West Yorkshire Combined Authority Carbon Impact Assessment

Summary findings

January 2022

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1 Purpose and content of this report

This report summarises the work that has been completed by Mott MacDonald and Ricardo on behalf of the West Yorkshire Combined Authority (hereafter the Combined Authority) to understand and improve the way that carbon is assessed on proposals within the Combined Authority's investment programmes. The report also summarises the findings from carbon assessment of a sample of proposals within the Combined Authority's investment programmes.

1.1 Commission purpose

In response to the formal declaration of a climate emergency in 2019 by the Combined Authority, with declarations of climate emergencies by all councils within West Yorkshire, the Carbon Impact Assessment project has sought to develop a robust new approach to support decision making that takes into consideration carbon impacts of proposals within the Combined Authority's investment programme.

1.2 Work undertaken

The West Yorkshire Carbon Impact commission has been structured into multiple phases with several objectives. The Carbon Impact Assessment project consisted of the following phases:

- Phase 1: Review industry carbon assessment best practice, compare against the Combined Authority's practice and make recommendations
- Phase 2: Develop the Combined Authority carbon assessment guidance and toolkits
- Phase 3: To undertake carbon assessments of current projects within the Combined Authority's programmes, providing a view of the carbon impacts of these programmes, and providing opportunity to trial and adapt assessment approaches
- Phase 4: Consider mitigation opportunities on current projects within the Combined Authority's programmes
- Phase 5: Training

1.3 Content of this report

The report is comprised of five further sections following this explanatory primer:

- **Phase 1 – review of current and best practice:** This section summarises the key learnings from a review of current West Yorkshire Combined Authority approaches to carbon assessment and the outcomes of a parallel best practice review of approaches to carbon emission calculation within project development and appraisal. This summary section focuses on key recommendations for improvement of the processes in West Yorkshire.
- **Phase 2 – developing guidance and toolkits for carbon assessment:** This section provides a summary of the central drivers of change underpinning the new assessment approach that has been developed within the commission. These new approaches have subsequently been developed into detailed guidance on carbon impact assessment approaches and have been applied to existing Combined Authority proposals in Phase 3 of the commission.
- **Phase 3 – assessment of existing proposals:** The Combined Authority is keen to understand the carbon impact of schemes in development within its investment programmes. This section summarises the approach taken, and results of, carbon assessment of a selection of 41 projects which are progressing through the Combined Authority's Assurance Framework.

- **Phase 4 – review of mitigation approaches:** This section considers the extent to which carbon mitigation measures have been implemented or proposed for projects within the current investment programme.
- **Conclusions from the review of current investment plans and future actions required:** This final section summarises the headlines, at programme level, of the review of the sample of 41 projects from within the current investment programme. The narrative advances the need for a future investment programme that places addressing the climate emergency as a clearer priority and looks forward to opportunities and the actions required to deliver investment programmes and broader policies needed to tackle the climate emergency.

2 Phase 1: Current West Yorkshire Combined Authority approaches to carbon assessment and key recommendations

In seeking to develop a robust new approach to support decision making on investments in West Yorkshire that takes into consideration carbon impacts, the Combined Authority's approaches to carbon assessment were reviewed and found to be broadly consistent with national guidance and approaches for business case development. This includes consideration of HM Treasury guidance on delivering best value for public investment, and scheme appraisal guidance relevant for specific sectors, for example guidance published by the Department for Transport. This conclusion was reached following review and identification of best practice for calculating carbon emissions in project development and appraisal approaches, and through review of current practices within the Combined Authority's Assurance Framework.

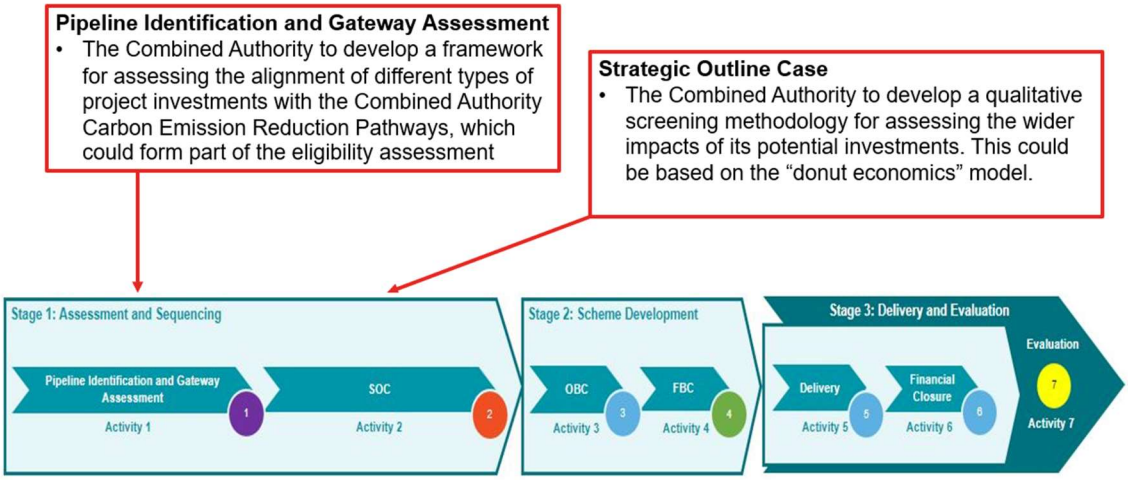
However, there are several areas where limitations were identified through review of best practice, and consequently where recommendations are made to strengthen the Combined Authority approaches. The principal issues identified and recommendations that follow are set out below.

2.1 Strategic alignment of projects in the early stages in project selection

Many of the projects in the Combined Authority's investment pipeline do not seem to be sufficiently aligned with decarbonisation goals. This may be linked to the absence of any formal challenge in the early stage of scheme development (i.e., at Strategic Outline Case). Prior to this commission, there was no formal process to track whether projects proposed for investment included an objective to addressing net zero, or to assess how likely any proposal will be supportive of West Yorkshire's decarbonisation goals.

The inclusion of a high-level statement on how a proposal will help address zero carbon and climate change commitments within Stage 1 at the Strategic Assessment and Strategic Outline Case (SOC) decision points will highlight the importance of the issue and provide a frame for more detailed assessments which can be presented at subsequent decision points.

It is recommended that initial screening of proposals should be undertaken in terms of their potential carbon (and possibly other environmental) impact to determine progression through the Assurance Framework at the earliest decision point (eligibility – Stage 1). To achieve this, the Combined Authority should develop a framework for assessing the alignment of different types of investments with West Yorkshire's Carbon Emissions Reduction Pathways, which could form part of the eligibility assessment. Furthermore, the Combined Authority should develop a qualitative screening methodology for assessing the wider impacts of its potential investments. This could focus initially on the greenhouse gas emissions, and potentially also the climate risks, and then be broadened out to cover other environmental impacts.



Toolkits and guidance have subsequently been developed for use during Stage 1 in the Combined Authority's assurance process to address this issue.

It is important to undertake a carbon assessment at an early stage of a project to consider how it aligns with the Combined Authority's environmental commitments, and the results of any early-stage assessment should ideally be re-evaluated as the scheme progresses. This will not only help to ensure better accuracy for the current project but provide the Combined Authority with a set of benchmarks or references they can use in future to improve the early-stage assessment process. This should be achieved through the application of the recommended approaches as the project moves through Stages 2 and 3 of the assurance processes.

2.2 Tailored approach to different sectors to account for non-transport proposals

The Combined Authority's investment pipeline is dominated by transport proposals, which are covered by national guidance issued by the Department for Transport. There is presently very little guidance provided for carbon assessment on non-transport proposals in the Combined Authority's processes. A review of external best practice examples has not found a single tool that could evaluate all project types in a robust way. Detailed appraisals tend to use sector-specific tools. Whilst more simplified tools do exist, and which are able to cover several project types, they have less accuracy.

It is therefore recommended that the Combined Authority develops a consistent, tailored approach which recognises that different issues exist for different sectors, likewise different tools can be used. It is recommended that regardless of sector or tool, the proportionality principle should be followed; the overall approach should be underpinned by a consistent set of assumptions and rules, for example with respect to the scope of the emissions that are included in the assessment, and the metrics that are used[1]; and that impacts should be considered for all project types and not just for "good" emission reduction projects.

'Non-transport' covers a great diversity of proposal types across several sectors which may have quite specific carbon assessment issues. Applying a standardised approach to carbon assessment across all these project types is extremely challenging based on existing methodologies. Best practice is likely to change in future as more attention is given to this topic

[1] Other examples could include boundaries (what is the extent of the project, what is included in the assessment), defined time span covering the assessment, defined and recorded assumptions, referenced data sources, up to date representative carbon emission factors

area. Guidance (see section 3 below) has consequently been developed setting out the principles of carbon assessment that apply regardless of proposal type, with approaches covering a range of non-transport proposal types currently invested in by the Combined Authority or likely to be part of future investment plans.

2.3 Presentation of carbon assessment findings in business case templates

The assurance process currently requires the presentation of the results of a Value for Money exercise only, with calculated carbon impacts monetised over the appraisal period and reported in units of pound sterling. There is no further requirement for the reporting of carbon in terms of units of greenhouse gas emissions (e.g., tonnes carbon dioxide equivalent, in total, per year and per pound investment).

Due to the lack of reporting requirement, it was found that where carbon impacts had been reported in units of greenhouse gas emissions, this was done inconsistently. For example, in some cases greenhouse gas emissions were reported as an annual summary and in others only carbon reductions were reported, as opposed to the total carbon impact.

Reporting in units of greenhouse gas emissions (as opposed to the monetised carbon impact) allows greater transparency and scrutiny, the ability to aggregate impacts over a programme and more direct comparison between proposals as well as local and national carbon targets.

It is recommended that the Combined Authority should agree what information it plans to report with respect to the greenhouse gas impacts of projects, and in what format, so that the relevant processes and systems are designed to provide the required information. To support this, guidance has been developed on greenhouse gas reporting, including recommending pro forma carbon assessment templates to be included in business case documentation.

2.4 Consideration of capital or embodied carbon

The current focus of Combined Authority processes on transport projects has led to a reliance on the Department for Transport approaches to appraisal of carbon. In turn, this has resulted in a concentration of effort on the assessment of operational emissions from vehicles related to fuel and electricity consumption. This excludes assessment of other sources such as the capital or embodied carbon component of materials. The same issue applies to other construction projects, as there is generally no legal or planning policy requirement to consider embodied carbon.

Ignoring this capital or embodied carbon component of investments risks excluding a significant proportion of the associated whole life carbon. This will be exacerbated in future years given the present focus of the programme appraisal on transport investments where tailpipe emissions from vehicles are predicted to decrease in the future, for example through increased uptake of electric vehicles.

It is therefore recommended that the scope of carbon emissions from proposed investments to be assessed should include all greenhouse gas emissions, including those resulting from the production of materials used in any infrastructure (e.g., capital, or embodied carbon).

2.5 Background assumptions

As legislation, local, or national targets move ahead of current approaches, these approaches and metrics used to inform the forecasted split of vehicle types over future years are not yet consistent with local goals and targets, nor with the UK's legislated net zero goal.

This leads to a situation where the assumptions in the Department for Transport's web-based Transport Analysis Guidance (DfT TAG) for the relative split of fuel and vehicle types used to estimate the impact of a transport scheme are out of step with the stated carbon reduction objectives in West Yorkshire. This presents a problem as using these forecasts and assumptions may overestimate the 'without scheme' carbon emissions by assuming a more limited uptake of electric and other low emission vehicles than will naturally occur and so will potentially distort the size of the modelled carbon savings due to the scheme intervention.

It is recommended that the assessment of carbon emissions from transport proposals should be consistent with an alternative assumed constitution of future vehicle fleets required to meet the Combined Authority's carbon reduction goals. Adopting an approach based on scenarios and associated assumptions within the Combined Authority's Carbon Emissions Reduction Pathways (CERP) report is therefore recommended as a comparison, or sensitivity test, to provide an assessment more compatible with local objectives for carbon emission reduction.

2.6 Induced demand

Induced demand impacts resulting from changes in behaviour and response to transport investments, including mode shifts, destination changes, and strategic re-routing are not always captured within the analysis of transport proposals. This can be due to proportionate modelling of some transport proposals, such as signalisation or other relatively modest road improvement proposals, being undertaken using fixed matrix approaches. In terms of carbon this can contribute to counter-intuitive results for projects that make driving more attractive, with carbon emissions being found to reduce due to improved traffic operations and the impacts on demand of the improved conditions being disregarded.

It is therefore recommended that assessment of carbon emissions from proposed transport investments should account for the impacts of this induced traffic, and that this should be achieved through the application of elasticities where necessary. The subsequent assessment should be presented as a discrete element of the appraisal, thereby ensuring both clarity of the carbon impact, and retaining compatibility with the Department for Transport approaches to appraisal.

Induced demand is not generally accounted for in building-related projects, which focus on the impacts of the buildings themselves, and are restricted to the redline boundary of the site (or building footprint). However, where construction (or demolition) projects are intended to unlock sites for future use, it is recommended that the emissions from subsequent developments be considered. This is analogous to the concept of 'induced demand' in transport.

3 Phase 2: Developing guidance and toolkits for carbon assessment

In delivering phase 2 of the Carbon Impact Assessment project, detailed guidance has been developed based on the outcomes and recommendations of Phase 1 together with the development of some task specific bespoke toolkits. This is intended to inform future assurance process, and future iterations of the Combined Authority's Assurance Framework.

The resources developed within this phase of the commission consist of a Stage 1 (of the assurance process) assessment toolkit and a Stage 2 user guide, as detailed below:

- **Stage 1:** It is recommended that the Stage 1 guidance helps inform discussions on how to enhance the carbon reduction benefits derived from a scheme and/or how to mitigate a carbon increase resulting from the scheme. These discussions **must be considered** at the design/development stage to ensure all avenues have been explored and in turn ensuring that all future schemes are compatible with the Combined Authority's net zero ambitions. The guidance is split into the following activities, and **it is recommended that the Combined Authority mandate the use of these activities on all schemes, and to meaningfully review the outcomes and accordingly update project design before progressing through the project pipeline:**
    - **Activity 1:** a qualitative screening exercise that involves reviewing the Combined Authority's Climate and Environment Plan and considering whether the project is likely to be compatible with Combined Authority's vision for a net zero future. This will help to embed consideration of climate change in the decision-making process and in turn will enable early identification of projects that are at risk of being non-compatible with net zero ambitions.
    - **Activity 2:** a qualitative exercise, ensuring that decision-making on investments in the region takes account of the scale and potential impact of greenhouse gas (GHG) emissions and wider environmental impacts, and of their alignment to West Yorkshire's net zero target. This helps to demonstrate that the Combined Authority's other priorities and policies[2] have been considered from an early stage.
- **Stage 2: It is recommended that the Stage 2 guidance is embedded into the Combined Authority's assurance processes.** This will provide scheme promoters with a transparent and consistent calculation methodology and reporting framework. The stage 2 guidance and toolkits include:
    - Instructions on how to quantify greenhouse gas emissions for a variety of scheme components.
    - Guidance on the calculation approach to deploy at various stages of the assurance process (Outline Business Case (OBC) and Full Business Case (FBC)), corresponding with the level of data available to scheme promoters.
    - A scheme reporting template (pro forma) and a step-by-step guide on how this pro forma should be populated.
    - An induced traffic assessment toolkit and accompanying technical note.

[2] Notably: the Leeds City Region (LCR) Energy Strategy, LCR Green and Blue Infrastructure Strategy, West Yorkshire Low Emission Strategy, LCR Housing Vision and Planning Policy Position Statement, and the West Yorkshire Transport Strategy.

A full list of the recommendations from Phase 1 that informed the development of the resources described above is provided in Appendix A, highlighting what has been actioned as part of this commission and what is recommended moving forward for new proposals. Table 3-1 illustrates how the key components of the new Stage 1 and 2 assessment approaches compare to the existing assessment approach undertaken by the Combined Authority. It also demonstrates some of the limitations of the new assessment approaches, as demonstrated by the comments on what further work is required when the approach is adopted by the Combined Authority in the future.

The approach set out in the new guidance documents was used during the detailed reassessment of projects during phase 3 of the project. Note that there were various limitations in applying the new guidance documents retrospectively to schemes. The review and reassessment of current proposals within the Combined Authority's investment programme is described in more detail in the following chapter. The learnings from that process of reassessment provides evidence to support the recommended future approaches.

Table 3-1: Scope of assessments (current approach, approach adopted in new guidance documents, and approach to be adopted in the future)

Consideration	Previous/current West Yorkshire Combined Authority approach	Approach set out in new guidance documents (and applied retrospectively to existing proposals)	Future West Yorkshire Combined Authority approach (recommended to be adopted)
Stage 1 Assessment			
Stage 1 Assessment	No consideration of compatibility with Carbon Emission Reduction Pathways (CERP).	Proposals categorise according to alignment with carbon pathways and links to Strategic Economic Framework identified, alongside other sustainability indicators, where data allows.	Requirement for compatibility assessment to be completed, with assessment results influencing gateway decisions and scheme development.
Stage 2 Assessment			
Assessment boundary (I.e., what is in and out of the assessment scope)	Inconsistent, with the boundary used for the claimed scheme benefits (e.g., economic) not matching the boundary used for consideration of environmental impacts.	Proposals appraised to align carbon assessment boundary with other assessments (e.g., economic assessment boundary), where data allows.	Requirement to adopt consistent boundaries for all parts of the assessment.
Consideration of induced effects (behavioural response)	Inconsistent. Reasonably well accounted for on major transport proposals, where variable demand models are used. Not well accounted for on some smaller proposals.	Application of screening methodology to assess whether induced affects require additional consideration. Induced demand module application to projects identified by screening.	Clear guidance on scheme characteristics that will require full variable demand modelling and those proposals where using the induced demand module will be the proportionate approach.

Consideration of capital (embodied) carbon	No consideration of capital carbon.	Application of benchmarking approach to provide high level estimate of capital carbon. More detailed calculation approach adopted where data allows.	Requirement and clear guidance for scheme promoters to report capital carbon. Preferred calculation methodology is more granular, with a benchmarking approach as the fallback.
Alignment of future assumptions with CERP	Significant misalignment. Future assumptions used are generally consistent with national guideline (e.g., DfT TAG). This means that the assessment results (carbon, economic) are inconsistent with the future that the Combined Authority has committed to.	Significant misalignment (unchanged from existing) It is not possible to retrofit the recommended approach onto projects already in the assurance framework.	Requirement for scheme promoters to assess using a Carbon Emission Reduction Pathways scenario, in both the carbon and economic assessment (as a sensitivity test). This will require an additional scenario to be modelled.

4 Phase 3: Carbon assessment of existing West Yorkshire Combined Authority proposals

The Combined Authority is keen to understand the carbon impact of proposals in development within its investment programmes. This section summarises the approach taken to assessment of a selection of 41 projects which are progressing through the Combined Authority's Assurance Framework and presents the results of applying revised carbon assessment approaches to those projects.

4.1 Objective of assessments

The primary objective of this exercise is to provide the Combined Authority with some indication of the carbon impact of proposals that are being developed within its investment programmes. The results of the assessments therefore also provide useful evidence to inform understanding of the overall carbon impact at programme level of these proposed investments. It is expressly not the intention of these assessments to re-visit historic decisions or approvals within the assurance process in respect of specific proposals which have been developed under existing or previous guidance. The proposals examined have in some cases been under development for several years. Proposals will therefore have been developed using current and historic guidance that has led to analysis of carbon being framed and developed in ways that do not fit with the proposed approaches going forward. Crucially, these assessments focus only on carbon impact, and do not examine the proposals in terms of other economic, social, or environmental benefits.

A useful outcome of these assessments is that by testing the proposed carbon assessment methodology on real projects that are already in the assurance process, the exercise has highlighted practical problems and opportunities in the application of the guidance to real-world proposals. This has in turn led to adaptation and revision to approaches for carbon assessment that will inform the development of future carbon assessment methodology and guidance in West Yorkshire.

The learnings from this exercise have therefore:

- Enabled refinement of the carbon assessment guidance that has been developed within this commission
- Highlighted several implementation challenges that need to be planned for in the application of future carbon impact assessment methodologies

4.2 Assessment methodology

There were two stages to the assessment work. The first stage involved undertaking detailed analysis, including engagement with stakeholders, for a selection of 41 proposals within the Combined Authority programmes. This represents only a part of the Combined Authority's full portfolio of schemes. The selection was made by the Combined Authority for several reasons, but ultimately reflects a diverse set of proposals that provide a representative snapshot of the whole programme, and helpfully provided a variety of projects from several sectors, at a range of different stages of development, enabling the methodologies developed during Phase 2 of the commission to be tested and refined under a variety of circumstances.

Subsequently, a second stage comprised a high-level examination of the remaining capital programme, with assessments undertaken based solely on data presented by promoters in the respective business cases.

Throughout the analysis undertaken on this commission, both when undertaking the more detailed assessments and the later high-level review of the broader programme, significant use has been made of the Combined Authority's Portfolio Information Management System (PIMS). This system is the Combined Authority's repository for information on proposed investments for use in the assurance process and contains information on proposals for the variety of stages within that process. The information on PIMS consequently varies in scale and content dependent on the stage of development of the proposal.

4.3 Detailed analysis of proposals within the Combined Authority programmes

Briefly, in summary, the main activities undertaken to assess the current proposals within the Combined Authority programmes included:

- The development of a pro forma template to improve consistency in the gathering and presentation of results. The pro forma is split into the following sections:
  a. Summary of results
  b. General project information
  c. Description and critique of existing carbon assessments
  d. Results of revised carbon assessments
  e. Unassessed carbon
  f. Further information
- Review of existing assessments and data available within PIMS.
- Engagement with scheme promoters and wider project teams to attempt to determine the extent of evidence available, and to obtain data not available on PIMS.
- Critique existing assessment and complete gap analysis with new carbon impact assessment recommendations.
- Completion of new assessment, where data limitations permitted. This includes consideration of capital (embodied) carbon, and calculation of induced traffic impacts omitted from existing assessments where applicable.

