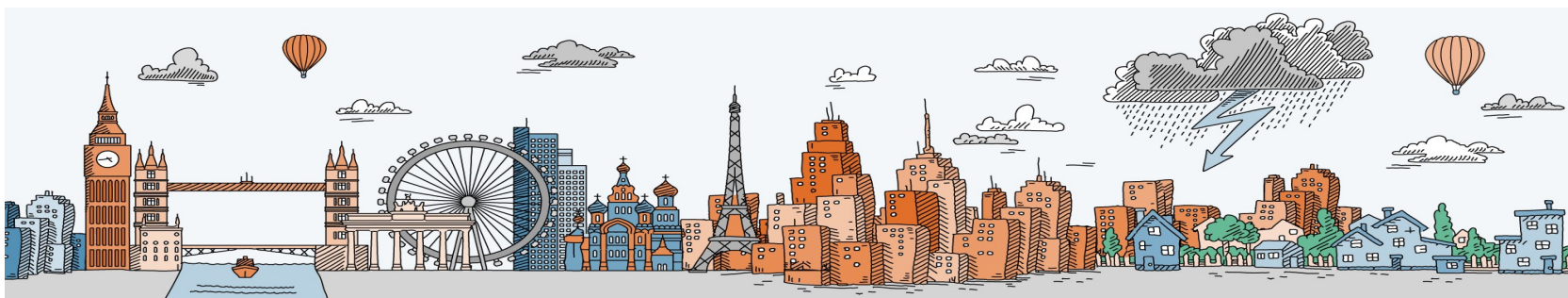




The University of Manchester

Tyndall°Centre
for Climate Change Research



East Midlands East of England London North East North West South East South West West Midlands Yorkshire and the Humber Scotland
Northern Ireland Wales Aggregate Budgets

Setting Climate Commitments for Liverpool City Region

Quantifying the implications of the United Nations Paris Agreement for Liverpool City Region

LIVERPOOL CITY REGION CONSISTS OF THE FOLLOWING LOCAL AUTHORITIES: HALTON, KNOWSLEY, LIVERPOOL, SEFTON, ST. HELENS, WIRRAL

Date:	March 2021
Prepared By:	Dr Jaise Kuriakose, Dr Chris Jones, Prof Kevin Anderson, Dr John Broderick & Prof Carly McLachlan

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

Key Messages

This report presents climate change targets for Liverpool City Regionⁱ that are derived from the commitments enshrined in the Paris Agreement, informed by the latest science on climate change and defined in terms of science based carbon setting. The report provides Liverpool City Region with budgets for carbon dioxide (CO₂) emissions and 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 ⁱⁱ. The UK budget is then split between sub-national areas using different allocation regimes. 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-CO₂ emissions are considered separately to the energy CO₂ budget in this report.

Based on our analysis, for Liverpool City Region 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 46.1 million tonnes (MtCO₂) for the period of 2020 to 2100. At 2017 CO₂ emission levelsⁱⁱⁱ, Liverpool City Region would use this entire budget within 7 years from 2020.
2. Initiate an immediate programme of CO₂ mitigation to deliver cuts in emissions averaging a minimum of -12.6% 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 2043. This report provides an indicative CO₂ reduction pathway that stays within the recommended maximum carbon budget of 46.1 MtCO₂. At 2043 5% of the budget remains. This represents very low levels of residual CO₂ emissions by this time, or the Authority may opt to forgo these residual emissions and cut emissions to zero at this point. Earlier years for reaching zero CO₂ emissions are also within the recommended budget, provided that interim budgets with lower cumulative CO₂ emissions are also adopted.

Sections 1, 2 and 5 of this report - **Introduction, Methods and References** - can be found in the [full print report](#)