Completion of the pro forma was undertaken for each of the 41 proposals within the investment programme that were examined in detail.

A high-level summary of the outcomes of the review and reassessment of the current Combined Authority investment programme can be found at Appendix B.

Detailed results in the form of one-page summaries for each scheme can be found in Appendix C.

4.3.1 Programme level view

Taken in isolation the total carbon emissions calculated for proposals within the programme is somewhat meaningless given the complexities and variations between the individual projects and components included in the programme. Given the incompleteness of data available, the challenges of retrofitting assessments to appraisals undertaken using historic guidance, the diversity of scope and appraisal periods considered, and the variety of stages of development of proposals reviewed, the value of total carbon emissions resulting from the proposals assessed does not provide a comprehensive overall view of the programme, nor is it likely to provide clear distinction between the potential benefits of each proposal. Through the remainder of this report

some of the limitations and caveats on the analysis available from the proposals, albeit supplemented by additional analysis within this commission, will be examined.

The summary of carbon impacts, as outlined in Table 4-1, nevertheless provides a high-level view of the programme, distinguishing between transport and non-transport measures, and for transport proposals, between the stages of development of the evidence presented. Of the c. 200,000 tCO_2e total scheme impact calculated to be from the 41 reviewed proposals, representing an increase in emissions resulting from investments within the proposals examined, the majority (roughly three-quarters) of this is derived from the 11 non-transport proposals. One reason for this is likely that for all but one of the buildings proposals under consideration, the do-minimum scenario had a carbon impact of 0 tCO_2e when aligning to the do-minimum assumptions set out in the business case (i.e., the development is a new build, and therefore did not exist and consequently did not emit carbon previously, or the previous building was not occupied and therefore did not consume energy previously). The importance of defining the counterfactual scenario, and making this transparent in assessment assumptions and limitations, is highlighted in section 4.3.3.

The net increase in carbon emissions from proposals examined is almost entirely equivalent to the estimated capital carbon emissions from the proposals. Looking solely at the transport proposals, and viewing the stage of development, those included at Strategic Outline Case (SOC) stage have an estimated carbon benefit (reduction) of c. -35,000 tCO_2e, with the assessments of proposals that have been further developed indicating a progressively higher carbon impact.

Table 4-1: Summary of Carbon Impact of the 41 Reviewed Proposals

	Operational emissions (tCO_2e)	Capital carbon emissions (tCO_2e)	Total emissions (tCO_2e)
Total for SOC Transport all proposals	-61,848	27,877	-33,971
Total for OBC Transport all proposals	-22,230	30,940	8,710
Total for FBC Transport all proposals	12,196	56,369	68,565
Total for Non-Transport all proposals	76,940	80,795	157,735
Total for all proposals	5,059	195,980	201,039

It is apparent that transport proposals included in the assessment at this stage show a progressively higher carbon impact (increase in carbon) as they progress through gateway approval stages from SOC, through to FBC. There are several factors which could influence this result, including the greater detail and scrutiny as proposals are developed and progressed. This may result in increasingly accurate assessment and may expose a tendency to under-estimate the carbon emissions in early-stage development.

Changes in local, regional, and national policy may also be influential. Given the time taken to pass through gateway approval stages, higher total emissions for proposals at FBC could reflect changes in policy and investment programmes. Even five years ago, it is clear from the selection of proposals reviewed within this commission that are at FBC stage, that programmes focused on investments that sought to address significant highway constraints and deliver congestion relief. In contrast, more recent policy proposals, which are represented in this review by proposals at SOC stage, have seen alternative transport modes coming to the fore, with investments specifically targeting behavioural shift to modes that are less carbon emitting.

Pertinently, in respect of the proposals reviewed within this commission, the change in carbon emissions resulting from the proposed investments is small. The analysis indicates that the estimated change in carbon emissions over the appraised life of the 41 projects represents a change of only 0.04% between the “do minimum” situation and the “do something” proposed.

For context, the Combined Authority’s 2020 Carbon Emission Reduction Pathway report identifies that West Yorkshire currently emits 11.1 million tonnes of carbon dioxide equivalent per year (11.1 $MtCO_2e$). Transport is identified as the largest emitting sector, dominated by road transport and private vehicle use. Many of the projects within the basket of proposals examined are transport investment proposals, with significant numbers of the projects being highway-based investments. The sample of proposed investments examined is therefore of some relevance when considering future carbon emissions.

The change in emissions from the proposed investment reported through the analysis (an increase of 200,000 tCO_2e across the appraised timeframes for each project, accounting for the fact that much of the analysis covers a 60-year appraisal period) is therefore insignificant when viewed against the annual carbon emissions of more than 11.1 $MtCO_2e$ each year in West Yorkshire.

In the review that follows, some further high-level observations are presented.

4.3.2 An overview of transport proposals

Some 30, of the 41 proposals examined, can be viewed as transport proposals. This includes a wide variety of investments, from highway-based corridor improvement proposals that encompass some capacity measures, junction improvements, bus priorities and active travel improvements; through to facility improvements such as new rail station proposals, station gateway improvements, and park and ride proposals. One transport proposal also includes some building-related elements.

Of the 30 transport proposals, 8 are currently at SOC stage, being the stage where the known project details and associated assessments are at the least developed level. At this stage, there are 5 proposals seeking to improve the provision of active modes and public transport, 1 bus priority scheme, 1 park and ride scheme, and 1 station gateway scheme. The commonality across all 8 proposals is that they focus on providing enhanced alternatives to traditional highway schemes and corridor improvements.

The proposals at SOC stage provide an overall carbon ‘benefit’ with total emissions across the 60-year appraisal period being c. -35,000 tCO_2e. Two proposals contribute significantly to this, both offering enhancements to walking and cycling, alongside public transport improvements. These two proposals show an increased capital carbon value, with the operational carbon savings driving the overall carbon reduction across them.

Of the remaining 6 proposals assessed at SOC, total carbon emissions are c. 9,000 tCO_2e. However, it has not been possible to quantify the operational emissions of some of these proposals given the lack of detail provided at this stage. While the value of operational carbon is unknown, it could be expected that, given the nature of the proposals and the results shown by other similar proposals (resulting in an operational carbon value of c. -62,000 tCO_2e from the 4 proposals at SOC with data available, i.e., a carbon reduction), further carbon reduction could be possible.

Eleven of the 30 transport proposals assessed are at OBC stage, allowing for more detail in the assessment, given greater knowledge of the scope and design. Of the proposals assessed at OBC, 9 focussed on walking and cycling improvements, as well as public transport improvements (including bus priority measures and station gateways), with the remaining two being new railway stations.

Overall, the proposals currently at OBC and included in the assessment resulted in a reduction in operational carbon of c. -22,000 tCO_2e. However, the inclusion of the capital carbon associated with the construction of these 11 proposals results in an overall increase in total carbon emissions of c. 8,500 tCO_2e. Of the 11 proposals assessed at OBC, only one (a new station proposal) did not provide data with which to calculate operational emissions.

The remaining 11 transport proposals included in the programme level assessment are at FBC stage. At this stage, it is expected that the assessment from the promoter is rigorous and results in an accurate overall appraisal, adequately justifying the investment sought. Nine of the 11 proposals at FBC have an active mode element to the scheme, combining that with highways measures, public transport provision and station access. The other two proposals assessed at FBC are a bus interchange facility and a park and ride scheme. The proposals included in the assessment at FBC result in an increase in operational carbon of c. 12,000 tCO_2e, and total carbon of c. 68,500 tCO_2e. Of these 11 proposals, only the bus interchange had insufficient data to accurately present operational carbon emissions.

A theme emerging while assessing proposals at OBC stage, and continuing through to FBC assessments, is the variability in results of operational carbon, despite some individual proposals being of the same nature. Further scrutiny of these proposals suggests that different modelling approaches have resulted in varying results.

Amongst the many variables in the transport modelling and analysis that influence the reported operational carbon emissions predicted to result from the proposals, either in terms of benefits or disbenefits, are:

- The type of proposal. The 30 transport proposals examined include a new rail station, a new park and ride site, an extended park and ride side, improvements to station gateways, rail and bus station improvements, highway corridor capacity improvements, new bus lanes and priority measures, new cycle lanes, improvements for pedestrians, and combinations of the above. Each proposal is in a different location, with a range of contexts both urban and rural, and a variety of underlying social and economic contexts within the local area of the proposals. Some are large in scale and scope; some are relatively small.
- The model used. Proposals have been modelled using a variety of different tools, including strategic multi-modal transport models, relatively simple highway models, or models that focus on junctions. Some of the proposals have not been modelled in any of these conventional transport modelling tools. Dependent upon the type and location of the intervention, many have been modelled or assessed using tools that have been developed as bespoke tools expressly for the purpose of analysing such proposals in the local area. Conversely, some proposals have been modelled using tools that are not suited to the proposal or context, with analysis being undertaken simply in the best tool available. Analysis has been undertaken in a variety of proprietary software tools.
- A variety of parameters have been used. Different models have a variety of base years defined for the analysis. This in turn will lead to a variety of traffic growth assumptions, with consequent differences that will result in the future demand forecasts that underly any modelling of proposals in future years.
- Where transport modelling has been undertaken the modelled area has a significant impact on the reported results, with the defined area of impact influencing the journeys reported and therefore the carbon impact. The analysis examined for the A6120 Leeds Northern Outer Ring Road Improvements proposal has a very large carbon emissions figure associated with its analysis, resulting from the potentially wide impact of such a proposal and the consequent large, modelled area. Inevitably this will influence any change in carbon emissions reported because of a particular intervention.

- The location in the transport model of a proposed intervention. It is well understood within the transport modelling sector that that if a proposal lies towards the edge of a model, accuracy of any modelling will be diminished.

This serves to emphasise the importance of reporting the context of the analysis undertaken, in addition to any quantitative results of such analysis. In terms of the reported carbon emissions benefits (or disbenefits) resulting from different types of proposal, it is therefore difficult to provide general commentary on the carbon impact of certain types of proposal. Some broad inferences can nevertheless be made.

For instance, each of the three proposals that can be purely identified as active travel improvements yield an operational carbon reduction through the appraised periods of the projects. This is logical, as proposals assessed using the Department for Transport's Active Travel Appraisal Toolkit (AMAT) are assumed to deliver some level of mode shift, which will in turn provide a carbon benefit. However, the amounts of carbon are small in the context of overall emissions in West Yorkshire, with the three projects appraised as reducing operational carbon emissions by less than 1,700 tCO_2e across the appraisal period. This benefit is more than negated by an increase of more than 3,000 tCO_2e of capital carbon in the construction of these proposals. Looking forward, this minimal predicted impact on carbon from isolated interventions to encourage active travel is illustrative of the need for a broader shift in travel behaviour change, and consideration of the cumulative impacts of a variety of interventions and policy changes that encourage mode shift and increased levels of active travel.

The multi-modal corridor proposals are more difficult to address collectively. These proposals include a variety of measures, and demonstrate a range of predicted carbon impacts, including both positive and negative. Intuitively, some corridor improvement schemes will deliver improved highway capacity, improving traffic flow, and therefore reducing carbon. However, the removal of congestion will encourage further use of such corridors, and the impact of behavioural changes with consequent induced demand impacts are addressed elsewhere in this report. In combination with a variety of bus, cycling and walking improvements in these corridor proposals, it is difficult to generalise on the carbon impact.

Most of the station gateway proposals, which include some active travel access improvements, similarly reduce operational carbon emissions. Generally, the analysis for projects which aim to promote modal shift and lead to a reduction in congestion, can give rise to carbon reductions. However, in some instances station gateway proposals can be predicted to lead to a significant increase in carbon emissions, such as the Selby Station Gateway proposal. This results from the closure of Denison Bridge to traffic to facilitate the proposal, which while it improves access for active modes, results in significant re-routing of traffic over much longer distances. In respect of carbon, this shows as a significant carbon disbenefit (increase in carbon emissions) from the proposal.

The small sample sizes of other distinct types of project make it unwise to generalise, as the scope of the proposals, and the scope and assumptions underlying the analysis undertaken, influence the results reported. Taken together, the 30 transport projects reviewed are estimated to increase carbon emissions over the appraisal period (often 60 years) by less than 45,000 tCO_2e, which is insignificant in the context of annual transport emissions in West Yorkshire.

4.3.3 Non-transport

Eleven of the 41 proposals examined are non-transport proposals. Nine of these relate to building investments, including some new building proposals, some refurbishment and energy efficiency proposals, and two proposals for demolition and land remediation. One buildings project incorporated all these elements. The other two proposals examined are unique in terms of this sample, one being a proposal for business grants (where no quantified appraisal is

available), the other a flood alleviation proposal (where the carbon emissions estimated relate only to capital carbon).

New building projects generally result in an increase in emissions. The analysis indicates that the nine building projects, where analysis is available, will lead to an increase in carbon emissions of over 134,000 tCO_2e. Of this, just over 40% is estimated to be from capital carbon emissions.

This increase in carbon emissions holds true even for projects that are designed to achieve comparatively good standards of energy efficiency, such as the Guinness/Points Cross project. One of the main reasons for this is that energy performance targets typically only impact a sub-set of total emissions from buildings. Standard methodologies to assess emissions from buildings, such as Energy Performance Certificates (EPCs) and its associated modelling methodology, do not account for all sources of emissions, and only provide a snapshot in time, whereas a full carbon assessment would consider the impacts over the building's lifecycle.

Operational carbon emissions are also largely ‘locked in’ once a building is constructed unless it undergoes major refurbishment. This highlights that there is a big difference between achieving good practice (as many of these schemes do) and delivering net zero construction projects, which requires radically more stringent energy and carbon performance standards. Any new buildings that are not capable of operating with net zero emissions will need to undergo refurbishment between now and 2050 at the latest, potentially at public expense.

Emissions were shown to increase even for the energy efficiency refurbishment of Northgate House. The reason for this is that the ‘Do Nothing’ or ‘Do Minimum’ scenario in the FBC assumed that the building would remain unoccupied, and our carbon assessment was intended to align as much as possible with the FBC. Therefore, the assessment compared emissions from an unoccupied building (zero) against the total emissions from the operation of the refurbished building, plus all the emissions from the materials and construction process. If the building had been assumed to be occupied, the results of the appraisal and consequently of the assessment reported here would have indicated a net reduction in emissions. This is an example of why the results require careful interpretation, and the challenges of aligning the economic assessment with the carbon impact assessment.

The example above highlights the importance of defining and selecting the counterfactual (do-minimum) scenario. The method of selecting the scenario should be consistent across schemes. In line with the Stage 2 guidance, the assessment boundary should align to what is reported within the rest of the appraisal. It is therefore recommended that the approach to define the do-minimum scenario is consistent with what is claimed within the business case, and to be clearly described within the reporting pro forma. For example, in the case above, the do-minimum scenario was chosen to be aligned with the FBC, which was that the building was unoccupied. Of course, it is not possible to have full certainty over what may occur under a do-minimum scenario, and it is possible that alternative situations may occur. Given the sensitivity of the do-minimum scenario on the overall results, it would be recommended that scheme promoters show awareness of this sensitivity. Scheme promoters would therefore be advised to consider plausible alternative scenarios and discuss how this may change the outcome of the results, at least qualitatively. The reporting pro forma produced as part of Phase 2 of this project allows scheme promoters to present these discussions within the Additional Information section. Transparency over this matter is an effective method of presenting the limitations to the study, which is standard best practice in carbon assessments.

The approach to appraisal is also pertinent when looking at the District Heating Network (DHN) proposal within the proposals reviewed. Although a full assessment of the DHN proposal was not carried out, we note that the existing carbon assessment only considers a snapshot in time, and the comparative benefits of a DHN compared with individual systems relies heavily on

assumptions about future emissions from grid electricity. It is recommended that future carbon assessments of any proposal should consider grid decarbonisation (or other relevant trends in fuel consumption or technological change, if known). This will help to inform a more complete understanding of key risks and sensitivities, and whether the project 'makes sense' in a net zero future. Our guidance on Stage 1, Activities 1 and 2, is aimed at prompting consideration of the latter. Grid decarbonisation is accounted for in the guidance presented for Stage 2.

4.3.4 Induced traffic effects findings

The provision of new facilities leading to behavioural responses such as increased travel demand is well known, but not consistently allowed for in existing appraisals. Induced demand is used in the context of transport appraisal to describe change in trip demand that would not have occurred without the intervention. For many investments or interventions, the behavioural response will act to increase demand, however, in some cases the opposite may occur, for example measures that reduce the attractiveness of highways to private car drivers.

Induced effects will be important for the assessment of carbon on some proposals and negligible on others. For transport proposals, while there is provision for induced effects to be appraised using DfT TAG methodologies, review of business cases submitted to the Combined Authority for consideration within a variety of funding programmes suggests that induced effects are rarely allowed for explicitly. Nevertheless, existing appraisal approaches used by the Combined Authority do allow for some induced effects including, for example, following DfT TAG where variable demand models are used to forecast trip demand and which take account of behavioural responses. Some complex strategic models may not directly account for induced effects specific to mode shift but will account for some induced effects of a highway scheme resulting from strategic re-assignment. The Active Mode Appraisal Toolkit (AMAT) also estimates additional active mode trips such as those switching from different modes.

For some transport proposals induced effects will therefore already have been well accounted for in the transport assessments undertaken by project promoters. In other cases, a simple screening exercise agreed with the Combined Authority has identified that additional assessment may be required to adequately account for induced effects that will lead to previously unaccounted for carbon emissions. For non-transport proposals, additional induced effects would include effects not well accounted for in existing appraisal approaches.

The application of an induced demand screening has resulted in four additional induced carbon calculations being undertaken (around 14% of the transport projects examined). A calculation module has been developed within the commission to estimate these induced effects. The module is relatively simple and can be easily applied without requiring any further transport modelling. The calculation module, while being sufficient for smaller junction and relatively simple fixed-matrix transport models, faces limitations in assessing induced impacts of strategic transport models. The elasticity-based approach used in the tool has the potential to double count some impacts within the strategic model, even where there is a fixed matrix, due to the induced effects associated with trip re-assignment. This will ultimately impact any results of the carbon assessment. The results of these additional calculations for three proposals are presented in Table 4-2 below, the fourth being omitted due to concerns around the input values available[3].

[3] The Transport Users Benefit Appraisal (TUBA) files used to support the induced carbon calculation indicated a very large journey time benefit between the 'Do minimum' and 'Do something' scenarios, which is likely driving a very high number of induced trips and associated carbon emissions. The induced demand modelling is consequently likely over-estimating the impact of induced effects resulting from the scheme.

Table 4-2: Results of application of induced demand module

Emission Source	Fink Hill (Leeds corridor improvement programme)	A58-A672 (Calderdale corridor improvement programme)	A646-A6033 (Calderdale corridor improvement programme)
Operational transport emissions (tCO_2e)*	4,890	-751	1,696
Of which: Induced element (tCO_2e)*	1,557	1,282	2,624
Capital carbon (tCO_2e)	490	437	379

*Difference between Do Minimum and Do Something over 60-year appraisal period

In each case, the additional carbon emissions identified through the induced demand analysis is significant. In the case of the A58-A672, while the overall operational emissions continue to show an overall carbon reduction, the scale of that benefit has been reduced from an apparent 2,000 tCO_2e saving to only 750 tCO_2e saving over the appraisal period. In the case of the A646-A6033 and proposal an apparent carbon benefit has been shown to be an increase in carbon emissions due to the impact of the induced effects.

4.3.5 Capital carbon findings

Capital or embodied carbon is not often considered in existing Combined Authority assurance and appraisal of proposals. It is well recognised that capital carbon is an important component of infrastructure carbon, that will become more significant over time[4] and there is currently an increasing policy focus.

Where project-specific information is available in the form of material types and quantities, an in-depth assessment[5] has been undertaken during the re-assessment of projects, unless capital carbon is minimal for the scheme. However, in many instances no detailed data was available for the proposals considered. This is unsurprising because the Combined Authority has to date not been routinely requesting this information, and therefore capital carbon calculations are not yet often carried out for construction and infrastructure projects. Therefore, for many proposals reviewed in this commission, capital carbon estimates have been based on benchmarks. The information used for the capital carbon assessment varies across scheme types. In most cases for transport proposals a benchmark has been applied to the construction cost to obtain a high-level estimate, with more granular benchmarks based on specific scheme components (e.g., length of cycle path) applied where possible. In the case of buildings, the floor area was used, applying a standard benchmark according to the building use type to calculate capital carbon emissions.

The scale of capital carbon emissions compared to total project footprint can vary widely. In some instances, emissions associated with capital carbon were only a minor impact compared to the total scheme impact, however in other instances, the impact was much greater. Regardless of the potential impact of capital carbon emissions on the total project footprint, it remains best practice to assess capital carbon wherever possible, with the outcomes of the review of projects presented above indicating that close to 100% of the net carbon emissions generated by the investment programme can be attributed to capital carbon. The Stage 2

[4] Infrastructure Carbon Review (publishing.service.gov.uk)

[5] Due to data availability, the carbon assessment included the embodied carbon from construction materials and emissions from construction transport and plant. The assessment did not include maintenance and replacement, or decommissioning activities.

guidance has been developed in such a way to allow for a capital carbon assessment to be carried out even when minimal project information is available. This method allows schemes to identify an estimate of the potential size of the capital carbon emissions associated with a scheme and understand their significance. This in turn can help guide mitigation decisions.

4.3.6 Unassessed impacts findings

Although the pro forma attempts to capture the key emission sources emerging from a proposal quantitatively, it is not always possible to calculate the impact of all potential emission sources within the detailed assessments. Table 4-3 provides an overview of some of the common emission sources that are not quantified within the assessment, though this varies on a case-by-case basis.

Table 4-3: Emission sources not quantified within the assessment

Carbon source	Typical impact on carbon emissions	Typical reason for not being quantified	Expected significance on results
Additional operational energy from electric vehicle charging points	Increase carbon emissions associated with the site/building due to higher electricity but reduce overall carbon emissions due to facilitating a shift to electric vehicles.	Data constraints	Low significance, varying depending on energy source.
Unlocked housing development	Increase carbon emissions	Data constraints (typically something that has been written into business cases – often in the strategic case - as a benefit of proposals, but is not accounted for within the direct scope of a proposal or its appraisal)	High significant impact (which may be captured in carbon assessments of future proposals). Varying depending on scale of development.
Carbon sequestration from tree planting and green infrastructure	Decrease carbon emissions	Unless undertaken on a large scale (i.e., measured in hectares, not numbers of trees) and accompanied by a long-term maintenance plan (i.e., many decades, not years), the impact will generally be too small and not permanent enough to merit an assessment, compared with the scheme overall.	Low significance, varying depending on extent of intervention compared to scheme size.
Low carbon materials and local procurement	Decrease carbon emissions	Data constraints - in most cases, a high-level quantification method was used given that a bill of quantities was not available, this method does not allow for the granularity of including specific emission factors	Low to high significance. Not possible to tell with data constraints, will vary case by case.

Carbon source	Typical impact on carbon emissions	Typical reason for not being quantified	Expected significance on results
Benefits from modal shift to active transport	Decrease carbon emissions	Data constraints (traffic modelling input data not accounting for the estimated benefits from modal shift)	Low significance but will vary case by case.

In most cases, the unquantified carbon impacts are expected to have a low significance on the overall impact of the scheme. In the case of unlocked housing development, where the emission source is likely to be significant, these emissions should be considered during the assurance process, if they form part of the business case.

Though it is not possible to quantify some emission sources, these are presented qualitatively within the pro forma with an indication of expected significance specific to the scheme. Presenting this information qualitatively helps to provide a more holistic understanding of the potential carbon impact of a proposal. This also demonstrates how the final quantified carbon impact of a scheme should be considered carefully and alongside all other relevant information.

4.4 High-level project review

Following the detailed assessment of proposals described above, to enable a broad picture of the current position across the Combined Authority's portfolio of projects, a high-level project review was undertaken on 54 further proposals which were not included within the detailed assessment phase. It was not possible to undertake this high-level review exercise on the whole of the remaining schemes within the Combined Authority's project portfolio due to a variety of limitations, such as the proposal being too early in its development to provide sufficient detail to enable any assessment to be undertaken.

1. The high-level project review consisted of examination of the most recent business case documentation within the Combined Authority's Portfolio Information Management System (PIMS) to undertake the following activities:
2. Review whether an operational carbon assessment had been undertaken, and whether any results were reported within the business case. Where results were reported, these were documented within a dedicated review workbook.
3. Review if any capital carbon analysis had been undertaken, and where a capital carbon assessment had not been included, a high-level estimate was undertaken (data permitting). This was undertaken in line with the Stage 2 Guidance developed as part of this commission.

An induced traffic demand screening[6] was completed on transport proposals to determine whether an induced assessment would be applicable to the project type, whether induced demand had already been accounted for within the operational carbon assessment, or whether additional analysis would be required moving forward.

The outputs of the high-level review across the 54 projects can be found in Appendix D. Note that this review was not intended to be an in-depth exercise, therefore there is low confidence in the quantitative results. However, the high-level review was illuminating and highlights an urgent need to improve the carbon assessment and reporting of the projects progressing through the Combined Authority's assurance process.

[6] Note, this step consisted of the screening exercise only. Where an induced traffic assessment was deemed applicable but not already accounted for, no calculation was carried out to estimate the impact of this.

A key finding was that operational and capital carbon assessments were only reported on 24% and 6% of the reviewed proposals respectively. This represents a significant under reporting of carbon emissions from this group of proposals. This finding aligns with conclusions from the detailed assessment phase of the project. It is therefore evident that more stringent calculation and reporting protocols are required.

It is intended that this issue will be mitigated through the application of new approaches and analytical requirements for scheme sponsors and promoters. The work undertaken in phase 2 of this commission to develop new carbon assessment guidance and toolkits for use in Stages 1 and 2 of the assurance processes, when applied through inclusion in the Assurance Framework, will enable a better understanding of the carbon impact of proposals from the earliest stages of the investment planning process. These new guidance resources will help scheme promoters to consider carbon and other strategic priorities from the outset of project scoping.

5 Phase 4: Mitigation findings

As part of the process of reviewing and completing carbon impact assessments on the projects selected for detailed review, the team also considered the extent to which carbon mitigation measures had been implemented or proposed.

5.1 Findings and recommendations

After reviewing business case documentation and engaging with scheme promoters within review sessions, it is apparent that the extent to which carbon mitigation measures are considered varies across projects. What is clear from this exercise is that carbon mitigation is not often the primary driver of measures. In many cases, carbon mitigation is an indirect benefit of project design decisions.

Discussions with scheme promoters highlight that, when asked if mitigation had been considered to date within the project, the response is that mitigation measures would be considered at a later stage of the project. The carbon reduction hierarchy highlights the importance of considering carbon at the earliest stage possible within a project as this presents the greatest ability to influence and reduce carbon emissions. The lack of consideration for carbon mitigation at an early stage is evident for transport proposals, where only three of the carbon impact assessments under review have actively considered mitigation and written this into the business case. When considering non-transport projects, the level of ambition varies from a do-minimum approach to align with building regulations to a full Passivhaus[7] scheme with optimally reduced carbon emissions. **It is therefore recommended that mandatory consideration of carbon mitigation is addressed for all projects, from the earliest stages of development.** This would ensure engagement across all schemes and allow for greater knowledge sharing across the whole of the Combined Authority's portfolio.

The variety in the extent to which mitigation is currently being considered highlights the risk of this not being a mandatory consideration at present. Rather, the driver of carbon reduction primarily falls upon the ambition of the individual project team. Due to various other demands and challenges that project teams face when passing proposals through the assurance process, it is unlikely that most scheme promoters would volunteer to complete this additional exercise, though in one instance during the commission one promoter did offer to examine mitigation more closely. Nonetheless, some scheme promoters did highlight their interest in implementing mitigation measures if they had not done so already and were interested to learn more around the subject. **This highlights the need for the Combined Authority to deliver more in-depth training.** Such training would be beneficial for scheme promoters to help them understand the value in carbon mitigation on overall project design and how to effectively implement mitigation measures within projects.

5.2 Mitigation training workshops

To engage scheme promoters in further discussion and begin providing a more in-depth understanding, a series of mitigation workshops were held. The workshops covered both transport and non-transport mitigation. Within the workshops, there was an interactive session whereby scheme promoters helped identify further carbon mitigation measures that could be

[7] According to The Energy Saving Trust, a Passivhaus refers to buildings which maintain an almost constant temperatures, because of the way they are constructed, insulated and ventilated. A Passivhaus requires minimal additional heating or cooling. Source: Passivhaus: the gold standard in energy efficiency - Energy Saving Trust.

considered based on the carbon reduction hierarchy. The outcomes of these sessions are presented in Appendix E.

The examples listed below were presented to scheme promoters as best practice during a series of mitigation workshops (some of which were extracted from examples discovered during scheme promoter review meetings).

Operational phase

- Addition of pedestrian and cycle paths
- Reduce energy demands through high levels of energy efficiency and airtightness
- Traffic management systems
- Use of low carbon and renewable energy sources
- Maximise opportunities for on-site renewable energy technologies (and co-locate these with EV charging infrastructure)
- Setting targets for reducing operational carbon as part of the brief from the outset
- Provide building users with smart energy control/management systems, energy, and water meters

Construction phase

- Use of prefabricated elements and off-site construction to optimise efficiency of resources
- Use sustainably sourced timber, along with reclaimed or recycled materials (e.g., recycled steel, aggregates, etc.)
- Implementation of a Site Waste Management Plan, and Materials and Resource Efficiency Management to ensure waste minimisation and re-use of materials on site
- Prioritisation of the use of local materials to minimise transport emissions (and seek low carbon options for transporting material)
- Engagement with material suppliers, considering their policies and commitments to greenhouse gas reduction
- Implementation of targets for reducing capital or embodied carbon as part of the brief from the outset

The interactive sessions within the workshops had strong engagement from scheme promoters. The sessions, which included questions on mitigation, ideas scheme promoters had around potential mitigation implementation, and concerns they had around mitigation implementation, highlighted that carbon mitigation is a subject in which scheme promoters are willing to get involved with but it is still relatively novel to some, and further training is required. Therefore, **it is recommended that the Combined Authority:**

- **Encourage project teams to hold similar workshops to those delivered within the interactive sessions in early project stages**
- **Host further training sessions and make this readily available as a key resource to scheme promoters**

5.3 Challenges to mitigation

Challenges to effective carbon mitigation implementation were discussed both within the review meetings and within the workshops. One such challenge was the mitigation measures in which scheme promoters viewed to be an effective intervention. Carbon sequestration through tree planting was often cited by scheme promoters as an example of carbon mitigation considered on the scheme. However, this usually consisted of planting a small number of trees where the primary purpose was for aesthetic reasons. Although tree planting is a viable carbon mitigation

option, where only small numbers of trees are planted it is very unlikely to offset the emissions associated with the construction and operation of a scheme (the Stage 2 guidance developed as part of this commission provides further information on this within the Woodland Schemes section). It would therefore be encouraged to implement a mitigation strategy that has been informed by a review of the primary carbon hotspots and viable solutions to address these. Where tree planting is part of the mitigation strategy, it should be considered alongside wider environmental impacts such as biodiversity and should be supported by a rigorous sustainable management plan.

Another challenge is that, in some cases, mitigation options are felt to be limited due to the nature of the Combined Authority's involvement. For example, on the Parry Lane scheme, the Combined Authority only funded the site remediation and land preparation; therefore, there was no guarantee the future site developer would adopt energy efficiency measures such as ones set out in BREEAM standards. This leads to a situation where the Combined Authority might be enabling subsequent developments that are not compatible with a net zero future.

Discussions with scheme promoters also highlighted that the cost of mitigation is often a concern to projects. If applied in the correct manner a reduction in carbon can also result in a reduction in cost. This common misconception highlights that further training would be beneficial to increase the understanding of carbon mitigation.

6 Conclusions from the review of current investment plans and future actions required

6.1 Current investment programmes contribute little to tackling the climate emergency

In addressing the development of an investment programme that can help tackle the climate emergency, it is accepted given the broader economic and social objectives of the Combined Authority that carbon impact alone cannot be the basis on which investment decisions are made. Nevertheless, carbon impact assessment can be an important input to decision making.

The outcomes of the carbon assessment undertaken on the sample of proposals from within the current investment programme, reported above, indicates:

- The sample of current proposals within the investment programme that has been examined have predicted impacts on carbon emissions that are relatively small. The analysis indicates that the estimated change in carbon emissions over the appraised life of the 41 projects represents a change of only 0.04% between the “do minimum” situation and the “do something” proposed.
- When put in the context of West Yorkshire total carbon emissions, the combined impact of these proposals on carbon emissions is minimal and does not materially change the direction of travel. The change in emissions from the proposed investment reported through the analysis (an increase of 200,000 tCO_2e across the appraised timeframes for each respective project), accounting for the fact that much of the analysis covers a 60-year appraisal period, is insignificant when viewed against the annual carbon emissions of more than 11.1 $MtCO_2e$ each year in West Yorkshire.

There are important caveats to note in making these observations. Firstly, the current investment programme has not been developed with the explicit intention of reducing the region’s carbon emissions, and therefore proposals within the programme are generally not specifically designed to lower carbon emissions. Ensuring the right projects that support carbon reduction are included within the investment programme is therefore an important future consideration. The Stage 1 guidance developed within this commission, if appropriately implemented, will help to address this over time, driving greater transparency in promoting projects that support carbon reduction as well as other strategic objectives.

Furthermore, the 41 infrastructure projects are responsible for or influence a small portion of carbon emissions across West Yorkshire. Therefore, while these proposals have little impact on carbon emissions, more action will be necessary in tackling the climate emergency, including actions beyond the scope of the Combined Authority’s infrastructure programmes.

6.2 Delivering a portfolio of projects that addresses the climate emergency

Recognising that the proposals have been assessed retrospectively, and therefore were not likely to have passed through the assurance process with the ambition of tackling the climate emergency, this still leaves a question of what investments should the Combined Authority be seeking to include in its investment programmes in the future. Moving forward, to ensure future Combined Authority investments are compatible with a net zero future, the types of interventions and projects which are funded need to be carefully considered from project inception. As noted above, the Stage 1 guidance developed as part of this commission should help to achieve this.

Nonetheless, there are opportunities to develop investment programmes to overtly respond to carbon reduction objectives.

The Combined Authority should seek that any investment is aligned with the targets and goals set out in the Combined Authority's Emission Reduction Pathways Report (CERP)[8]. The CERP report sets out the requirements to reduce private car travel by 21% through shifts to active travel (including a 78% increase in walking and a 2000% increase in cycling) to meet emissions targets by 2038. Additionally, the report outlines the requirement for 66% of buses to be powered by electric battery and up to 34% powered by hydrogen fuel cell by 2038. A priority should therefore be investing in the infrastructure changes required to help deliver this ambition. Alongside the CERP, the Combined Authority has also published a West Yorkshire Climate and Environment Plan 2021-2024[9], which covers a range of transport commitments made by the Combined Authority. Commitments include:

- Exploring opportunities for shared mobility models
- Delivering better active mobility neighbourhoods
- Developing a Bus Service Improvement Plan which sets out to decarbonise the bus network and encourage modal shift
- Setting out the role of railways as an attractive integrated sustainable and low carbon network

In respect of transport, key government reports such as the recently published Decarbonising Transport plan[10] should act as a guide to the type of measures which are required to meet net zero targets. The report outlines several policies and priorities, including the acceleration of modal shift to public and active transport. The plan presents a target that at least half of all journeys in town and cities should be made by active travel by 2030. Priorities such as this highlight the need for future developments to consider how the requirement for greater uptake in active travel is met. For example, the plan aims to tackle journeys below two miles, which represent 43% of all urban journeys. The Combined Authority should seek to influence the decarbonisation of short distance journeys through its policies and investment programmes.

Other priorities within the plan include ensuring that UK charging infrastructure can meet the increasing demand from electric vehicle owners. Combined Authority investments should therefore actively support this uptake, especially given that local authorities will play a crucial role in supporting the roll-out of charging, and navigating the complexities involved.

The Climate Change Committee's Polices for the Sixth Carbon Budget and Net Zero[11] is another important report which provides guidance on what is fundamentally required to reach net zero emissions. The report stresses that local authorities have a key role in reducing emissions and facilitating strategies to deliver decarbonisation. Local authorities have the potential to influence the transition to low carbon transport through several levers, including:

- Planning policy to be used to steer spatial and local planning that favours housing and commercial developments in the right places to reduce traffic
- Low emissions zones to be introduced to mandate a minimum standard for carbon emissions

[8] West Yorkshire Combined Authority (2020). Tackling the Climate Emergency. Emission Reduction Pathways Report. Available online: emission-reduction-pathways-report.pdf (westyorks-ca.gov.uk). Accessed January 2022.

[9] West Yorkshire Combined Authority (2021). West Yorkshire Climate and Environment Plan 2021-2024. Available online: west-yorkshire-climate-and-environment-plan.pdf (westyorks-ca.gov.uk). Accessed January 2022.

[10] Department for Transport (2021). Decarbonising Transport. Available online: Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk). Accessed January 2022.

[11] Climate Change Committee (2020) Policies for the Sixth Carbon Budget and Net Zero. Available online: Policies-for-the-Sixth-Carbon-Budget-and-Net-Zero.pdf (theccc.org.uk). Accessed January 2022.

- Coordinating and supporting economic partnerships to invest in low carbon transport infrastructure
- Using parking fees to incentivise sustainable transport, such as repurposing parking spaces for cycle parking and EV charge points and implementing parking charges to discourage private car use

Regarding buildings, the CERP, Climate and Environment Plan and Climate Change Committee reports are aligned in their priorities for reaching net zero emissions. The CERP identifies numerous actions to reduce emissions, including increasing district and communal heating by up 28% for non-domestic buildings. The Commission for Climate Change report builds on this, stating that for new builds, a strong set of standards are required to ensure buildings deliver high levels of energy efficiency, alongside shifting toward low carbon heating such as heat pumps and district heating. To help deliver on the net zero target, the Combined Authority should therefore look to invest in district and community heating. The Combined Authority will also need to set radically higher standards for buildings within its investment programmes to ensure that they are fully compatible with a net zero future. This presents a range of technical and cost-related challenges that require further consideration and guidance. In addition, any existing buildings that are not capable of operating with net zero emissions will require investment in refurbishment activities.

These reports highlight the need to invest in schemes which strongly promote active travel, disincentivise private car use, and set robust building standards which incorporate low carbon heat and energy efficiency measures. Schemes which do not consider these types of interventions may not be compatible with the Combined Authority's net zero target.

Even for schemes that are likely to be aligned towards facilitating a net zero future, carbon mitigation interventions on any scheme must still be considered from project inception. This will help ensure that not only are Combined Authority investments delivering the right infrastructure to help transition to net zero, but that it is being delivered in a low carbon way.

Furthermore, whilst the Combined Authority should focus investment on infrastructure developments that are aligned with those outlined above, infrastructure alone will not be sufficient to tackle the climate emergency. Beyond delivering the infrastructure required to aid low-carbon choices, the net zero transition will also rely upon other policy levers including regulatory and fiscal measures to influence and/or incentivise behavioural change.

Finally, the Combined authority's investments risk unlocking development or other forms of growth that could result in much higher emissions. The implication is that this should be accounted for, and the opportunity to steer or influence later developments should be considered when framing future investment programmes.

A. Phase 1 Guidance and Toolkits recommendations

A series of recommendations emerged from Phase 1 of the project, which was to review industry carbon assessment best practice, compare against the Combined Authority practice and make recommendations. These are detailed below. Many of the recommendations were addressed in later phases of the Carbon Impact Assessment project.

To aid the reader, the recommendations that have been addressed in subsequent stages of the Carbon Impact Assessment commission are shown in plain text below, while aspects that remain as recommendations for the future are shown in *italic text*.

6.2.1 General principles

In addition to specific recommendations for different stages of the Combined Authority's Assurance Process, there are several general principles which should be followed when considering carbon within the Assurance Process. The Combined Authority should:

4. Follow the proportionality principle. This will ensure the major sources of carbon are assessed in the most detail and prevent unnecessary effort being required on proposals which have a minimal impact.
5. Underpin the overall approach with a consistent set of assumptions and rules. These should be articulated clearly to scheme sponsors and decision-makers.
6. *Consider carbon for all project types where a significant impact is expected, not just for "good" emission reduction projects, in the interests of transparency.*
7. *Continue to include carbon in the economic assessment, but also report carbon separately, whether as a clearly defined part of the Strategic Case (which would fit best with government guidance) or as a 6th case in the business case model. Reporting the carbon impact separately will emphasise its importance to decision makers.*
8. *Continue to value the economic impact of carbon in the appraisal of transport* proposals *and include the economic valuation of carbon for non-transport* proposal *types such as non-transport projects, in line with Green Book guidance. The Combined Authority should also consider including the valuation of other environmental impacts*[12]*, where methodologies already exist to capture these impacts, and the data is available for their application.*
9. *Contextualise the magnitude of carbon emissions from* proposals *to relevant local scale targets and indicators, rather than only compare to national targets and budgets.*

6.2.2 Recommendations for toolkit development

10. Test and pilot proposed approaches before deciding on final methods. This will be essential to refine the methods for real projects being assessed within the assurance process to account for data limitations and other practical constraints. Compatibility with the requirements of the Combined Authority assurance process also needs to be fully tested.
11. Engage directly with the team revising the Combined Authority assurance process which is being developed in parallel to the recommendations in this project. Collaboration will be essential to ensure that the two processes integrate effectively. Also agreeing distinct areas

[12] Other environmental impacts include indicators such as air quality, biodiversity, chemical pollution, nitrogen and phosphorus loading, and soil and waterway health.

of ownership for the two teams will provide clarity and focus and allow effective delivery of both workstreams.

12. Produce guidance and training within an assurance process used to support consistent application of methodologies. The supporting guidance and categorisation lists should be regularly reviewed and updated, considering lessons learned through the application of the Assurance Framework.

6.2.3 Recommendations for toolkit application

13. *Responsibility for preparing the business case documentation, including the carbon assessment, should sit with the scheme promoters.*
14. *To ensure consistency of toolkit application, it is recommended that the Combined Authority make provision to audit and quality assure business cases and provide support to project promoters where necessary.*

6.2.4 Stage 1: Assessment and sequencing

Activity 1: Pipeline identification and gateway assessment

The Strategic Assessment stage should:

15. *Have a section on "tackling the climate emergency".*
16. Require project promoters to categorise their project according to whether they are expected to directly support the region's decarbonisation pathways or be in conflict. Similar project types which have previously been completed may be used as a benchmark to determine whether the project is expected to increase or decrease carbon emissions, which will be outlined in supporting guidance. The suggested categories are:
    a. Fully compatible (positive): fully aligned with decarbonisation pathways
    b. Conditional: compatible only under certain conditions
    c. Risk of non-compatibility (negative): risk of supporting investments that are inconsistent with the pathways.
17. Be supported by guidance for project promoters to undertake this qualitative assessment. This should take the form of a list of project types that are expected to fall into each category which will be developed as part of this project if this recommendation is adopted. The list could be based on the analysis that has been carried out to develop West Yorkshire's Carbon Emissions Reduction Pathways. A methodology note should be developed to accompany the list of project types, to provide transparency on the approach used and to categorise project types. This will be developed as part of this project if this recommendation is adopted. The guidance would help ensure a more consistent assessment of projects against this priority area, as well as helping project promoters to understand the types of projects that will contribute strongly towards the region's climate target.