3. Results

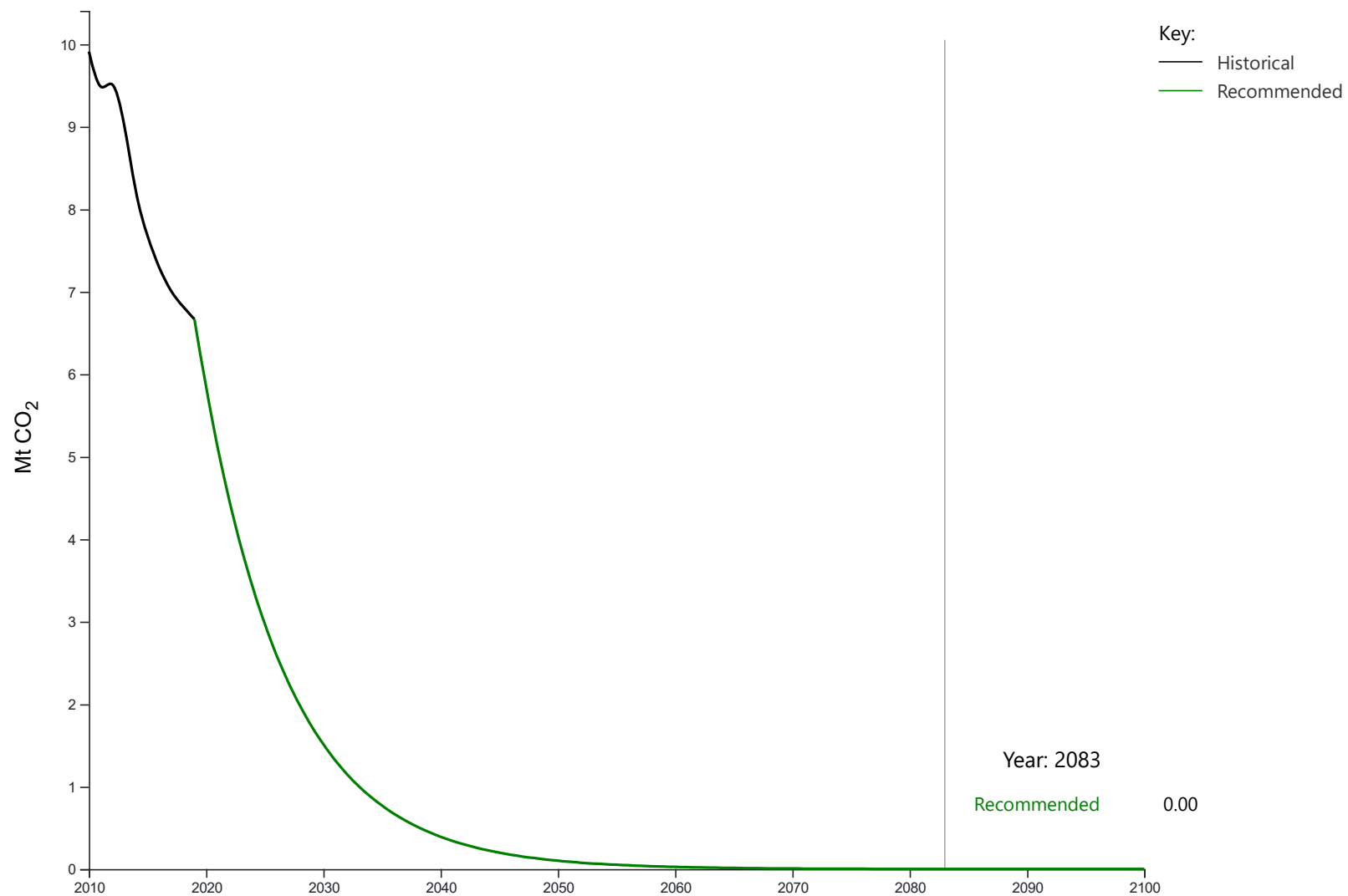
3.1 Energy Only Budgets for Liverpool City Region

Following the Method the recommended energy only CO₂ carbon budget for the Liverpool City Region area for the period of 2020 to 2100 is 46.1 MtCO₂. To translate this into near to long term commitments a CO₂ reduction pathway within the 46.1 MtCO₂ is proposed here. A consistent emissions reduction rate of -12.6% out to the end of the century is applied. In 2043 95% of the recommended carbon budget is emitted and low level CO₂ emissions continue at a diminishing level to 2100.

Figure 1: An interactive chart of Energy related CO₂ only emissions pathways (2010-2100) for Liverpool City Region premised on the recommended carbon budget.

Tracking your mouse over this chart will display the actual figures for each of the pathways, as well as for the lead-in historical values.

Pathway projections for Liverpool City Region



□ *Show alternative pathway projections (see below)*

Table 1 presents the Liverpool City Region energy CO₂ 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 CO₂ emissions for Liverpool City Region for 2018 and 2019, based on BEIS provisional national emissions data for 2018 and assuming the same year on year reduction rate applied to 2019. The combined carbon budget for 2018 to 2100 is therefore 59.6 MtCO₂.

Table 1: Periodic Carbon Budgets for 2018 for Liverpool City Region.