Activity 2: Strategic Outline Case (SOC)

The Strategic Outline Case stage should:

18. *Have a section on "tackling the climate emergency".*
19. Require project promoters to capture at a high level the magnitude of the project's carbon impact in addition to the direction (positive or negative). This will help to differentiate the impact of different projects and identify where strong positive impacts are expected (which should be enhanced) or strong negative impacts are expected (which should be mitigated). The suggested categories are:

a. Long lasting or extensive positive impact
b. Short term or limited positive impact
c. No impact or neutral impact
d. Short term or limited negative impact
e. Long lasting or severe negative impact

20. Be supported by guidance to assist the project promoter with the qualitative categorisation. For example, the guidance may include a form of scoring matrix, with different project types of different scales. This guidance will be developed as part of this project if the recommendation is adopted.
21. Ask supplementary questions about the project, the responses to which will drive the need for further assessment in the scheme development phase, for example:
    a. Is the proposal expected to involve significant construction or the consumption of significant volumes of materials or products? If yes, you will be expected to consider embodied emissions at OBC and FBC stages.
    b. Is the proposal economic case expected to depend on future traffic assumptions? If yes, you will be expected to conduct a sensitivity test on the economic case at OBC and FBC stages.
    c. Is the proposal expected to result in long term induced effects, such as attracting additional traffic demand or leading to further development? If yes, you will be expected to consider these effects in more detail at OBC and FBC stages.

In addition, the Combined Authority should consider whether to develop an approach using the doughnut economics framework, which would be used to assess a broader range of impacts in addition to carbon:

- The doughnut economics framework could be adapted to assess the specific priorities of the region, for example being shaped around the five priorities set out in the Strategic Economic Framework.
- However, adopting such an approach would need careful consideration to ensure compatibility with the ongoing revision to the Assurance Framework. Many of the indicators normally included in a doughnut economics approach are already considered elsewhere in the Wider Strategic Alignment template, so to avoid the risk of incompatibility and/or duplication this would require both processes to be designed in an integrated way.
- The doughnut economics approach is effective as a communication device when considering a range of indicators, in addition to its use as an assessment tool. The doughnut economics approach may therefore be used as a way of representing the overall Strategic Outline Case (SOC) assessment using the full range of indicators in the Wider Strategic Alignment.

Should the Combined Authority choose to develop the doughnut economics approach for application at SOC, it is suggested that its development be owned by the team revising the Assurance Framework. As part of the specification to be developed during Phase 2 of this project, a suggested list of categories for the Assurance Framework to adopt will be included, which will be in line with those set out in the West Yorkshire Combined Authority Strategic Economic Framework.

6.2.5 Stage 2: Scheme development

Activity 3: Outline Business Case (OBC)

The Outline Business Case should:

22. *Have a section on "tackling the climate emergency" in which the carbon would be quantified and reported separately from the economic case.*

23. Where the emissions sources are judged to be significant, seek to quantify carbon emissions sources for transport and non-transport proposals including:
    a. In operation
    b. Additional induced effects
    c. Embodied or capital carbon

    These three categories should be reported separately, to enable consistency with existing Green Book guidance (for example, DfT TAG only includes “in operation”) and existing reporting (for example, Combined Authority emissions and carbon pathways work does not include embodied). The degree of accuracy and level of effort required to perform this quantification should be proportionate to the expected magnitude of the impact.
24. Adopt a screening approach to establish whether quantification is necessary and a proportionate approach to adopt. For example:
    a. For capital carbon, the promoter would be asked to confirm if a significant amount of construction is involved and a threshold (e.g., capital spend) could be used to identify which proposals should be subject to a more detailed assessment versus the application of a simple benchmark.
    b. For additional induced effects, only scheme types that have been previously identified as being reasonably sensitive to these induced effects need perform this calculation.
    c. For the value for money assessment, only scheme types known to have an economic case reasonably sensitive to the “carbon pathway compliant” set of assumptions need to perform this sensitivity assessment.

    The results of the assessments carried out during Stage 1 can be used to inform this screening.
25. Develop a tailored approach to carbon quantification which recognises that different issues exist for different sectors and likewise different tools should be used for different types of proposals.
26. Primarily seek to use off the shelf tools for carbon quantification. Bespoke calculations or new methodologies should be developed only for project types where there is not an existing approach and the magnitude of carbon emissions warrant a bespoke method.
27. Guide the project promoter to the most appropriate quantification approach for their project.
28. Use a consistent reporting framework for the carbon quantification, even though a diversity of tools and approaches may be used across different project types.
29. *Seek to use assumptions for carbon quantification into the future that are consistent with the future assumptions in the Combined Authority carbon pathways. A future set of assumptions should be developed for this agreed “carbon pathway compliant” future scenario to cover the assumptions required in the most common* proposal *types. The set of assumptions should be based on the carbon pathways work and analysis conducted by Element Energy.*
30. *Include an additional sensitivity test in the value for money assessment, which tests the impact of the “carbon pathway compliant” set of assumptions on the economic case for the project. The findings of this sensitivity test would be reported in addition to the value for money assessment using the standard Green Book compliant set of assumptions.*
31. Have standard approaches developed for assessing embodied carbon and additional induced effects. Noting that neither of these impacts are currently assessed for the Combined Authority projects, the calculation approaches should be proportionate, reflect the level of data likely to be available and not place an unnecessary burden on the project promoters.
32. *Require project promoters to consider lower carbon alternatives.*

Activity 3: Full Business Case (FBC)

The Full Business Case should:

33. Adopt the same principles, calculation methodologies and reporting framework as at OBC. The project promoter should be required to update the assessment results where more detailed information has become available and identify carbon reduction measures adopted compared to the proposal as characterised at OBC.

6.2.6 Stage 3: Delivery and Evaluation

In the delivery and evaluation stage:

34. *The project promoter should be requested to update the carbon assessment completed at Outline Business Case with improved carbon data. This may take the form of measured data (e.g., using post scheme traffic levels) which is often recorded as part of the normal project delivery process but may not be consistently reported back up to the Combined Authority.*
35. *In the spirit of continuous improvement, the findings of the updated assessments along with other observations (e.g., carbon reduction opportunities identified) should be fed back to improve the evidence base and the assessment methodology in Stage 1 and Stage 2.*

B. Summary table of assessment results

Scheme information			Scheme impact				Other information	
Scheme name	Scheme type(s)	Decision point	Operational emissions (tCO2e)	Capital carbon emissions (tCO2e)	Total emissions (tCO2e)	Intensity metric of scheme impact (tCO2e/£m)	Confidence rating	Notes
A629 (Phase 5) - Ainley Top into Huddersfield	Transport (cycling and walking) & Transport (highways)	FBC	33,433	2,947	36,380	2,541	Low confidence	There is low confidence in the assessment result, given that the operational transport output used (Defra EFT ~40k tCO2e) differs from the TUBA assessment output (~7K tCO2e). The difference between the two results is significant given the different methodologies applied by the two assessment tools.
A641 Bradford - Huddersfield Corridor	Transport (cycling and walking) & Transport (bus priority) & Transport (highways)	SOC	-32,844	9,518	-23,326	-309	Low confidence	As the project is at an early stage of delivery and no final design option has been selected there was low confidence in the operational assessment results. There was also low confidence in the capital carbon impact of the scheme as this was estimated using high-level carbon intensity benchmarks. As a result the overall confidence in the assessment results was low.
Flood Alleviation - Leeds (FAS2)	Flood Alleviation Scheme	FBC	Scoped out	23,559	23,559	308	High confidence	There was high confidence in the capital carbon assessment carried out for the scheme as it used a detailed calculation approach which included emissions associated with construction transport, plant and the embodied carbon of construction materials. This is the approach recommended within the Stage 2 guidance.
Leeds District Heat Network	Buildings - refurbishment and energy efficiency	FBC +	Not possible to quantify	Not possible to quantify	Not possible to quantify	Not possible to quantify	N/A	N/A - A detailed carbon assessment had already been carried out and the scheme promoter did not wish for a revised assessment to be undertaken. However, information relating to the existing assessment was not provided. Therefore, it was not possible to
Castleford Growth Corridor Scheme	Transport (cycling and walking) & Transport (highways) & Buildings - demolition and land remediation	OBC	-7,601	1,032	-6,570	-928	Low confidence	There is low confidence in the assessment result, as the operational transport assessment uses modelling which is deemed no longer fit for purpose (based on significant changes made to the scheme since the modelling was undertaken). Additionally, the capital carbon impact of the scheme was estimated using high-level carbon intensity benchmarks.
CityConnect Phase 3 Huddersfield Town Centre	Transport (cycling and walking)	OBC	-127	368	241	116	Low confidence	The is low certainty in the confidence of the operational carbon assessment, given that the current active mode appraisal suggests that the scheme will not increase cycling demand, and therefore only includes the pedestrianisation benefits. Additionally, although the capital carbon assessment was largely undertaken using a detailed approach (using a Bill of Quantities), there is a high level of uncertainty in the result due to confusion around which type of stone will be used (i.e. general stone or granite). As a result, there is low confidence in the assessment results.
Corridor Improvement Programme - Bradford - A6177 Great Horton Road - Horton Grange Road (15)	Transport (cycling and walking) & Transport (highways)	FBC	-4,092	366	-3,726	-836	Medium confidence	There is medium confidence in the assessment result, as there is confidence in the approach taken for the transport modelling, however there is low confidence in the capital carbon assessment result, which is based on high-level carbon intensity benchmarks.
Corridor Improvement Programme - Calderdale - A58 - A672 Corridor	Transport (cycling and walking) & Transport (bus priority) & Transport (highways)	FBC +	-751	437	-314	-64	Medium confidence	There is reasonable confidence in the approach taken for the transport modelling, however there is no additional modelling which considers the impact active modes would have on modal shift. The capital carbon impact is based on high-level carbon intensity benchmarks which uses the construction cost of the scheme. There is low confidence in the result of this calculation. Given that there is a reasonable level of confidence in the operational transport assessment, yet low confidence in the capital carbon assessment, the overall scheme has been given a medium confidence rating.
Corridor Improvement Programme - Calderdale - A646 - A6033 Corridor	Transport (cycling and walking) & Transport (highways)	FBC +	1,696	379	2,075	481	Medium confidence	There is reasonable confidence in the approach taken for the transport modelling, however there is no additional modelling which considers the impact active modes would have on modal shift. The capital carbon impact is based on high-level carbon intensity benchmarks which uses the construction cost of the scheme. There is low confidence in the result of this calculation. Given that there is a reasonable level of confidence in the operational transport assessment, yet low confidence in the capital carbon assessment, the overall scheme has been given a medium confidence rating.

Leeds City Centre Network and Interchange Package - Armley Gyratory	Transport (cycling and walking) & Transport (bus priority) & Transport (highways)	OBC	15,692	7,749	23,441	381	Low confidence	The overall confidence rating for the scheme is low, this is a result of the reported operational results being based on the modelling completed for the OBC design. It could be expected that the FBC modelling would have a different outcome as a result of the significant design changes that have occurred. Furthermore, due to the high level nature of the assessment and lack of specific detail on construction activities, there is also low confidence in the capital carbon result.
Rail Parking Package - Shipley	Transport (park and ride) & Transport (railway station) & Carpark extensions	SOC	11	409	420	165	Low confidence	The overall confidence rating for the scheme is low as the operational carbon assessment only relates to the energy use from the proposed car park structure and does not account for the travel impacts of the rail parking scheme. Additionally, there is low confidence in the capital carbon assessment due to the use of carbon intensity benchmarks.
TCF - A61 Bus, Cycle and Walking Improvements	Transport (cycling and walking) & Transport (bus priority) & Transport (highways)	SOC	Not possible to quantify	739	739	106	Low confidence	There is low confidence in the assessment results as the operational benefits of the scheme had not been reported in PIMS and further information allowing for a reassessment could also not be located. Furthermore, the capital carbon assessment was carried out using a carbon intensity benchmark based on the CAPEX of the scheme, given that more detailed design information was not available at SOC stage. As a result of a lack of specific project information, there is low confidence in the assessment.
TCF - Dewsbury Bus Station	Transport (cycling and walking) & Transport (bus priority) & Buildings - refurbishment and energy efficiency	SOC	Not possible to quantify	1,276	1,276	71	Low confidence	The overall confidence rating for the scheme was low as the scheme was at SOC stage and it was not possible to carry out an operational carbon assessment due to a lack of project information. Furthermore, the capital carbon assessment was carried out using a carbon intensity benchmark based on the CAPEX of the scheme. As a result of a lack of specific project information, there is low confidence in the assessment.
TCF - Leeds Station - Sustainable Travel Gateway	Transport (cycling and walking) & Transport (bus priority) & Transport (station gateway)	OBC	878	2,524	3,402	102	Low confidence	There is low confidence in the assessment results as, due to data constraints it was not possible to quantify the carbon impact of operational transport emissions associated with the scheme. The operational energy emissions of part of the scheme were calculated using industry standard benchmarks. The capital carbon emissions were also calculated using high level carbon intensity benchmarks.
TCF - Selby Station Gateway	Transport (cycling and walking) & Transport (station gateway)	OBC	26,148	603	26,751	1,000	Medium confidence	There is medium confidence in the assessment results as the modelling used in the operational transport assessment likely overestimates the displacement caused by the scheme, it also assumes no change to fleet composition past 2050. There is a greater level of confidence in the capital carbon assessment carried out for the scheme as, where possible, detailed calculations using bills of quantities have provided a more robust result. As a result the overall confidence in the assessment results is medium.
TCF - West Bradford - Cycle Superhighway Extension	Transport (cycling and walking)	SOC	-515	2,100	1,585	86	Low confidence	There is low confidence in assessment results as the assumptions used in the operational transport assessment, which takes into account reduction in vkms as a result of the scheme, do not appear to be well evidenced. Additionally, the capital carbon assessment has been calculated using a high level carbon intensity benchmark based on scheme characteristics.
Thorpe Park Station	Transport (railway station)	OBC	Not possible to quantify	3,987	3,987	126	Low confidence	The information available on PIMS for this scheme was very limited with only the costing document available. As a result, the operational emissions could not be calculated. The capital carbon impact of the scheme was estimated using a high level carbon intensity benchmark. As a result, the confidence in the assessment result is low.
Business Growth Programme	Business grants	FBC +	Not possible to quantify	Not possible to quantify	Not possible to quantify	Not possible to quantify	N/A	N/A - A quantitative assessment has not been carried out. As a result no confidence rating was given for the scheme.
East Leeds Housing Growth - Red Hall	Buildings - demolition and land remediation	FBC +	Not possible to quantify	Not possible to quantify	Not possible to quantify	Not possible to quantify	N/A	N/A - A quantitative assessment has not been carried out. As a result no confidence rating was given for the scheme.
EZ - Bradford - Parry Lane	Buildings - demolition and land remediation	FBC +	N/A for this project type	398	398	57	High confidence	There is high confidence in the assessment result of this scheme as a detailed assessment of the carbon impacts of the scheme had already been undertaken, based on real data obtained during the demolition and site remediation process. The assessment was undertaken using a calculator tool produced by the Environment Agency (EA).
GPF LEP Loan - Citu Bridge - 308 (Inc 319)	Buildings - new & Pedestrian bridge & Renewable energy	FBC +	2,563	12,480	15,043	Unknown	Medium confidence	It is considered likely that a carbon assessment for the scheme was carried out, based on information in the Sustainability Statement submitted as part of the planning application, but that was not available for review. The assessment is therefore based on a benchmarking exercise. While the results are considered to provide a reasonable estimation of the scheme impacts (in terms of relative order of magnitude), the results are subject to uncertainty. As a result, the confidence in the overall assessment result is medium.

Halifax Town Centre (Northgate House)	Buildings - refurbishment and energy efficiency	FBC +	2,935	3,875	6,810	639	Medium confidence	The operational assessment of the scheme relies heavily on the carbon intensity of grid electricity, which was assumed to decarbonise in line with the HM Treasury Green Book Guidance. However, in the event that this does not happen, the operational emissions of the scheme would be greater. Furthermore, the embodied carbon emissions are likely to represent an overestimate. This is because benchmarks for new buildings were used and then reduced by half, in the absence of benchmarks for refurbishment schemes. As a result of the above assumptions, the confidence rating is medium.
Shipley College - Salt Building	Buildings - refurbishment and energy efficiency	FBC +	Not possible to quantify	Not possible to quantify	Not possible to quantify	Not possible to quantify	N/A	N/A - A quantitative assessment has not been carried out. As a result no confidence rating was given for the scheme.
Calder Valley Line - Elland Station plus TCF - Elland Station Access	Transport (cycling and walking) & Transport (railway station)	FBC	-1,563	4,254	2,691	92	Low confidence	There is low confidence in the carbon assessment result as it is not clear from the business case what the assumptions behind the operational carbon assessment were (e.g. reduction in vehicle kms, emission factors or the vehicle split over time). It was therefore not possible to complete a reassessment of this impact due to data constraints. Additionally, the capital carbon assessment used high level carbon intensity benchmarks based on scheme characteristics.
GBF Bradford City Village Phase 1	Buildings - new & Buildings - refurbishment and energy efficiency & Buildings - demolition and land remediation	FBC +	-2,444	2,880	436	18	Medium confidence	There is medium confidence in the assessment results as both the operational and capital carbon assessments are based on a high level benchmarking exercise, due to a lack of detailed design information. Therefore, while the results are considered to provide a reasonable estimation of the scheme impacts in terms of relative order of magnitude, they are still subject to uncertainty.
TCF - A64 Park and Ride	Transport (bus priority) & Transport (park and ride)	SOC	Not possible to quantify	1,821	1,821	121	Low confidence	There is low confidence in the assessment results as the scheme was at SOC stage and therefore limited information was available. The operational transport impacts of the scheme were not included in the assessment due to a lack of information. The capital carbon assessment was carried out using a carbon intensity benchmark based on the CAPEX of the scheme, given that more detailed design information was not available at SOC stage.
York Castle Gateway	Transport (cycling and walking) & Transport (station gateway)	OBC	-20	2,175	2,156	108	Low confidence	The operational assessment result was calculated using the avoided vehicle-km values which were provided by an AMAT assessment. However, the assessment result does not take into account the carbon impact of any re-rerouting which may occur as a result of the scheme. Additionally the capital carbon assessment is based on the construction cost of the scheme and high level carbon intensity benchmarks in the absence of specific scheme design information. As a result, the scheme was given a low confidence rating.
York Central Access Road and Station Access Improvements and TCF - York Railway Station Gateway	Transport (station gateway)	SOC	Not possible to quantify	2,858	2,858	88	Low confidence	There is low confidence in the assessment results as the scheme only had the SOC and accompanying documents available on PIMS. As a result, it was not possible to quantify the operational carbon impact, and the capital carbon assessment was calculated using a high level carbon intensity benchmark and the assumed construction cost of the scheme.
Bradford to Shipley Corridor	Transport (cycling and walking) & Transport (highways) & Transport (bus priority)	OBC	-73,637	5,746	-67,891	-892	Medium confidence	There is medium confidence in the reported assessment results as although the transport modelling accounts for strategic rerouting, it is potentially underestimating congestion. Furthermore, the model does not account for the benefits of shared or active modes. In addition, the capital carbon emissions have been estimated using a high-level benchmarking approach.
Corridor Improvement Programme - Kirklees - Holmfirth Town Centre	Transport (cycling and walking) & Transport (highways) & Buildings - demolition and land remediation	OBC	22,104	531	22,635	5,702	Low confidence	There is low confidence in the assessment result, primarily due to the modelled impact of induced demand, which significantly influences the overall result. The impact of induced demand is likely being over-estimated given that the TUBA files used indicated a significant journey time benefit between the DM and DS scenarios, which is likely driving the high number of induced trips and associated carbon emissions. In addition, the modelling undertaken does not account for the impact that the walking and cycling provision would have on modal shift.

Corridor Improvement Programme - Leeds - Fink Hill	Transport (cycling and walking) & Transport (highways)	FBC	4,890	490	5,380	991	Low confidence	There is low confidence in the assessment results as although this scheme involves improvements in operational efficiency to the road network, and is modelled using a fixed trip matrix (which normally leads to a carbon benefit), there is an increase in operational emissions. This is likely due to an error in the modelling data, which is subsequently used to estimate carbon emissions. Additionally the capital carbon estimate is also subject to some uncertainty due to the use of carbon intensity benchmarks.
TCF - Halifax Bus Station	Transport (bus interchange)	FBC	Not possible to quantify	2,015	2,015	127	Low confidence	At the time of assessment, the information available on PIMS was limited. As a result, no operational transport assessment could be carried out. Additionally, the capital carbon impact of the scheme was calculated based on high-level carbon intensity benchmarks. Therefore, as there was a lack of project specific data available on PIMS, and the project was at an early stage of development, there is low confidence in the carbon assessment result produced.
Rail - Leeds Bradford Airport Parkway	Transport (railway station)	OBC	-3,553	5,851	2,298	55	Low confidence	There is a low level of confidence in the carbon assessment of this scheme as both the operational assessment and capital carbon assessment have been carried out using high level calculations, due to a lack of project specific information.
Point Cross, Hunslet scheme (aka the Guinness project)	Buildings - new	FBC +	29,226	20,692	49,918	665	Medium confidence	The assessment represents a best estimate based on the level of data was available, recognising that there is always a high level of uncertainty when estimating energy use in buildings, due to factors such as occupant behaviour. Additionally, the assessment focuses solely on energy use in buildings, and does not account for wider factors such as transport accessibility, electric vehicle (EV) charging, and the site location (brownfield versus greenfield site) which may have an additional carbon benefit/impact. As a result, there is medium confidence in the results.
Leeds City College - Quarry Hill	Buildings - new	FBC +	44,661	16,910	61,571	1243.864271	Medium confidence	The assessment represents a best estimate based on the level of data was available, recognising that there is always a high level of uncertainty when estimating energy use in buildings, due to factors such as occupant behaviour. Additionally, the assessment focuses solely on energy use in buildings, and does not account for wider factors such as transport accessibility, electric vehicle (EV) charging, and the site location (brownfield versus greenfield site) which may have an additional carbon benefit/impact. As a result, there is medium confidence in the results.
TCF - Leeds City Centre Cycle Improvements	Transport (cycling and walking)	FBC	-1,020	663	-357	-48	Low confidence	There is low confidence in the assessment results given that the operational carbon assessment was calculated using a high-level estimation approach, based on the output of avoided vehicle-km from AMAT. Additionally, the operational assessment does not account for rerouting, which would likely increase the carbon impact. In addition, the capital carbon assessment result was calculated using carbon intensity benchmarks, which are subject to uncertainties.
GBF – Temple Green P & R Extension	Transport (park and ride)	FBC +	-2,767	655	-2,112	-270	Low confidence	There is low confidence in the overall assessment given that both the capital carbon and operational transport emissions were calculated using high-level estimation approaches.
TCF - White Rose Station	Transport (cycling and walking) & Transport (railway station)	FBC	-5,424	1,488	-3,936	-179	Low confidence	There is low confidence in the operational transport modelling approach given that there are concerns over the catchment for the new station, and that the benefits from the active modes appraisal have not been included in the final output for the carbon assessment. As such, the scheme could be underrepresenting the carbon reduction. There is also low confidence in the capital carbon assessment approach, which has been undertaken using a high-level benchmarking exercise.
Transformational - A6120 Leeds Northern Outer Ring Road Improvements	Transport (cycling and walking) & Transport (bus priority) & Transport (highways)	SOC	-28,500	9,156	-19,344	-113	Low confidence	There is low confidence in the assessment result being reflective of the carbon impact of this scheme. Endorsement of the SOC is currently being sought, as a result, there was very little information available at the time of assessment. The project may significantly change in scope moving forwards. In addition, the capital carbon emissions have been estimated using a high-level benchmarking approach, which further reinforces the 'low confidence' scoring for this assessment.

Wakefield City Centre Package (Phase 2) - Ings Road	Transport (cycling and walking) & Transport (highways)	OBC	-2,115	374	-1,741	-384	Medium confidence	The operational transport carbon assessment includes strategic rerouting in the model, though there could be more clarity on the forecast years. As a result, there is medium confidence in the assessment result. In addition, the carbon reduction impacts from modal shift to active transport is not included within the transport modelling. However, this is not likely to have a significant impact on the overall results. The use of a high-level benchmark to estimate capital carbon emissions also contributes to the medium assessment rating, given that this approach is not robust and provides only an indication of the scale of emissions.
York Northern Outer Ring Road	Transport (cycling and walking) & Transport (highways)	FBC	-12,206	42,675	30,470	469	High confidence	There is high confidence in the carbon impact of this scheme given that an in-depth capital carbon assessment has been undertaken, and the approach taken for transport modelling is sufficient for the scheme, accounting for the impacts of strategic rerouting. In addition, the impact of carbon sequestration for 30 hectares of tree planting has also been included within the assessment.
Total for all schemes			5,059	195,980	201,039			

C. Scheme carbon assessment result summaries

Carbon impact assessment summary information

Scheme name:	A629 (Phase 5) - Ainley Top into Huddersfield
Decision point:	FBC
Scheme type:	Transport (cycling and walking) & Transport (highways)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Average growth of ~10% in 2023 and 26% by 2038 (base year not specified).
Fleet mix used	A subset of the modelled network has been used to quantify operational carbon emissions using Defra Emissions factor toolkit (version 9).
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	2,947	Material resources, material transport, worker commuting, onsite energy use and waste	Detailed bottom-up carbon calculation
Operational carbon (tCO_2e) **[B]**	33,433	Operational transport (including rerouting): **39,754 tCO_2e**; Net carbon sequestration impact from tree planting & removal: **-6,141 tCO_2e**	Defra EFT (transport); i-Tree Design tool (carbon sequestration)

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	0	N/A original result deemed fit for purpose	N/A
Operational carbon (tCO_2e) **[D]**	0	N/A extracted result from original modelling	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	2,947
Operational carbon (tCO_2e) **[B+D]**	33,433
Total carbon (tCO_2e) **[A+B+C+D]**	36,380
Intensity metric (tCO_2e/£m)*	2,541
Confidence rating	Low confidence

Notes

Note that the emissions reported in this summary are the those reported in the Carbon Impact Assessment carried out for the scheme. As the modelling of the scheme was undertaken in SATURN (a strategic transport model), wider rerouting associated with the scheme is accounted for through the model's reassignment.

The operational transport assessment accounts for the total annual link emissions of tCO_2e for the modelled road network and was calculated using the Defra Emissions Factor Toolkit (EFT). The operational emissions were also calculated in TUBA, but these were not reported. There is low confidence in the assessment result, given that the operational transport output used (Defra EFT ~40k tCO_2e) differs from the TUBA assessment output (~7K tCO_2e). The difference between the two results is significant given the different methodologies applied by the two assessment tools.

The difference in the EFT and TUBA results has led to uncertainty in the reported outcome. The schemes location in relation to the detailed modelled area is also a factor in the confidence of the operational outcome, with typically less reliable results for assessments nearer to the edge of the detailed modelled area.

Furthermore, although this scheme involves improvements in operational efficiency to the road network and is modelled using a fixed trip matrix, there is an increase in operational emissions. This is likely due to an error in the modelling data, which is subsequently used to estimate carbon emissions. Resultantly, there is low confidence in the assessment results.

Note, the business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	A641 Bradford - Huddersfield Corridor
Decision point:	SOC
Scheme type:	Transport (cycling and walking) & Transport (bus priority) & Transport (highways)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-32,844	Operational transport (including rerouting)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	9,518	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	0	N/A extracted result from original modelling	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	9,518
Operational carbon (tCO_2e) **[B+D]**	-32,844
Total carbon (tCO_2e) **[A+B+C+D]**	-23,326
Intensity metric (tCO_2e/£m)*	-309
Confidence rating	Low confidence

Notes
Note that the operational transport emissions were not previously reported, but were extracted from TUBA to report for the purpose of this exercise. This scheme is shown to reduce carbon emissions, due to modelled reduction in congestion levels. The operational transport assessment accounts for rerouting. However, there is low confidence in the results, as the project is at an early stage of delivery and no final design option has been selected. The assessment is still being refined and is likely to change. In addition, the capital carbon emissions have been estimated using a high-level benchmarking approach. The business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment. In addition, although likely minor, the assessment excludes carbon reduction from proposed tree planting due to data constraints, active modes, and public transport modes.

Carbon impact assessment summary information

Scheme name:	BHF Points Cross - Hunslet Road
Decision point:	FBC +
Scheme type:	Buildings - new
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	Assumptions for regulated emissions from the buildings are in line with Part L requirements

Modelling approach:	Part L compliance calculations for the whole development have been undertaken

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	310 (in opening year)	Operational energy from fixed building fabric and services, for **opening year only**	Part L compliance calculations

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	20,692	New capital carbon calculation (construction plant, materials and transport of materials)	High-level benchmark assessment
Operational carbon (tCO_2e) **[D]**	28,916	New assessment methodology for operational energy **over appraisal period**	High-level benchmark assessment

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	20,692
Operational carbon (tCO_2e) **[B+D]**	29,226
Total carbon (tCO_2e) **[A+B+C+D]**	49,918
Intensity metric (tCO_2e/£m)*	665
Confidence rating	Medium confidence

Notes
These results show the emissions from constructing and operating the proposed development. In line with the 'Do-Nothing' and 'Do-Something' scenarios in the Business Case, it assumes that there would be no development at all without WYCA funding. In reality, it is understood that a similar scheme would likely be delivered elsewhere (subject to need), but that was not one of the proposed options for this scheme. The assessment represents a best estimate based on the level of data that was available, recognising that there is always a high level of uncertainty when estimating energy use in buildings due to factors such as occupant behaviour. The scheme was designed to achieve a 20% reduction in regulated operational carbon emissions compared with the minimum requirements of Building Regulations. This was achieved through energy efficiency measures and solar photovoltaic (PV) panels, the impacts of which are reflected in this calculation. The assessment focuses solely on energy use in buildings, and therefore does not account for wider factors such as transport accessibility, electric vehicle (EV) charging, and the site location (brownfield versus greenfield site); this is due to the lack of a standard methodology for quantifying such impacts.

Carbon impact assessment summary information

Scheme name:	Bradford to Shipley Corridor
Decision point:	OBC
Scheme type:	Transport (cycling and walking) & Transport (highways) & Transport (bus priority)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	On average, 8.3% growth from 2018 to 2027, and 19.2% growth from 2018 to 2040
Fleet mix used	DfT TAG
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-73,486	Operational transport (including rerouting)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	5,746	New capital carbon calculation (construction plant, materials and	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	-151	The revised result includes carbon sequestration from tree planting	Woodland Carbon Code

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	5,746
Operational carbon (tCO_2e) **[B+D]**	-73,637
Total carbon (tCO_2e) **[A+B+C+D]**	-67,891
Intensity metric (tCO_2e/£m)*	-892
Confidence rating	Medium confidence

Notes
Note that the operational transport emissions were not previously reported, but were extracted from TUBA to report for the purpose of this exercise. The operational transport assessment accounts for rerouting. However, there is medium confidence in the assessment result, given that the operational transport calculation methodology is potentially underestimating congestion under the preferred option without bridge scenario (where the carriageway reduced from two lanes to one lane). In order to model this correctly, it would require a micro-simulation model. If significant congestion does occur here then it will reduce the scheme benefits. Furthermore, although the proposed scheme includes a variety of improvements for buses, cyclists and pedestrians, the model does not include these models (other than including buses as fixed trips in the model). It is assumed that the impact of these measures on the performance of the network in terms of reduced car journeys will be relatively minor. In addition, the capital carbon emissions have been estimated using a high-level benchmarking approach. As a result of this, and the above comments on operational carbon, an overall medium confidence rating has been assigned for this assessment. The business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment. In addition, although likely minor, the assessment excludes carbon reduction from green infrastructure.

Carbon impact assessment summary information

Scheme name:	Business Growth Programme
Decision point:	FBC +
Scheme type:	Business grants
Appraisal period:	28.09.17-31.03.2021

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	No assessment undertaken

Modelling approach:	No assessment undertaken

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Not calculated	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	Not possible to quantify	N/A	N/A
Operational carbon (tCO_2e) **[D]**	Not possible to quantify	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	Not possible to quantify
Operational carbon (tCO_2e) **[B+D]**	Not possible to quantify
Total carbon (tCO_2e) **[A+B+C+D]**	Not possible to quantify
Intensity metric (tCO_2e/£m)*	Not possible to quantify
Confidence rating	N/A

Notes
No data was available to support a quantitative assessment. In order to assess the carbon impacts of the scheme in detail, it would be necessary to consider every funding application separately. This would require all applicants to provide an estimate of their existing carbon footprint, along with a revised estimate of their carbon footprint once the funding has been utilised. Further information and commentary around the challenges of assessing this scheme and recommendations moving forward are available in the main pro forma document for this scheme.

Carbon impact assessment summary information

Scheme name:	Calder Valley Line - Elland Station plus TCF - Elland Station Access
Decision point:	FBC
Scheme type:	Transport (cycling and walking) & Transport (railway station)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Default AMAT assumption: 0.75%pa growth in walking and cycling trips
Fleet mix used	TAG (Active Modes appraisal) - Assumed 10% will cycle and 60% will walk to the station (30% will drive).
Other (non-transport)	N/A

Modelling approach:	TRACC

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-1,864	Operational transport	AMAT and MEC

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	4,254	New capital carbon calculation (construction plant, materials and transport of materials)	High-level benchmark assessment based on scheme metrics including CAPEX and cycle path length
Operational carbon (tCO_2e) **[D]**	301	Accounts for **operational energy** emissions from EV charging bays	High-level assessment based on number of charge points

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	4,254
Operational carbon (tCO_2e) **[B+D]**	-1,563
Total carbon (tCO_2e) **[A+B+C+D]**	2,691
Intensity metric (tCO_2e/£m)*	92
Confidence rating	Low confidence

Notes
Note that the operational transport carbon assessment accounts for active travel benefits through an AMAT assessment, however, due to data availability, it is unclear if the induced demand associated with rail travel has been accounted for within the modelling. The operational carbon benefit was reported within the FBC based on a reduction in vehicle kms, however, it is not clear from the business case what the assumptions behind the carbon calculation were (e.g. reduction in vehicle kms, emission factors or the vehicle split over time). It was therefore not possible to complete a reassessment of this impact due to data constraints. Alongside this, the operational transport assessment could be strengthened through the use of the Calderdale Strategic Transport Model, which would additionally estimate the impacts of mode shift on the highway network. The operational assessment also includes the impact that the provision of the eight EV charging bays could have on energy use. Although this leads to an increase in emissions, it should be noted that the benefits of EV infrastructure on road users **has not been accounted for**. As a result of the above, there is low confidence in the operational transport assessment carried out for the scheme. The capital carbon re-assessment included multiple carbon intensity benchmarks based on project design information such as construction cost, number of car parking spaces and length of cycle track. It took into account carbon impact of the construction of the platform and track, car park and access package. However, as these were based on high level caron intensity benchmarks based on high level project design information, there is also low confidence in this result. For example, the carbon associated with the access package is likely a large underestimation as the assets being constructed (pedestrian bridges) are likely to be carbon intensive. Note that carbon mitigation has not been considered within the assessment due to data constraints, however there may be some further carbon reduction from tree planting proposed within the FBC.

Carbon impact assessment summary information

Scheme name:	Castleford Growth Corridor Scheme
Decision point:	OBC
Scheme type:	Transport (cycling and walking) & Transport (highways) & Buildings - demolition and land remediation
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-7,601	Operational transport (including rerouting)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	1,032	New capital carbon calculation (construction plant, materials and transport of materials)	High-level benchmark assessment based on scheme components
Operational carbon (tCO_2e) **[D]**	0	N/A extracted result from original modelling	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	1,032
Operational carbon (tCO_2e) **[B+D]**	-7,601
Total carbon (tCO_2e) **[A+B+C+D]**	-6,570
Intensity metric (tCO_2e/£m)*	-928
Confidence rating	Low confidence

Notes
Note that the operational transport emissions were not previously reported, but were extracted from TUBA to report for the purpose of this exercise. The scheme is shown to reduce emissions, due to the modelled congestion alleviation from adding an additional traffic lane in each direction. The operational transport assessment accounts for rerouting. However, there is low confidence in this result being reflective of the carbon impact of this scheme. The modelling is no longer fit for purpose based on significant changes made to the scheme since the modelling was undertaken. For example, the scheme moving forward will not be adding the additional lane. Furthermore, the impact of avoided car-km from modal shift as a result of the cycling and walking provision has not been included within the transport modelling (though not likely to have a largely significant carbon impact). In addition, the capital carbon emissions have been estimated using a high-level benchmarking approach, which further reinforces the 'low confidence' scoring for this assessment. Due to data constraints, the assessment does not include the construction emissions beyond those associated with the footpath and cycle way (such as from widening the carriageway). It has also not been possible to quantify the impact of the proposed demolition that will occur as part of the scheme, though this is likely to be minor. Furthermore, although likely insignificant, the assessment excludes carbon reduction from landscaping, such as tree planting and the incorporation of a wildflower meadow. Note that the business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	Corridor Improvement Programme - Calderdale - A58 - A672 Corridor
Decision point:	FBC +
Scheme type:	Transport (cycling and walking) & Transport (bus priority) & Transport (highways)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	The A58 assessment comprised of two separate VISSIM models with three time periods. The growth applied between 2019 and 2038 was on average 12%.
Fleet mix used	National Atmospheric Emissions Inventory (NAEI) UK Fleet Composition Projections for the UK outside of London was used.
Other (non-transport)	N/A

Modelling approach:	Local modelling in VISSIM (a local junction model including no significant reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-2,033	Operational transport (excluding induced demand impacts)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	437	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	1,282	The revised result includes operational transport induced demand impacts	Application of induced demand module

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	437
Operational carbon (tCO_2e) **[B+D]**	-751
Total carbon (tCO_2e) **[A+B+C+D]**	-314
Intensity metric (tCO_2e/£m)*	-64
Confidence rating	Medium confidence

Notes
This scheme is shown to decrease carbon emissions, this is largely due to reductions in journey time and easing congestion. The reassessment of the scheme showed a reduction in the scheme carbon benefits due to the modelled impact of induced demand, which was added during the reassessment of the carbon impact as a bolt-on to the existing TUBA outputs. In addition, the modelling undertaken does not account for the impact that the public transport, walking and cycling provision would have on modal shift. However, the benefits of this are expected to be negligible. The capital carbon assessment has been undertaken using a high-level benchmarking approach, in the absence of further information. Furthermore, due to data constraints, it was not possible to quantify the carbon impact of the associated demolition works of the market structure and relevelling of the land. This is not expected to have a significant impact given that carbon emissions from demolition are very small, especially in comparison to the full life cycle of a building. It is also possible that these emissions are covered under the existing benchmark approach. The business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment. Given that there is a reasonable level of confidence in the operational transport assessment, yet low confidence in the capital carbon assessment, the overall scheme has been given a medium confidence rating.

Carbon impact assessment summary information

Scheme name:	Corridor Improvement Programme - Calderdale - A646 - A6033 Corridor
Decision point:	FBC +
Scheme type:	Transport (cycling and walking) & Transport (highways)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	The A646 assessment comprised of four separate VISSIM models with three time periods The growth applied between 2019 and 2038 was on average 7%.
Fleet mix used	National Atmospheric Emissions Inventory (NAEI) UK Fleet Composition Projections for the UK outside of London was used.
Other (non-transport)	N/A

Modelling approach:	Local modelling in VISSIM (a local junction model including no significant reassignment and no variable demand)

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-1,078	Operational transport (excluding induced demand impacts)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	379	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	2,774	Operational transport induced demand impacts: **2,624 tCO_2e**; Operational energy demand from EV charging: **150 tCO_2e**	Application of induced demand module; High-level calculation based on number of charging bays

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	379
Operational carbon (tCO_2e) **[B+D]**	1,696
Total carbon (tCO_2e) **[A+B+C+D]**	2,075
Intensity metric (tCO_2e/£m)*	481
Confidence rating	Medium confidence

Notes
This scheme is shown to increase carbon emissions, due to the modelled impact of induced demand, which was added during the reassessment of the carbon impact as a bolt-on to the existing TUBA outputs. In addition, the modelling undertaken does not account for the impact that walking and cycling provision would have on modal shift. However, the benefits of this are expected to be negligible. The operational assessment also includes the impact that the provision of the four EV charging bays could have on energy use. Although this leads to an increase in emissions, the overall impact is marginal compared to the overall scheme impact. It should also be noted that the benefits of EV infrastructure on road users has not been accounted for. The capital carbon assessment has been undertaken using a high-level benchmarking approach, in the absence of further information. The business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment. Given that there is a reasonable level of confidence in the operational transport assessment, yet low confidence in the capital carbon assessment, the overall scheme has been given a medium confidence rating.