Carbon Budget Period	Recommended Carbon Budget (Mt CO₂)
2018 - 2022	28.8
2023 - 2027	15.1
2028 - 2032	7.7
2033 - 2037	3.9
2038 - 2042	2.0
2043 - 2047	1.0
2048 - 2100	1.0

The recommended budget is the maximum cumulative CO₂ amount we consider consistent with Liverpool City Region's fair contribution to the Paris Agreement. A smaller carbon budget, with accelerated reduction rates and an earlier zero carbon year, is compatible with this approach. It is however important that for an alternative zero carbon year the proposed 5 year budget periods are the same or lower than those specified in Figure 2. Furthermore meeting the budget must not rely on carbon offsets.

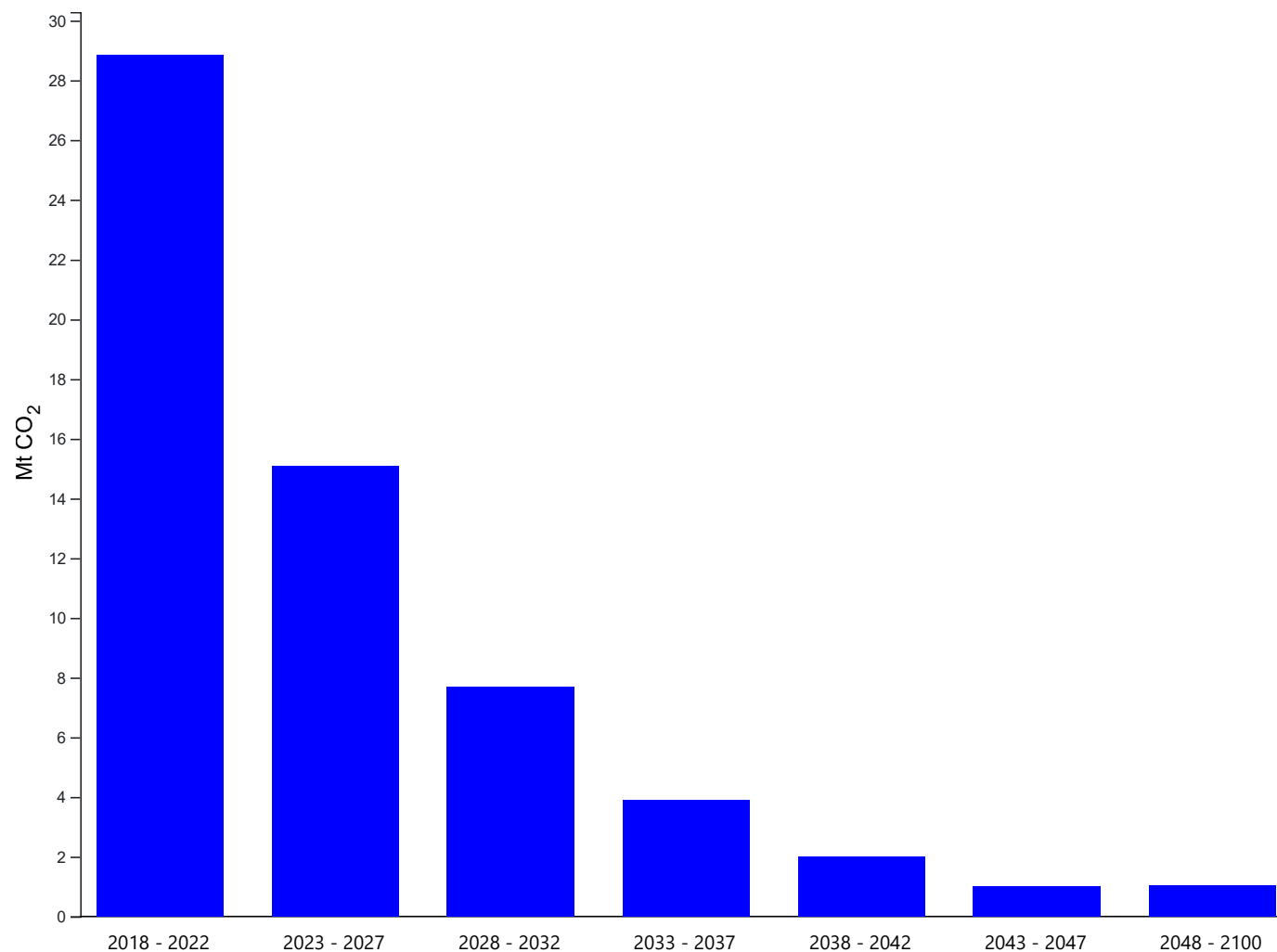


Figure 2: Cumulative CO₂ emissions for budget period (based on Table 1) from 2018 to 2100 for Liverpool City Region

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 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^{iv} (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 is compared to that of Liverpool City Region from 2011 to 2016. The carbon budget (2020-2100) for Liverpool City Region 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 is compared to that of Liverpool City Region from 2011 to 2016. The carbon budget (2020-2100) for Liverpool City Region is then apportioned based on Liverpool City Region'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 is 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 alternative allocation regimes – population and gross value added (GVA).