Carbon impact assessment summary information

Scheme name:	Corridor Improvement Programme - Bradford - A6177 Great Horton Road - Horton Grange
Decision point:	FBC
Scheme type:	Transport (cycling and walking) & Transport (highways)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	At a model level, traffic growth is constrained to Tempro but varies in different parts of the modelled network.
Fleet mix used	Fleet mix used is based on the ground traffic surveys. Within the model, it's based on the traffic counts observed in the area around the scheme.
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-4,092	Operational transport (including rerouting)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	366	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	0	N/A extracted result from original modelling	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	366
Operational carbon (tCO_2e) **[B+D]**	-4,092
Total carbon (tCO_2e) **[A+B+C+D]**	-3,726
Intensity metric (tCO_2e/£m)*	-836
Confidence rating	Medium confidence

Notes
Note that the operational transport emissions were not previously reported, but were extracted from TUBA to report for the purpose of this exercise. This scheme is shown to reduce carbon emissions, due to modelled reduction in congestion levels, the scheme also includes some walking and cycling provision. The operational transport assessment accounts for rerouting. There is medium confidence in the results, as although the approach taken for the transport modelling is reasonable, there has been no additional modelling undertaken to account for the impact that the walking and cycling provision would have on modal shift. However, given that this appears to be a minor part of the scheme, the benefits are expected to be negligible. In addition, the capital carbon emissions have been estimated using a high-level benchmarking approach. The business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	Corridor Improvement Programme - Leeds - Fink Hill
Decision point:	FBC
Scheme type:	Transport (cycling and walking) & Transport (highways)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Background growth is constrained to TEMPRO.
Fleet mix used	DfT TAG
Other (non-transport)	N/A

Modelling approach:	Local Junction Model

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	3,333	Operational transport (not including induced demand)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	490	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	1,557	The revised result includes the carbon impact of induced demand	Application of induced demand module

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	490
Operational carbon (tCO_2e) **[B+D]**	4,890
Total carbon (tCO_2e) **[A+B+C+D]**	5,380
Intensity metric (tCO_2e/£m)*	991
Confidence rating	Low confidence

Notes
This scheme is shown to increase carbon emissions. This may require investigation as although this scheme involves improvements in operational efficiency to the road network and is modelled using a fixed trip matrix, which normally leads to a carbon benefit, there is an increase in operational emissions. This is likely due to an error in the modelling data, which is subsequently used to estimate carbon emissions. Resultantly, there is low confidence in the assessment results. The capital carbon estimate is also subject to some uncertainty due to the use of benchmarks (in the absence of detailed design information), and should be considered to provide a the relative scale of emissions only. The business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	Corridor Improvement Programme - Kirklees - Holmfirth
Decision point:	OBC
Scheme type:	Transport (cycling and walking) & Transport (highways) & Buildings - demolition and land remediation
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Junction modelling in TRANSYT

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-365	Operational transport (excluding induced demand impacts)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	531	New capital carbon calculation (construction plant, and materials)	Detailed, bottom-up calculation based on a Bill of Quantities
Operational carbon (tCO_2e) **[D]**	22,469	Operational transport induced demand impacts: **22,275 tCO_2e**; Operational energy demand from EV charging: **194 tCO_2e**	Application of induced demand module; High-level calculation based on number of EV charging points

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	531
Operational carbon (tCO_2e) **[B+D]**	22,104
Total carbon (tCO_2e) **[A+B+C+D]**	22,635
Intensity metric (tCO_2e/£m)*	5,702
Confidence rating	Low confidence

Notes
This scheme is shown to increase carbon emissions, due to the modelled impact of induced demand. However, the impact of induced demand is likely being over-estimated and therefore there is low confidence in the overall carbon impact assessment result. This is because the TUBA files used indicated a significant journey time benefit between the DM and DS scenarios, which is likely driving the high number of induced trips and associated carbon emissions. In addition, the modelling undertaken does not account for the impact that the walking and cycling provision would have on modal shift. However, the benefits of this are expected to be negligible. Although a capital carbon assessment has been undertaken using a bill of quantities, data constraints mean that the assessment does not account for emissions from the transportation of construction materials to site. This emission source usually has a minor carbon impact compared to the embodied carbon of the materials themselves. Furthermore, due to data constraints, it was not possible to quantify the carbon impact of the associated demolition works and planned tree planting. However, the carbon impact of these interventions are not likely to be of a significant scale. The business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	CityConnect Phase 3 Huddersfield Town Centre
Decision point:	OBC
Scheme type:	Transport (cycling and walking)
Appraisal period:	30 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Default AMAT assumption: 0.75%pa growth in walking and cycling trips
Fleet mix used	DfT TAG assumptions assumed for the use of AMAT
Other (non-transport)	N/A

Modelling approach:	AMAT

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Not calculated	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	368	New capital carbon calculation (construction plant, materials and transport of materials)	Detailed bottom-up assessment for construction materials. CAPEX benchmarking approach for plant and transportation.
Operational carbon (tCO_2e) **[D]**	-127	Operational transport from avoided vehicle-km	High-level calculation using AMAT outputs

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	368
Operational carbon (tCO_2e) **[B+D]**	-127
Total carbon (tCO_2e) **[A+B+C+D]**	241
Intensity metric (tCO_2e/£m)*	116
Confidence rating	Low confidence

Notes
The results show an overall increase in emissions due to the capital carbon impact of the cycle lane. Note that although the capital carbon assessment was largely undertaken using a Bill of Quantities, there is a high level of uncertainty in the result due to confusion around which type of stone will be used (i.e. general stone or granite). The result could increase by around 400% if granite is used over general stone. In addition, there is low certainty in the confidence of the operational carbon assessment, given that the current active mode appraisal suggests that the scheme will not increase cycling demand, and therefore only includes the pedestrianisation benefits. In reality, operational carbon reductions from increased cycling demand may be expected. Furthermore, the various mitigation methods identified within the review meeting (including the use of electric plant during construction, local procurement of materials and the provision of LED lighting) are not reflected within the assessment due to data constraints. These interventions would all likely reduce the carbon impact of the scheme. In addition, there is low confidence given that no additional transport modelling has been undertaken to account for the impact on surrounding highways. According to the OBC, the vehicles using the road as a through route are assumed to be displaced onto the A62 northbound. This would likely lead to a marginal increase in vehicle-km. However, it is expected that the scheme would cause fewer vehicle-km for those who currently use the road to access parking. It is not possible to understand the impact of this without the additional transport modelling.

Carbon impact assessment summary information

Scheme name:	TCF - Dewsbury Bus Station
Decision point:	SOC
Scheme type:	Transport (cycling and walking) & Transport (bus priority) & Buildings - refurbishment and energy efficiency
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Combination of SATURN, AMAT and MEC based spreadsheets

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Information not provided	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	1,276	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	Not possible to quantify	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	1,276
Operational carbon (tCO_2e) **[B+D]**	Not possible to quantify
Total carbon (tCO_2e) **[A+B+C+D]**	1,276
Intensity metric (tCO_2e/£m)*	71
Confidence rating	Low confidence

Notes
The assessment results do not include the operational transport. As the scheme was at SOC stage there was limited information available to be used in a carbon assessment. As the scheme develops it would be recommended that the carbon impact of the scheme is assessed, utilising outputs from transport modelling. It is likely this scheme would have a carbon benefit as it promotes the uptake of active travel modes. The operational energy of the station building is also not included within the assessment. Project specific information, such as floor area, was not available at the time of assessment, therefore it was not possible to complete even a high-level benchmarking assessment. The capital carbon assessment was carried out using a carbon intensity benchmark based on the CAPEX of the scheme as more detailed design information was not available at SOC stage. As a result of a lack of specific project information the confidence in the assessment was low. Note that the business case also claims that the scheme will help to support future growth within the area. However, the carbon impact of this unlocked development has not been considered within the boundary of this carbon impact assessment. In addition, the scheme mentions a number of energy efficiency measures such as the use of renewable energy (solar pv) and installation of electric infrastructure such as EV charging ports. These measures will result in an overall carbon reduction, however further detail is required to quantify potential savings.

Carbon impact assessment summary information

Scheme name:	East Leeds Housing Growth - Red Hall
Decision point:	FBC +
Scheme type:	Buildings - demolition and land remediation
Appraisal period:	N/A

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	No assessment undertaken

Modelling approach:	No assessment undertaken

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Not calculated	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	Not possible to quantify	N/A	N/A
Operational carbon (tCO_2e) **[D]**	Not possible to quantify	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	Not possible to quantify
Operational carbon (tCO_2e) **[B+D]**	Not possible to quantify
Total carbon (tCO_2e) **[A+B+C+D]**	Not possible to quantify
Intensity metric (tCO_2e/£m)*	Not possible to quantify
Confidence rating	N/A

Notes
This project relates to demolition, site remediation and other enabling works intended to release the Red Hall site for development of c. 400 new homes, and also provide land for a new orbital road. The FBC indicates that the Do-minimum (DM) scenario would probably still result in these projects going ahead in some form, but potentially at a later date. On this basis, the difference in carbon impacts between Do-minimum and Do-something is likely to be minimal. The carbon impacts of the demolition, site remediation and other enabling works themselves are difficult to assess in a meaningful way. As discussed in the Stage 2 Guidance (provided separately), emissions from these processes vary hugely depending on factors such as the types of buildings on site, the level of contamination, the type of remedial work that is required, how the construction, demolition and excavation waste is handled, and so on. Therefore, these have not been assessed quantitatively. However, it is noted that the work would result in road expansion, and also unlock future development that is likely to have significant carbon impacts. This is particularly true given that a large portion of the site is previously undeveloped (greenfield), and that the planning proposals currently include low-density housing. A more detailed summary of potential impacts from these interventions is provided in Section F of the Pro Forma.

Carbon impact assessment summary information

Scheme name:	Enterprise Zone - Parry Lane, Bradford
Decision point:	FBC +
Scheme type:	Buildings - demolition and land remediation
Appraisal period:	14/12/2017 - 29/04/2022

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	Incorporation of assumptions around the carbon intensity of the materials, site transportation and others.

Modelling approach:	Capital carbon assessment based on detailed project information.

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	398	Construction operations taking place on site in order to complete the demolition, remediation and site preparation works; transportation of waste and materials to/from site	EA Carbon Tool
Operational carbon (tCO_2e) **[B]**	N/A for this project type	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions* ***additional*** *to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	0	N/A original result deemed fit for purpose	N/A
Operational carbon (tCO_2e) **[D]**	N/A for this project type	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	398
Operational carbon (tCO_2e) **[B+D]**	N/A for this project type
Total carbon (tCO_2e) **[A+B+C+D]**	398
Intensity metric (tCO_2e/£m)*	57
Confidence rating	High confidence

Notes
The assessment does not consider the emissions from the future development of the site, only the initial site preparation works that are being funded by WYCA. Although the future development is outside the scope of the project from WYCA's perspective, it should be noted that emissions from the construction and operation of the scheme are likely to be very large in comparison with the emissions from the site preparation works alone. Further information on this is provided in Section F of the Pro Forma. The scheme will also unlock future changes to the road/transport network, but those have not been assessed both because they are out of scope of WYCA's project and due to lack of sufficient information. The capital carbon assessment does not include carbon that is emitted as a result of land use change. This is likely to be small compared with total emissions. More information is provided in a separate briefing note.

Carbon impact assessment summary information

Scheme name:	GBF Bradford City Village Phase 1
Decision point:	FBC +
Scheme type:	Buildings - new & Buildings - refurbishment and energy efficiency & Buildings - demolition and land remediation
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	No assessment undertaken

Modelling approach:	No assessment undertaken

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Not calculated	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	2,880	New capital carbon calculation (construction plant, materials and transport of materials)	High-level benchmark assessment
Operational carbon (tCO_2e) **[D]**	-2,444	New operational energy use assessment	High-level benchmark assessment

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	2,880
Operational carbon (tCO_2e) **[B+D]**	-2,444
Total carbon (tCO_2e) **[A+B+C+D]**	436
Intensity metric (tCO_2e/£m)*	18
Confidence rating	Medium confidence

Notes

This assessment considered the difference in emissions between keeping the existing marketplace or demolishing it and replacing it with a low-energy new building.

It is understood that the new building would have low capital/embodied carbon due to the use of timber construction, that it would predominantly be naturally ventilated and unheated, and that low carbon technologies such as heat pumps, solar hot water, and solar PV are being considered. The alternative would be to make no changes to the existing marketplace, which according to the business case would see a decrease in occupancy of around 10% per year. On this basis, our assessment shows that both the embodied and operational carbon of the proposed new building would be much lower than the existing building. These results are based on a rough benchmarking exercise, reflecting the lack of detailed design information or previous carbon assessment. Therefore, while the results are considered to provide a reasonable estimation of the scheme impacts in terms of relative order of magnitude, they are still subject to uncertainty.

Note that the improved carbon performance of the new scheme would not necessarily be enough to offset the additional embodied carbon (although not included in the total emissions for the new building, it is also worth noting that the embodied carbon of the existing buildings would essentially be 'wasted' if they are demolished unnecessarily.)

Carbon impact assessment summary information

Scheme name:	TCF - Halifax Bus Station
Decision point:	FBC
Scheme type:	Transport (bus interchange)
Appraisal period:	40 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	No modelling undertaken at time of assessment
Fleet mix used	No modelling undertaken at time of assessment
Other (non-transport)	N/A

Modelling approach:	No modelling undertaken at time of assessment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Not calculated	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	2,015	New capital carbon calculation (construction plant, materials and transport of materials)	High-level benchmark assessment based on scheme components
Operational carbon (tCO_2e) **[D]**	Not possible to quantify	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	2,015
Operational carbon (tCO_2e) **[B+D]**	Not possible to quantify
Total carbon (tCO_2e) **[A+B+C+D]**	2,015
Intensity metric (tCO_2e/£m)*	127
Confidence rating	Low confidence

Notes
At the time of assessment, the information available on PIMS was limited. As a result, no operational transport assessment could be carried out. The capital carbon impact of the scheme has been calculated based on high-level carbon intensity benchmarks. Therefore, as there was a lack of project specific data available on PIMS, and the project was at an early stage of development there is low confidence in the carbon assessment result produced. Due to limited information, it was not possible to include the proposed mitigation measures (e.g. low carbon materials) within the capital carbon assessment. If these measures materialise, the expected impact from the capital carbon assessment may reduce.

Carbon impact assessment summary information

Scheme name:	Halifax Town Centre (Northgate House)
Decision point:	FBC +
Scheme type:	Buildings - refurbishment and energy efficiency
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	No assessment undertaken

Modelling approach:	No assessment undertaken

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Not calculated	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	3,875	New capital carbon calculation (construction plant, materials and transport of materials)	High-level benchmark assessment
Operational carbon (tCO_2e) **[D]**	2,935	New operational energy use assessment	High-level benchmark assessment

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	3,875
Operational carbon (tCO_2e) **[B+D]**	2,935
Total carbon (tCO_2e) **[A+B+C+D]**	6,810
Intensity metric (tCO_2e/£m)*	639
Confidence rating	Medium confidence

Notes
This assessment considers the impacts of refurbishing Northgate House, which was previously empty. In a do-minimum scenario, the existing building would be unaltered, and therefore remain empty. In the do-something scenario, there are embodied carbon impacts from the use of construction materials, equipment, etc., and in addition, there is a large increase in operational energy use. It is important to understand that, if the building was currently occupied, the refurbishment would be expected to reduce operational carbon emissions (more information available in the Pro Forma). The proposed scheme achieves significant CO2 reductions compared with alternative proposals that would have demolished and replaced the existing buildings, because the embodied carbon of a demolition scheme would potentially be several times higher than that shown above (though the latter has not been assessed in detail). The calculations also do not consider the likelihood that similar commercial space would likely be developed on another site, if not on this one, so the do-minimum scheme may not accurately reflect the range of possibilities. Note that the carbon assessment is based on high-level benchmarks and therefore has large margins of error.

Carbon impact assessment summary information

Scheme name:	Leeds City Centre Network and Interchange Package - Armley Gyratory
Decision point:	OBC
Scheme type:	Transport (cycling and walking) & Transport (bus priority) & Transport (highways)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Background growth is constrained to TEMPRO
Fleet mix used	DfT TAG
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	15,692	Operational transport (including reassignment)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	7,749	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	0	N/A extracted result from original modelling	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	7,749
Operational carbon (tCO_2e) **[B+D]**	15,692
Total carbon (tCO_2e) **[A+B+C+D]**	23,441
Intensity metric (tCO_2e/£m)*	381
Confidence rating	Low confidence

Notes
The operational transport assessment includes rerouting. Traffic demand has increased at the gyratory given the capacity improvements and the city centre changes influencing wider rerouting. The overall increase in carbon emissions is therefore primarily as a result of increased traffic flow, which is likely driven by improved capacity on the Armley gyratory and being attributed to re-routing as a result of the city centre scheme Although there is reasonable confidence in the approach taken to model the operational transport emissions, there is low confidence in the capital carbon assessment, which has been undertaken using a high-level benchmarking approach. Also, the overall carbon impact does not include the carbon reduction potential of proposed tree planting due to data constraints, however this would likely have a negligible overall impact. In addition, the design has significantly changed as it has passed into FBC stage. Therefore the carbon impact result is not likely to reflect the current scheme design.

Carbon impact assessment summary information

Scheme name:	Leeds Bradford Airport Parkway
Decision point:	OBC
Scheme type:	Transport (railway station)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Passenger demand modelling based on various sources

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Information not provided	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	5,851	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	-3,553	New operational transport calculation based on avoided vehicle-km	High-level assessment based on AMAT outputs

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	5,851
Operational carbon (tCO_2e) **[B+D]**	-3,553
Total carbon (tCO_2e) **[A+B+C+D]**	2,298
Intensity metric (tCO_2e/£m)*	55
Confidence rating	Low confidence

Notes
The results show an overall increase in emissions due to the capital carbon impact of the scheme. There is a high level of uncertainty in the result of the capital carbon assessment as it was based on high-level benchmarks. In addition, there is low certainty in the confidence of the operational carbon assessment, given that this has also been calculated using a high-level estimation approach based on the output of avoided vehicle-km from AMAT. Overall, there is very low confidence in both the operational and the capital carbon emissions assessment, given that project specific information is not available, therefore only high level calculations have been made based on generalised assumptions at this stage.

Carbon impact assessment summary information

Scheme name:	Leeds District Heat Network
Decision point:	FBC +
Scheme type:	Buildings - refurbishment and energy efficiency
Appraisal period:	N/A

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	Information not provided

Modelling approach:	Information not provided

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Information not provided	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	Not possible to quantify	N/A	N/A
Operational carbon (tCO_2e) **[D]**	Not possible to quantify	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	Not possible to quantify
Operational carbon (tCO_2e) **[B+D]**	Not possible to quantify
Total carbon (tCO_2e) **[A+B+C+D]**	Not possible to quantify
Intensity metric (tCO_2e/£m)*	Not possible to quantify
Confidence rating	N/A

Notes
This scheme involves the construction of a district heat network (DHN) in Leeds, which would connect to several thousand residential properties and a number of other non-domestic buildings. One of the primary purposes of the scheme is to reduce emissions from heating, and according to publicly available documents, the scheme would reduce carbon emissions for the initial customers connecting to the network by c. 11,000 tCO_2e per year at full buildout. A detailed carbon assessment has already been carried out and the scheme promoter did not wish for a revised assessment to be undertaken, therefore due to a lack of information, it has not been possible to either validate the calculations or update them to align with the approach taken for assessing other projects. Therefore, due to presumed methodological differences, the 11,000 tCO_2e figure should not be compared against other carbon savings figures that have been provided as part of the WYCA Carbon Assessment project. It is not possible to multiply this figure by the presumed lifespan of the scheme because doing so would not account for future electricity grid decarbonisation, so the results would not be comparable.

Carbon impact assessment summary information

Scheme name:	GPF LEP Loan - Citu Bridge - 308 (Inc 319)
Decision point:	FBC +
Scheme type:	Buildings - new & Pedestrian bridge & Renewable energy
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	No assessment undertaken

Modelling approach:	No assessment undertaken

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Information not provided	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Information not provided	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	12,480	New capital carbon calculation (construction plant, materials and transport of materials)	High-level benchmark assessment
Operational carbon (tCO_2e) **[D]**	2,563	New operational energy use assessment	High-level benchmark assessment

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	12,480
Operational carbon (tCO_2e) **[B+D]**	2,563
Total carbon (tCO_2e) **[A+B+C+D]**	15,043
Intensity metric (tCO_2e/£m)*	Unknown
Confidence rating	Medium confidence

Notes
This assessment considered the impacts of a proposal for 312 new low-energy homes. The scheme impact reflected in the calculations show this in comparison with a scenario where no development takes place on the site, which is the alternative scenario described in the business case. In reality, this number of homes would potentially be delivered elsewhere, and built to a lower energy performance standard, so the project could be considered to save carbon emissions compared with that hypothetical situation. This assessment is based on a benchmarking exercise. While the results are considered to provide a reasonable estimation of the scheme impacts in terms of relative order of magnitude, they are subject to uncertainty. Around 83% of the total scheme impact emissions result from the capital carbon assessment. Note that embodied carbon falls outside the scope of UK Building Regulations and is therefore not typically assessed or addressed in the design of buildings. However, for buildings that achieve low operational energy use, embodied carbon will account for a much larger proportion of total carbon emissions. The provision of a pedestrian bridge would be expected to promote walking and cycling to/from the city centre, and in particular could decrease residents' journey times. These impacts have not been assessed but are likely to be small in comparison with the total emissions from the development. Overall this scheme is understood to have achieved very good practice in terms of sustainable design and could be adopted as a model for similar developments.

Carbon impact assessment summary information

Scheme name:	Leeds Flood Alleviation Phase 2
Decision point:	FBC
Scheme type:	Flood Alleviation Scheme
Appraisal period:	100 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	Various assumptions made in relation to material types and transportation distances

Modelling approach:	Capital carbon assessment using Bill of Quantity activity data

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	23,559	All major construction activity emissions, construction plant, materials and transport of materials	Detailed, bottom-up assessment
Operational carbon (tCO_2e) **[B]**	Not calculated (scoped as de minimis)	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	0	N/A original result deemed fit for purpose	N/A
Operational carbon (tCO_2e) **[D]**	Not calculated (scoped as de minimis)	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	23,559
Operational carbon (tCO_2e) **[B+D]**	Scoped out
Total carbon (tCO_2e) **[A+B+C+D]**	23,559
Intensity metric (tCO_2e/£m)*	308
Confidence rating	High confidence

Notes
Note that the operational emissions were considered de minimis for this scheme and as a result were scoped out due to large uncertainties associated with the calculation methodologies, the accompanying pro forma provides more information on this. There was high confidence in the capital carbon assessment carried out for the scheme as it used a bottom up approach which included emissions associated with the definitions of activities A1-5 that are contained within PAS2080 - Carbon Management in infrastructure. Activities A1-5 include emissions associated with the use of material, construction plant and transport of materials to site. Emission factors used had been taken from industry recognised and accepted sources such as BEIS and ICE. The methodology used in the capital carbon assessment is a thorough and suitable approach for the size of the scheme. The carbon mitigation of tree planting associated with the scheme had not been quantified, but is expected to be included at a later phase of the project. Carbon mitigation targets have also been set for the scheme which could realise a carbon reduction of 3,700 tCO_2e including using both low carbon materials and energy used during construction. These have not been included within the reported calculation,

Carbon impact assessment summary information

Scheme name:	Leeds City College - Quarry Hill
Decision point:	FBC +
Scheme type:	Buildings - new
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	No assessment undertaken

Modelling approach:	No assessment undertaken

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Not calculated	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	16,910	New capital carbon calculation (construction plant, materials and transport of materials)	High-level benchmark assessment
Operational carbon (tCO_2e) **[D]**	44,351	Operational energy over appraisal period	High-level benchmark assessment

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	16,910
Operational carbon (tCO_2e) **[B+D]**	44,661
Total carbon (tCO_2e) **[A+B+C+D]**	61,571
Intensity metric (tCO_2e/£m)*	1,244
Confidence rating	Medium confidence

Notes
These results show the emissions from constructing and operating the proposed development. In line with the 'Do-Nothing' and 'Do-Something' scenarios in the Business Case, it assumes that there would be no development at all without WYCA funding. In reality, it is understood that a similar scheme would likely be delivered elsewhere (subject to need), but that was not one of the proposed options for this scheme. The project includes some new build and a minor refurbishment element. This assessment has only considered the new build portion, because minor refurbishments are not required to meet improved energy efficiency levels, and are therefore assumed to have no significant impact on energy demands. The assessment represents a best estimate based on the level of data that was available, recognising that there is always a high level of uncertainty when estimating energy use in buildings due to factors such as occupant behaviour. The calculation used industry standard benchmarks for energy consumption, based on the size and type of building. The assessment focuses solely on energy use in buildings, and therefore does not account for wider factors such as transport accessibility, electric vehicle (EV) charging, and the site location (brownfield versus greenfield site); this is due to the lack of a standard methodology for quantifying such impacts.