Table 2: Energy only CO₂ budgets and annual mitigation rates for Liverpool City Region (2020-2100) by allocation regime

Allocation regime (% of UK Budget allocated to Liverpool City Region)	UK Budget ^v (MtCO ₂)	Liverpool City Region Budget (MtCO ₂)	Average Annual Mitigation Rate (%)
-----------------------------------------------------------------------	---------------------------------------------	---------------------------------------------------	------------------------------------

Allocation regime (% of UK Budget allocated to Liverpool City Region)	UK Budget ^v (MtCO ₂)	Liverpool City Region Budget (MtCO ₂)	Average Annual Mitigation Rate (%)
Grandfathering to Liverpool City Region from UK (2.1%)	2,239	46.1	-12.6%
Population split to Liverpool City Region from UK (2.4%)	2,239	52.8	-11.2%
GVA split to Liverpool City Region from UK (1.8%)	2,239	40.8	-14.0%

To view the pathways for the Population and GVA allocation regimes, select the checkbox under Fig. 1

3.3 Land Use, Land Use Change and Forestry emissions for Liverpool City Region

Land Use, Land Use Change and Forestry (LULUCF) consist of both emissions and removals of CO₂ from land and forests. We recommend that CO₂ emissions and sequestration from LULUCF are monitored separately from the energy-only carbon budgets provided in this report. Liverpool City Region should increase sequestration of CO₂ through LULUCF in the future, aligned with Committee on Climate Change's high level ambition of tree planting, forestry yield improvements and forestry management . Where LULUCF is considered, we recommend it compensate for the effects of non-CO₂ greenhouse gas emissions (within the geographical area) that cannot be reduced to zero, such as non-CO₂ emissions from agriculture.

3.4 Non-CO₂ Emissions

The IPCC SR1.5 report identifies the importance of non-CO₂ climate forcers (for instance methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), sulphur dioxide (SO₂) and black carbon) in influencing the rate of climate change. However, a cumulative emission budget approach is not appropriate for all non-CO₂ greenhouse gases, as the physical and chemical properties of each leads to differing atmospheric lifetimes and warming effects . There are also substantial relative uncertainties in the scale, timing and location of their effects.

We do not provide further analysis or a non-CO₂ emissions reduction pathway in this report. However the global carbon budget in the IPCC Special Report on 1.5°C, that our analysis is based on, assumes a significant reduction in rate of methane and other non-CO₂ emissions over time. Therefore to be consistent with carbon budgets Liverpool City Region should continue to take action to reduce these emissions.

The Department of Business Energy and Industrial Strategy's Local Authority emissions statistics do not at this time provide non-CO₂ emissions data at the regional level. Given the absence of robust non-CO₂ emissions data, any non-CO₂ emissions inventory by other organisations at scope 1 and 2 for Liverpool City Region may form the basis of monitoring and planning for these emissions. We recommend considering the adoption of a LULUCF pathway that includes CO₂ sequestration sufficient to help compensate for non-CO₂ emissions within Liverpool City Region's administrative area.

4. Conclusions

The results in this report show that for Liverpool City Region 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 CO₂ emission levels^{vi}, Liverpool City Region will exceed the recommended budget available within 7 years from 2020. **To stay within the recommended carbon budget Liverpool City Region will, from 2020 onwards, need to achieve average mitigation rates of CO₂ from energy of around -12.6% per year.** This will require that Liverpool City Region rapidly transitions away from unabated fossil fuel use. For context the relative change in CO₂ 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 CO₂-only pathway out to 2050 in relation to 2015

Year	Reduction in Annual Emissions (based on recommended pathway)
2020	23.9%
2025	61.3%
2030	80.3%
2035	90.0%
2040	94.9%
2045	97.4%
2050	98.7%

The carbon budgets recommended should be reviewed on a five yearly basis 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 Liverpool City Region 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.

CO₂ emissions in the carbon budget related to electricity use from the National Grid in Liverpool City Region are largely dependent upon national government policy and changes to power generation across the country. **It is recommended however that Liverpool City Region promote the deployment of low carbon electricity generation within the region and where possible influence national policy on this issue.**

We also recommend that the LULUCF sector should be managed to ensure CO₂ sequestration where possible. The management of LULUCF could also include action to increase wider social and environmental benefits..