Carbon impact assessment summary information

Scheme name:	Shipley College - Salt Building
Decision point:	FBC +
Scheme type:	Buildings - refurbishment and energy efficiency
Appraisal period:	01/05/2016-01/07/2020

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A
Fleet mix used	N/A
Other (non-transport)	Information not provided

Modelling approach:	Information not provided

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Information not provided	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Information not provided	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	Not possible to quantify	N/A	High-level benchmark assessment
Operational carbon (tCO_2e) **[D]**	Not possible to quantify	N/A	High-level benchmark assessment

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	Not possible to quantify
Operational carbon (tCO_2e) **[B+D]**	Not possible to quantify
Total carbon (tCO_2e) **[A+B+C+D]**	Not possible to quantify
Intensity metric (tCO_2e/£m)*	Not possible to quantify
Confidence rating	N/A

Notes
A quantitative assessment has not been carried out. To do so would require data showing the previous energy demands of the building, as well as the energy demands post-refurbishment. Alternatively, the improvement could be estimated based on details of the construction materials and other equipment purchased as part of the refurbishment. However, this information was not available. In general, evidence suggests that the refurbishment of non-domestic buildings can reduce operational energy demands by up to c. 20-30%, although that is an upper estimate. Since energy efficiency improvements were not the primary aim of the refurbishment, the improvement is likely to be lower. It is also possible that energy demands would increase overall, if the refurbishment allows for more activity to take place in the building, if this was not happening previously. Note that, depending on the types of materials and equipment that were used, it is possible that the capital carbon emissions of the scheme could outweigh any operational carbon savings, resulting in an overall increase in carbon emissions from the building. This cannot be determined, however, based on available information.

Carbon impact assessment summary information

Scheme name:	Rail Parking Package - Shipley
Decision point:	SOC
Scheme type:	Transport (park and ride) & Transport (railway station) & Carpark extensions
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	N/A no operational transport modelling has been undertaken to date
Fleet mix used	N/A no operational transport modelling has been undertaken to date
Other (non-transport)	N/A no existing carbon assessment

Modelling approach:	N/A no existing carbon assessment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Not calculated	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	409	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	11	New assessment of operational energy demands	High-level benchmark assessment

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	409
Operational carbon (tCO_2e) **[B+D]**	11
Total carbon (tCO_2e) **[A+B+C+D]**	420
Intensity metric (tCO_2e/£m)*	165
Confidence rating	Low confidence

Notes
Due to limited data availability, the operational carbon results shown only relate to the energy use from the proposed car park structure itself, and do not account for the travel impacts of the rail parking scheme. As such, the result does not provide an indication of anything more than a small proportion of the carbon emissions from the intervention. The assessment has therefore been assessed as low confidence. Car parks have very low operational carbon emissions, the carbon impacts are dominated by the capital carbon of the car park structure itself. The results are subject to some uncertainty due to the use of benchmarks (in the absence of detailed design information), but is considered to provide a reasonable estimation of the relative scale of emissions. It is unknown whether this is offset by the potential benefits of increasing use of rail transport because those effects have not been estimated; however, from a qualitative standpoint, the scheme clearly aligns with the goal of achieving a low carbon future.

Carbon impact assessment summary information

Scheme name:	TCF - Leeds City Centre Cycle Improvements
Decision point:	FBC
Scheme type:	Transport (cycling and walking)
Appraisal period:	20 years (awaiting confirmation)

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Default AMAT assumption: 0.75%pa growth in walking and cycling trips
Fleet mix used	DfT TAG assumptions assumed for the use of AMAT
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-1,020	Operational transport (based on avoided vehicle-km)	AMAT

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	663	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	0	N/A original result deemed fit for purpose	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	663
Operational carbon (tCO_2e) **[B+D]**	-1,020
Total carbon (tCO_2e) **[A+B+C+D]**	-357
Intensity metric (tCO_2e/£m)*	-48
Confidence rating	Low confidence

Notes
The scheme has an overall carbon reduction as a result of the carbon benefits from active travel modal shift. The existing transport modelling approach is deemed suitable for this type of assessment, however the assessment could be enhanced by the use of the LTM2 (Leeds SATURN model), which would give a better insight of re-routing and the impact of the scheme on road users. This is because there will likely be impacts to the highway, albeit minor capacity reductions, which could result in some strategic reassignment. In addition, the capital carbon emissions have been estimated using a high-level benchmarking approach, of which there is low confidence in the results.

Carbon impact assessment summary information

Scheme name:	TCF - A61 Bus, Cycle and Walking Improvements
Decision point:	SOC
Scheme type:	Transport (cycling and walking) & Transport (bus priority) & Transport (highways)
Appraisal period:	30 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Highway impacts in SATURN, AMAT for active modes

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Information not provided	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	739	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	Not possible to quantify	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	739
Operational carbon (tCO_2e) **[B+D]**	Not possible to quantify
Total carbon (tCO_2e) **[A+B+C+D]**	739
Intensity metric (tCO_2e/£m)*	106
Confidence rating	Low confidence

Notes
The assessment results do not include the operational transport impacts of the scheme. As the scheme was at SOC stage there was limited information available to be used in a carbon assessment. The ASR states that the Wakefield SATURN model would be used alongside the LTM2 once its development is complete, however there is no mention of this in the SOC. It was reported within the business case that the scheme benefits have been assessed in TUBA and AMAT. However, these outputs were not readily available on PIMS so could not be displayed, further information allowing for reassessment could also not be located. As a result, the operational emissions associated with the scheme could not be presented. However, it is likely this scheme would have a carbon benefit as it promotes the uptake of active travel modes. The capital carbon assessment was carried out using a carbon intensity benchmark based on the CAPEX of the scheme, given that more detailed design information was not available at SOC stage. As a result of a lack of specific project information, there is low confidence in the assessment. As mentioned above, the assessment does include an operational assessment due to lack information at SOC stage. Note that the business case also claims that the scheme will help to support future growth within the area. However, the carbon impact of this unlocked development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	TCF - A64 Park and Ride
Decision point:	SOC
Scheme type:	Transport (bus priority) & Transport (park and ride)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Spreadsheet modelling informed by the WY Bus Network Review

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Information not provided	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	1,821	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	Not possible to quantify	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	1,821
Operational carbon (tCO_2e) **[B+D]**	Not possible to quantify
Total carbon (tCO_2e) **[A+B+C+D]**	1,821
Intensity metric (tCO_2e/£m)*	121
Confidence rating	Low confidence

Notes
The assessment result does not include the operational transport impacts of the scheme. As the scheme was at SOC stage there was limited information available to be used in a carbon assessment. As the scheme develops it would be recommend that the carbon impact of the scheme is assessed, making use of the outputs from transport modelling. The capital carbon assessment was carried out using a carbon intensity benchmark based on the CAPEX of the scheme, given that more detailed design information was not available at SOC stage. As a result of a lack of specific project information, there is low confidence in the assessment. As mentioned above, the assessment does include an operational assessment due to lack information at SOC stage. Note that the business case also claims that the scheme will help to support future growth within the area. However, the carbon impact of this unlocked development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	TCF - Leeds Station - Sustainable Travel Gateway
Decision point:	OBC
Scheme type:	Transport (cycling and walking) & Transport (bus priority) & Transport (station gateway)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Default AMAT assumption: 0.75%pa growth in walking and cycling trips
Fleet mix used	DfT TAG assumptions assumed for the use of AMAT
Other (non-transport)	N/A

Modelling approach:	TfL Ambience Benefit Calculation (ABC)

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Information not provided	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	2,524	New capital carbon calculation (construction plant, materials and transport of materials)	High-level benchmark assessment based on scheme components
Operational carbon (tCO_2e) **[D]**	878	Operational energy of proposed retail space	High-level benchmark assessment

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	2,524
Operational carbon (tCO_2e) **[B+D]**	878
Total carbon (tCO_2e) **[A+B+C+D]**	3,402
Intensity metric (tCO_2e/£m)*	102
Confidence rating	Low confidence

Notes
Due to data constraints, it was not possible to quantify the carbon impact of operational transport emissions within the assessment. This means that the potential carbon reduction emerging from increased cycle infrastructure and rail accessibility is not captured within the assessment result. After discussion with the project team, this assessment is expected to be carried out at FBC stage when more information is available (such as traffic modelling). However, an assessment of the operational energy associated with the retail space being constructed as part of the scheme has been carried out. The result is based on an assumed floor area of 200m^2 and industry standard benchmarks, this provides a sense of the scale of operational emissions associated with the new development. The capital carbon assessment has also been calculated using a high-level carbon intensity benchmark, based on the assumed floor area of 200m^2. Therefore, there is low confidence in the overall results as the results presented are based on high-level benchmarks due to a lack of more detailed information, and it was not possible to carry out an assessment of the operational transport emissions.

Carbon impact assessment summary information

Scheme name:	TCF - Selby Station Gateway
Decision point:	OBC
Scheme type:	Transport (cycling and walking) & Transport (station gateway)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	603	Manufacture and transport of materials used in the construction	WSP Zero Carbon Tool
Operational carbon (tCO_2e) **[B]**	26,148	Operational transport (including from modal shift and rerouting)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	0	N/A original result deemed fit for purpose	N/A
Operational carbon (tCO_2e) **[D]**	0	N/A extracted result from original modelling	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	603
Operational carbon (tCO_2e) **[B+D]**	26,148
Total carbon (tCO_2e) **[A+B+C+D]**	26,751
Intensity metric (tCO_2e/£m)*	1,000
Confidence rating	Medium confidence

Notes
The operational transport assessment includes both rerouting and the impact of modal shift to active transport. The operational carbon impacts to the highway have been assessed using the Selby Traffic Model (STM), a strategic model built in SATURN and active modes have been appraised through AMAT with a 60 year appraisal period. There is medium confidence in the operational transport assessment results as the STM likely overestimates the carbon impact of the scheme by overestimating the displacement caused by the scheme and, additionally, by assuming no change to the fleet composition past 2050. The significant increase in carbon is therefore largely as a result of the scheme modelling primarily being driven by the closure of Denison Bridge to highway modes. This results in a significant amount of re-routing and increased vehicle KMs. There is a greater level of confidence in the capital carbon assessment carried out for the scheme as, where possible, bottom-up calculations using bills of quantities have provided a more robust result. Note that the scheme also plans to use low carbon materials in its design, however this has yet to be finalised and so was not possible to quantify at this stage. In addition, it was not possible to quantify the carbon impact of the addition of electric vehicle charging points, due to data limitations.

Carbon impact assessment summary information

Scheme name:	TCF - West Bradford - Cycle Superhighway Extension
Decision point:	SOC
Scheme type:	Transport (cycling and walking)
Appraisal period:	30 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Average walking demand will increase by 20% as a result of the scheme's implementation
Fleet mix used	N/A - Active modes
Other (non-transport)	N/A

Modelling approach:	Approach used is AMAT

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Not calculated	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	2,100	New capital carbon calculation (construction plant, materials and transport of materials)	High-level benchmark assessment based on scheme components
Operational carbon (tCO_2e) **[D]**	-515	The revised result includes carbon from operational transport	High-level calculation based on AMAT outputs

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	2,100
Operational carbon (tCO_2e) **[B+D]**	-515
Total carbon (tCO_2e) **[A+B+C+D]**	1,585
Intensity metric (tCO_2e/£m)*	86
Confidence rating	Low confidence

Notes
The carbon assessment takes into account the vehicle reduction kms as a result of the scheme over the thirty year appraisal period. However, there is low confidence in the result as the background assumptions (walking demand increase by 20%) do not appear to be well evidenced. In addition, the capital carbon assessment has been calculated using a high level benchmark according to the scheme type. In this case, a carbon intensity benchmark has been applied to the presumed length of segregated cycleway (7km). Note, the business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	TCF - White Rose Station
Decision point:	FBC
Scheme type:	Transport (cycling and walking) & Transport (railway station)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	DfT TAG assumptions assumed for the use of AMAT (not for rail modelling/ forecasting)
Other (non-transport)	N/A

Modelling approach:	Passenger demand modelling based on various sources Active modes assessed in AMAT

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-5,424	Operational transport (from avoided vehicle-km)	AMAT

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	1,488	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	0	N/A extracted result from original modelling	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	1,488
Operational carbon (tCO_2e) **[B+D]**	-5,424
Total carbon (tCO_2e) **[A+B+C+D]**	-3,936
Intensity metric (tCO_2e/£m)*	-179
Confidence rating	Low confidence

Notes
The carbon reduction as a result of this scheme is due to modal shift toward public transport. However, there is low confidence in the operational transport modelling approach undertaken given that there are concerns over the catchment for the new station. In addition, it appears that active modes have been assessed however it is understood that the benefits from this appraisal have not been included in the final output for the carbon assessment. As such, the scheme could be underrepresenting the actual improvement in carbon. There is also low confidence in the capital carbon assessment approach, which has been undertaken using a high-level benchmarking exercise. The business case also claims that the scheme will help to support future economic development. However, the carbon impact of this unlocked economic development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	York Central Access Road and Station Access Improvements and TCF - York Railway Station Gateway
Decision point:	SOC
Scheme type:	Transport (station gateway)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Information not provided	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	2,858	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	Not possible to quantify	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	2,858
Operational carbon (tCO_2e) **[B+D]**	Not possible to quantify
Total carbon (tCO_2e) **[A+B+C+D]**	2,858
Intensity metric (tCO_2e/£m)*	88
Confidence rating	Low confidence

Notes
The assessment result does not include the operational transport impacts of the scheme. As the scheme was at SOC stage there was limited information available to be used in a carbon assessment. As the scheme develops it would be recommend that the carbon impact of the scheme is assessed, making use of the outputs from transport modelling. The capital carbon assessment was carried out using a carbon intensity benchmark based on the CAPEX of the scheme, given that more detailed design information was not available at SOC stage. As a result of a lack of specific project information, there is low confidence in the assessment. Note that the business case also claims that the scheme will help to support future economic development within the area. However, the carbon impact of this unlocked economic development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	GBF – Temple Green P & R Extension
Decision point:	FBC +
Scheme type:	Transport (park and ride)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction

Existing assessment

Background assumptions	
Background traffic growth	0.76% per annum between 2010 and 2040 based on TEMPRO v7.2
Fleet mix used	DfT TAG
Other (non-transport)	N/A

Modelling approach:	Bespoke spreadsheet model in line with TAG (including variable demand)

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-3,308	Operational transport (from avoided vehicle-km)	MEC

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	655	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	541	A new assessment was completed based on avoided vehicle-km	MEC

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	655
Operational carbon (tCO_2e) **[B+D]**	-2,767
Total carbon (tCO_2e) **[A+B+C+D]**	-2,112
Intensity metric (tCO_2e/£m)*	-270
Confidence rating	Low confidence

Notes
Note that the original carbon impact assessment result was only reported economically. The result in tCO_2e was not reported within the business case. Overall, the scheme leads to a carbon benefit of -2112 tCO2e, largely as a result of the operational carbon benefit of the scheme. Note that there is low confidence in the capital carbon assessment, which was undertaken using a carbon intensity benchmark, and does not reflect scheme specific circumstances. Due to limited access to the existing modelling approach for operational transport emissions, a revised assessment was undertaken in line with the Stage 2 guidance. There is limited confidence in the revised assessment, given that it is quite a high-level approach. It is possible that a greater carbon reduction may be achieved by this scheme than is currently being reported.

Carbon impact assessment summary information

Scheme name:	Thorpe Park Station
Decision point:	OBC
Scheme type:	Transport (railway station)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not available
Fleet mix used	Information not available
Other (non-transport)	N/A

Modelling approach:	Information not available

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Not calculated	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	3,987	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	Not possible to quantify	N/A	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	3,987
Operational carbon (tCO_2e) **[B+D]**	Not possible to quantify
Total carbon (tCO_2e) **[A+B+C+D]**	3,987
Intensity metric (tCO_2e/£m)*	126
Confidence rating	Low confidence

Notes
At the time of assessment, the information on PIMS was limited. As a result, no operational transport assessment could be carried out. Transport modelling and active mode appraisal should be carried out for this scheme in order to understand the potential carbon impact. The capital carbon impact of the scheme has been calculated based on high-level carbon intensity benchmarks and the total cost of the scheme. Therefore, as there was a lack of project specific data available on PIMS, and the project was at an early stage of development there is low confidence in the carbon assessment result produced.

Carbon impact assessment summary information

Scheme name:	Transformational - A6120 Leeds Northern Outer Ring Road Improvements
Decision point:	SOC
Scheme type:	Transport (cycling and walking) & Transport (bus priority) & Transport (highways)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-28,500	Operational transport (including rerouting)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	9,156	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	0	N/A extracted result from original modelling	N/A

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	9,156
Operational carbon (tCO_2e) **[B+D]**	-28,500
Total carbon (tCO_2e) **[A+B+C+D]**	-19,344
Intensity metric (tCO_2e/£m)*	-113
Confidence rating	Low confidence

Notes
Note that the operational transport emissions were not previously reported, but were extracted from TUBA to report for the purpose of this exercise. The scheme is shown to reduce emissions, due to the modelled congestion alleviation from increased capacity. The operational transport assessment accounts for rerouting. However, there is low confidence in this result being reflective of the carbon impact of this scheme. Endorsement of the SOC is currently being sought, as a result, there is very little information available at the time of assessment. It is likely that the project may significantly change in scope moving forwards. Furthermore, the impact of avoided car-km from modal shift toward public transport has not been included within the transport modelling (though not likely to have a largely significant carbon impact). In addition, the capital carbon emissions have been estimated using a high-level benchmarking approach, which further reinforces the 'low confidence' scoring for this assessment. The project is at optioneering stages, therefore the high-level estimate is proportionate to the level of data available, and should only be used to provide an indication of the sense of scale of emissions. It has also not been possible to quantify the impact of the proposed bridge demolition and reconstruction that will occur as part of the scheme. Note that the structures were already reaching the end of their life, and therefore likely to have required construction effort regardless of the scheme. Furthermore, due to data constraints, the assessment excludes the carbon impact of encroachment onto green belt land. This will likely increase carbon emissions, the extent to which will depend upon the existing vegetation of the land.

Carbon impact assessment summary information

Scheme name:	Wakefield City Centre Package (Phase 2) - Ings Road
Decision point:	OBC
Scheme type:	Transport (cycling and walking) & Transport (highways)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	-2,115	Operational transport (including rerouting)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	374	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	0	N/A original result deemed fit for purpose	N/A extracted result from original modelling

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	374
Operational carbon (tCO_2e) **[B+D]**	-2,115
Total carbon (tCO_2e) **[A+B+C+D]**	-1,741
Intensity metric (tCO_2e/£m)*	-384
Confidence rating	Medium confidence

Notes
This scheme is shown to reduce carbon emissions, due to modelled reduction in congestion levels. The operational transport carbon assessment includes strategic rerouting in the model. However, there could be more clarity on the forecast years used in the modelling, as the OBC and ASR report differing years. Note that the carbon reduction impacts from modal shift to active transport is not included within the transport modelling. However, this is not likely to have a significant impact on the overall results. Furthermore, although likely insignificant, the assessment excludes carbon reduction from tree planting. The high-level benchmark assessment used to estimate capital carbon emissions is not robust, and should be used to provide an indication of the scale of emissions only. Note that the business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment.

Carbon impact assessment summary information

Scheme name:	York Castle Gateway
Decision point:	OBC
Scheme type:	Transport (cycling and walking) & Transport (station gateway)
Appraisal period:	20 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	Not calculated	N/A	N/A
Operational carbon (tCO_2e) **[B]**	Information not provided	N/A	N/A

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions **additional** to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	2,175	New capital carbon calculation (construction plant, materials and transport of materials)	High-level CAPEX benchmark assessment
Operational carbon (tCO_2e) **[D]**	-20	Operational transport from avoided vehicle-km	High-level assessment using AMAT outputs

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	2,175
Operational carbon (tCO_2e) **[B+D]**	-20
Total carbon (tCO_2e) **[A+B+C+D]**	2,156
Intensity metric (tCO_2e/£m)*	108
Confidence rating	Low confidence

Notes
The operational transport assessment has been calculated using the avoided vehicle-km values which were provided by an AMAT assessment. The assessment result does not take into account the carbon impact of any re-rerouting which may occur as a result of the scheme, as transport modelling data was not available at the time of the assessment. The capital carbon assessment is based on the construction cost the scheme in the absence of specific scheme design information. The capital carbon figure likely underestimates the actual carbon impact of the scheme, given that planned pedestrian bridge will likely rely on large quantities of carbon intensive materials. Tree planting, which is set to be included within the scheme, has not been quantified due to data constraints. This will likely provide some carbon mitigation, however the extent to which is unknown without further information. As a result, there is low confidence in the carbon assessment carried out for this scheme. It would be advised that full capital and operational carbon assessments are carried out as the scheme progresses.

Carbon impact assessment summary information

Scheme name:	York Northern Outer Ring Road
Decision point:	FBC
Scheme type:	Transport (cycling and walking) & Transport (highways)
Appraisal period:	60 years

Note: All figures below are reported in tCO_2e and reflect the entire appraisal period. Negative values indicate a reduction in emissions whereas positive values indicate an increase in emissions as a result of the scheme impact.

Existing assessment

Background assumptions	
Background traffic growth	Information not provided
Fleet mix used	Information not provided
Other (non-transport)	N/A

Modelling approach:	Reassignment

Existing carbon impact assessment *Note: results reflect the scheme impact (difference between DM and DS) over the appraisal period*		**Scope** *Notes on emission sources included within the assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[A]**	42,675	Capital carbon calculation (construction plant, materials and transport of materials)	Highways England Tool
Operational carbon (tCO_2e) **[B]**	-7,875	Operational transport (including strategic reassignment)	TUBA

Revised assessment

Revised carbon impact assessment *Note: results reflect any emissions* ***additional*** *to the figures reported in the existing assessment over the appraisal period*		**Scope** *Notes on change in scope compared to existing assessment*	**Carbon calculation methodology**
Capital carbon (tCO_2e) **[C]**	0	N/A existing assessment deemed fir for purpose	N/A
Operational carbon (tCO_2e) **[D]**	-4,331	Includes carbon impacts of carbon sequestration from tree planting	Woodland Carbon Code

Overall results

Total carbon impact over appraisal period	
Capital carbon (tCO_2e) **[A+C]**	42,675
Operational carbon (tCO_2e) **[B+D]**	-12,206
Total carbon (tCO_2e) **[A+B+C+D]**	30,470
Intensity metric (tCO_2e/£m)*	469
Confidence rating	High confidence

Notes
There is relatively high confidence in the carbon impact of this scheme given that an in-depth capital carbon assessment has been undertaken, in addition the approach taken for transport modelling is sufficient for the scheme, accounting for the impacts of strategic rerouting. However, although a detailed capital carbon assessment has been undertaken, this does not account for mitigation interventions that will likely take place, such as provision of active modes, and the use of low-carbon materials and the planting of hedgerows. Whilst planting of hedgerows is likely to have less of an impact, the use of different materials can have quite significant impacts on the capital carbon assessment. However, no confirmation on exact materials has been given yet given that it is still within the planning stages. The operational reassessment of the scheme identified the 30 hectares of woodland planned to be planted as part of the scheme. The Woodland Carbon Code Carbon calculator was used to calculated the carbon sequestration associated with planting 30 ha of trees over the appraisal period. This was identified as 4,330.5 tCO_2e over 60 years. The large amount of sequestration can be accounted towards the large planned planting area but it should be noted this will only occur if all 30 has is planted and the planting methods are sustainable. The business case also claims that the scheme will help to support future housing development. However, the carbon impact of this unlocked housing development has not been considered within the boundary of this carbon impact assessment.

D. Results of high-level screening

Project information		Screening assessment			
Project Name	**Project Description**	**Operational carbon (tCO2e)**	**Capital carbon (tCO2e)**	**Induced demand screening**	**Comments**
Energy Accelerator	The project acts as an enabler to low carbon and energy efficiency projects, moving them from concept to the point of investment. It focuses on technical support for Commercial and Domestic Retrofit including Integration of Renewable Energy sources into the built environment (e.g. Solar PV, biomass; District Heating and Street Lighting).	Operational carbon value reported but anomaly compared to all others, therefore removed	Not possible to quantify based on information available	Induced assessment not applicable	The operational carbon is the "upper limit" calculated using Defra's tool kit for valuing change in greenhouse gases. The "lower limit" of carbon savings associated with the scheme has been calculated at -1,493,000tCo2e. It has not been possible to calculate the capital carbon based on the information provided.
Flood Alleviation - Mytholmroyd	Channel widening to the river Calder and Cragg Brook and wall raising works within the town to increase protection to households at risk.	Operational carbon emissions not provided.	1,890	Induced assessment not applicable	FBC states that environmental assessments of the scheme will be carried out and as part of that the embodied carbon footprint of different project options will be calculated and assessed. The capital carbon assessment outputs were not provided within the FBC. A high level carbon assessment has been carbon out using a carbon intensity benchmark based on the CAPEX of the scheme. No operational carbon emissions were provided within the FBC however, operational carbon emissions associated with the scheme are likely to be minimal.
Flood Alleviation - Wyke Beck	Flood alleviation works to protect the Wyke Beck Valley in West Yorkshire. The project, which will be delivered in two phases, comprises three elements, namely Arthur's Rein, Halton Moor (together comprising phase 1) and Killingbeck Meadows (phase 2).	Operational carbon emissions not provided.	599	Induced assessment not applicable	The FBC+ does not mention an operational or capital carbon assessment. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The business case mentions qualitatively that the scheme will increase the quality and extent of green infrastructure, including climate and carbon sequestration benefits related to tree cover prevented from being washed away due to flooding. A detailed capital carbon assessment should be carried out for the scheme as emissions associated with the construction of flood defences are likely to have a significant carbon impact. The operational carbon emissions associated with the scheme should also be investigated although they are likely minimal in comparison.
Natural Flood Management - Upper Aire	The Growing Resilience Natural Flood Management Upper Aire Project is the second phase of the Growing Resilience Natural Flood Management project. The Growing Resilience Natural Flood Management Phase 2 Upper Aire project will deliver hundreds of small individual interventions spread across a large area, working with multiple land owners, to slow the flow of water before it reaches the main river.	Operational carbon emissions not provided.	50	Induced assessment not applicable	The FBC+ does not mention an operational or capital carbon assessment. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The scheme mentions that the planting of hedgerows and woodlands as part of it's flood management methods will lead to carbon sequestration. The quantitative benefit of planting trees and hedgerows is being calculated with the Environment Agency FAS2 and once established will be monetised. A detailed methodology of how this is calculated should be created. As assigning a carbon reduction value per tree planted is a complex process and very dependant on a range of factors including land use management, type of tree planted, planting process etc. Meaning an exact carbon value per tree planted likely has a high degree of uncertainty. A detailed capital carbon assessment should be carried out, although the impacts of the scheme may be relatively minor. The operational carbon emissions associated with the scheme should also be investigated.
Resource Efficiency Fund 2	The Resource Efficiency Fund 2 (REF2) will support SMEs identify and implement cost effective improvements in energy and resource efficiency. It will do this by removing the barriers preventing SMEs investing in energy and resource efficiency, through provision of information, advice, guidance and financial support. The project will target SME participants for whom, these types of improvements would not have taken place without support.	- 2,572	N/A	Induced assessment not applicable	The FBC appraisal report indicates that the REF2 support will assist SME's to reduce their carbon emissions by an estimated 2,572 tCO2e a year through a range of energy and resource efficiency measures. In practice these measures are recommending reducing the use of finite virgin materials, designing products to last longer and minimising waste. No methodology has been provided within the report as to how the carbon reduction figure has been estimated. A detailed methodology should be provided for any carbon assessment carried out.
Tackling Fuel Poverty	This project addresses fuel poverty amongst some of the most vulnerable households in the Leeds City Region through a capital programme of energy efficiency improvements, including existing solid wall, and hard to treat housing stock across all tenures.	- 10,561	Not possible to quantify based on information available	Induced assessment not applicable	The FBC indicates that the scheme will result in carbon savings of 10,561 tonnes of CO2 by improving the energy efficiency of 406 homes through a number of techniques including cavity wall and attic room insulations. Within the business case and it's appendices there was limited information on the methodology used to calculate the carbon reduction. Appendix C provided expected CO2 savings of different property types and indicated that carbon savings have been derived from hypothetical EPC's based on the installation of Hard To Treat Cavity Wall Insulation. However, the detailed methodology used to estimate these reductions was not provided. A detailed methodology should be provided for any carbon assessment carried out. The business case did not contain enough information to carry out a high level capital carbon estimation. More detail around the amount and type of insulation used in the scheme would be required.
South East Bradford Access Road	The construction of a new highway from the Drighlington bypass towards Dick Lane that provides a strategic transport corridor and gives extra resilience to the nearby M62 / M621 motorways and facilitate development of sites that are currently land-locked.	Operational carbon not provided	5,833	Induced assessment required	Only expression of interest (EOI) document and PAT discussion paper available on PIMS. Project is currently at SOC stage and there are no references to the outcome or methodology for either a capital or operational assessment, which is expected at SOC stage. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the estimated total project value of the project. The carbon intensity benchmark used is normally applied to the CAPEX of schemes, however, this information was not available for the project. As a result the capital carbon value provided is likely not fully representative of the scheme. It should also be noted that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The information provided within the PAT notes that the project will deliver an improved transport corridor which will reduce congestion, improve connectivity and support housing growth and development. Through these interventions there is potential for significant operational transport emissions associated with new transport routes, allowing more private vehicles on the road. It would be recommended as this scheme progresses that an induced demand assessment is carried out. The capital and operational carbon associated with housing developments this scheme will promote should also be considered.
A629 (Phase 2) - Halifax Bus Station		Operational carbon not provided	1,991	Induced assessment not applicable	The FBC mentions that WSP was commissioned in March 2020 to complete a carbon impact assessment however there are no references to the outcome or methodology for either a capital or operational assessment. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The business case mentions qualitatively that there are potential benefits to carbon by reducing journey distance of some bus routes, including charging infrastructure for the electric buses, installing PV panels on the roof to enable local energy generation, using heat pump technology for heating and cooling requirements and incorporating energy efficient features such as LED lighting and insulation glazing. A detailed capital carbon assessment should be carried out for the scheme as emissions associated with the upgrades to the bus station are likely to have a significant carbon impact. The operational carbon emissions associated with the scheme should also be investigated although they are likely minimal in comparison.

Project information		Screening assessment			
Project Name	**Project Description**	**Operational carbon (tCO2e)**	**Capital carbon (tCO2e)**	**Induced demand screening**	**Comments**
A629 (Phase 2) - Halifax Town Centre		13,924	6,445	Operational assessment includes induced demand	The FBC states that, "*Predictions carried out using EFT calculations indicate that there would be an increase of 13,924 tonnes of carbon over 60 years, with a proposed scheme opening year increase of 614 tonnes* ." It is also noted in the FBC that whilst they acknowledge the carbon impacts of phase 2, these impacts will be offset by improvements in carbon in other phases. For example, by reducing congestion, including features such as living walls to absorb carbon and improving facilities for active modes to encourage walking and cycling. The FBC does not give any indication that capital carbon has been assessed, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
A629 (Phase 4) - Ainley Top	Highway improvements at Ainley Top and wider strategic interventions across the corridor to improve the appeal and uptake of public transport between Halifax and Huddersfield.	Operational carbon not provided	3,170	Induced assessment required	The OBC does not mention an operational or capital carbon assessment. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The OBC states that no detailed environmental assessments have been undertaken and the requirement for carbon assessment will be reviewed at FBC stage. It is noted in the OBC that there is likely to be a slightly adverse impact to carbon due to increased journey times due to traffic signals.
A650 Tong Street	The widening of Tong Street (Bradford) to provide two running lanes in both directions between the A650 / A651 Westgate Hill Street junction and Knowles Lane. This will include the creation of a combination of dedicated cycle lanes and shared cycle / pedestrian facilities including Toucan Crossings.	34,105	3,086	Induced assessment required	The FBC indicates that the scheme will result in carbon savings of 34,105 tonnes of CO2 by improving journey times, encouraging active travel and implementing green infrastructure. The carbon benefits have been calculated directly from TUBA outputs which is considered an appropriate method of assessment. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. A detailed capital carbon assessment should be carried out for the scheme as emissions associated with the highway improvements are likely to have a significant carbon impact.
Bradford Forster Square Station Gateway	The redevelopment of the existing Bradford Forster Square Station to provide a new, high quality, modern station facility which will significantly enhance the user experience, providing an attractive and welcoming gateway to the City of Bradford.	Operational carbon not provided	Not possible to quantify based on information available	Induced assessment not applicable	could not locate OBC on PIMS. OBC Appraisal report states that no detailed information has been provided within the OBC for carbon assessment. The business case appraisal did not contain enough information to carry out a high level capital carbon estimation. More detail around the amount and type of materials used in the scheme would be required.
Calder Valley Line - Elland Station	Provision of a new railway station and park and ride car park on the Calder Valley Line for the town of Elland and surrounding area on a site adjacent to the A629 and close to Lowfields Business Park, plus a package of complementary walking, cycling and public realm enhancements to connect the station to the existing land uses.	Operational carbon (tCO2e) not provided. Saving of -1598168 vehicle kms calculated from WebTAG MEC approach.	Not possible to quantify based on information available	Induced assessment not applicable	OBC indicates that for operational carbon, due to the modal shift from car to train, a reduction in a total of -1598168 vehicle kilometres travelled is expected to reduce emissions of CO2. A monetised impact estimated from vehicle km reduction has been calculated using the WebTAG MEC approach, however tCO2e has not been provided. Capital carbon should be calculated based on the preferred option of "Station plus two ped/cycle bridges and high priority links between station, business park and town centre " however more detail on the types and quantity of materials used are required to calculate this.
CityConnect Phase 3 Canals	The Leeds Liverpool Canal (Shipley Sections) scheme will utilise approx. 3km (1.9m) of the Leeds and Liverpool canal as a traffic free, flat and attractive alternative to the to the A6038 (Otley Road) and A657 (Leeds Road) as well as connecting the previous works undertaken by CityConnect along the Leeds Liverpool Canal. Huddersfield Narrow Canal Phase 2 will provide a 4.31km (2.68m) traffic free, flat and attractive alternative to the A62 Manchester Road Lock 11 (Milnsbridge) and will finish in Slaithwaite Centre.	Operational carbon (tCO2e) not provided. Saving of £3144 in greenhouse gas present value calculated from WebTAG MEC approach.	2,190	Induced assessment not applicable	OBC indicates that for operational carbon, due to the modal shift from car to cycling, a saving of £3144 in greenhouse gas present value has been calculated based on the WebTAG MEC approach. No capital carbon assessment was mentioned in the OBC, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the km of cycleways to be upgraded as part of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
CityConnect Phase 3 Cooper Bridge	The project will deliver a 6.5km high quality cycle and walking route between the settlements of Bradley and Brighouse crossing the Kirklees and Calderdale border. The route will predominantly be delivered off the highway but provide strategic links to the highway network, where required, to complement a number of other highways improvement schemes planned for the area. The project will complete a long standing 'missing link' in the strategic cycle network in the regioNational Cycle Network.	Operational carbon (tCO2e) not provided. Saving of £4686 in greenhouse gas present value calculated from WebTAG MEC approach.	1,950	Induced assessment not applicable	OBC indicates that for operational carbon, due to the modal shift from car to cycling, a saving of £4686 in greenhouse gas present value has been calculated based on the WebTAG MEC approach. No capital carbon assessment was mentioned in the OBC, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the km of cycleways to be upgraded as part of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
Corridor Improvement Programme - Bradford - A6177 Great Horton Road - Cross Lane (12)	Improve highway efficiency along part of the A6177 Outer Ring Road and extra capacity at the Great Horton Road/ A6177 junction to reduce congestion and facilitate housing and employment growth along both the A6177 and A647 corridors.	OBC indicates that a moderately beneficial operational carbon impact is calculated using TUBA outputs, however the result of this is not reported.	607	Induced assessment not applicable	The OBC indicates that the scheme will result in carbon savings of as a result of improved journey times and encouraging active travel. The carbon benefits have been calculated directly from TUBA outputs which is considered an appropriate method of assessment, however the results of this are not reported in the OBC. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.

Project information		Screening assessment			
Project Name	**Project Description**	**Operational carbon (tCO2e)**	**Capital carbon (tCO2e)**	**Induced demand screening**	**Comments**
Corridor Improvement Programme - Bradford - A6177 Thornton Road - Toller Lane (10)	Significantly increased capacity at the Toller Lane / A6177 and Thornton Road / A6177 junctions including the facilitation of turning movements, pedestrian and cycling facilities, bus priority where feasible and high quality soft and hard landscaping.	OBC indicates that a moderately beneficial operational carbon impact is calculated using TUBA outputs, however the result of this is not reported.	1,289	Induced assessment not applicable	The OBC indicates that the scheme will result in carbon savings of as a result of improved journey times and encouraging active travel. The carbon benefits have been calculated directly from TUBA outputs which is considered an appropriate method of assessment, however the results of this are not reported in the OBC. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
Corridor Improvement Programme - Kirklees - A62 Smart Corridor	A package of works including highway improvement works to the junction of Bradley Road / Colne Bridge Road; construction of the Cooper Bridge Relief Road (Bradley to the A644 Wakefield Road); highway improvement works to the junction of A62 Cooper Bridge Road, A644 Wakefield Road, A62 Leeds Road; and, widening of the A644 Wakefield Road.	-3123	1,104	Induced assessment required	The FBC indicates that operational carbon emissions have been calculated using TUBA software, with data inputted from the VISSIM model. Benefits are predicted as a result of the scheme reducing congestion. The FBC does not mention capital carbon, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
Corridor Improvement Programme - Kirklees - Huddersfield Southern Corridors	A comprehensive package of transport infrastructure improvements at Longroyd Bridge, Lockwood Bar, and Queensgate (Huddersfield Ring Road). This is likely to include increasing road and junction capacity, improved pedestrian and cycle provision, green infrastructure, public realm improvements and potentially unlocking land for development.	Operational carbon (tCO2e) not provided. Saving of £140,652 in greenhouse gas present value calculated from WebTAG MEC approach.	1,710	Induced assessment not applicable	OBC indicates that for operational carbon, due to the changes in traffic patterns and a modal shift from car to cycling, a saving of £140,652 in greenhouse gas present value has been calculated based on the WebTAG MEC approach. No capital carbon assessment was mentioned in the OBC, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
Corridor Improvement Programme - Leeds - Dawsons Corner	The scheme will fully remodel and enlarge the four-arm signal controlled roundabout, which is the junction of A6120 Outer Ring Road \ B6157 Bradford Road \ A647 Stanningley Bypass \ A647 Bradford Road in Pudsey	Operational carbon (tCO2e) not provided for the appraisal period. The change in emissions for the opening year is 318tCO2e and a cost of £7,000 in greenhouse gas Net Present Value has been calculated using TUBA.	2,371	Operational assessment includes induced demand	The FBC states that a Saturn Model assigned using variable demand has been used to calculate the operational carbon emissions. Operational carbon (tCO2e) is not provided for the appraisal period. The change in emissions for the opening year is 318tCO2e and a cost of £7,000 in greenhouse gas Net Present Value has been calculated using TUBA. No capital carbon assessment was mentioned in the FBC, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
Corridor Improvement Programme - Leeds - Dyneley Arms	The scheme will provide 'quick win' additional capacity required in the short and medium term to mitigate existing congestion, accommodate continued traffic growth and enable development in the Dyneley Arms junction area of Pool Bank New Road, Pool In Wharfedale.	2	288	Operational assessment includes induced demand	The FBC states that operational carbon has been assessed using TUBA which indicates that levels of emissions will remain neutral over the 60 year appraisal period as alleviation of congestion has the potential to reduce carbon, however increases in traffic flow might negate this benefit. No capital carbon assessment was mentioned in the FBC, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
Corridor Improvement Programme - Wakefield - A650 Newton Bar	A650 major roundabout improvement and carriageway widening.	Operational carbon not provided	1,099	Induced assessment not applicable	The FBC states that a carbon assessment has been undertaken using TUBA, which shows an improvement due to a decrease in congestion, however results are not presented. No capital carbon assessment was mentioned in the FBC, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
A62 - A644 (Wakefield Road) Link Road	The primary objectives of this scheme is is to relieve traffic congestion within this length of the A62 by removing large volumes of motorway bound traffic and rerouting them away from Cooper Bridge and onto the Relief Road. The scheme being progressed is as follows: •Highway improvement works to the junction of Bradley Road / Colne Bridge Road (incorporating Oak Road) •Construction of a link road between the A644 Wakefield Road and Bradley junction •Highway improvement works to the Cooper Bridge junction •Widening (in part) of the A644 Wakefield Road and A62 Leeds Road. •Provision of improved cycle lanes and pedestrian footways	Operational carbon not provided	9,702	Induced assessment required	Only change requests documents available on PIMS. Project is currently at SOC stage and there are no references to the outcome or methodology for either a capital or operational assessment, which is expected at SOC stage. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the estimated total project value of the project. The carbon intensity benchmark used is normally applied to the CAPEX of schemes, however, this information was not available for the project. As a result the capital carbon value provided is likely not fully representative of the scheme. It should also be noted that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The information provided within the change request documents that the project will enhance the existing network at Cooper Bridge and Bradley junctions to improve journey times and reliability along the A62 and A644 routes. This will be carried out mainly through road widening and improved cycling and walking facilities. Through these interventions there is potential for significant operational transport emissions associated with road widening, allowing more private vehicles on the road. It would be recommended as this scheme progresses that an induced demand assessment is carried out. It would also be recommended that a full capital and operational carbon assessment are carried out as the scheme progresses to OBC and FBC stage.
Halifax Station Gateway	This scheme is part of the wider Station Gateways programme to transform public realm, expand retail opportunities and improve passenger experiences. This scheme aims to construct a new station building that links to the current Grade II listed building, bring a disused platform back in to use, and relocate the car parking. The land in front of the station will also be redeveloped to enable walking and cycling access from the station in to the town centre.	Operational carbon (tCO2e) not provided. A saving of £182,797 in greenhouse gas present value has been calculated from DfT WebTAG Unit M5.	Not possible to quantify based on information available	Induced assessment not applicable	Only qualitative comments provided within the OBC, stating that there may be a slight benefit associated with modal shift from cars to rail. Capital carbon should be calculated based on the preferred option however more detail on the types and quantity of materials used are required to calculate this.
Corridor Improvement Programme - Wakefield - Owl Lane	The project involves the introduction of bus priority measures, enhanced roundabout efficiency, measures to address safety issues & improvements for pedestrians & cyclists	Operational carbon not provided	204	Induced assessment required	Only expression of interest (EOI) documents available on PIMS. Project is currently at SOC stage and there are no references to the outcome or methodology for either a capital or operational assessment, which is expected at SOC stage. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the estimated construction cost of the project. It should also be noted that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The information provided within the EOI notes that the project will deliver major junction improvements of an existing improvements of an existing roundabout and approach on the A638 at the Owl Lane /Chancery Road / Leeds Road junction. The scheme involves the introduction of bus priority measures, enhanced roundabout efficiency, measures to address safety issues & improvements for pedestrians & cyclists. It would be recommended that the active travel aspects of the scheme are assessed through AMAT to determine the number of vehicle kms reduced by the scheme and allow the potential carbon benefits of modal shift to be calculated While it would also be recommended that a full operational and capital carbon impact assessment is carried out for the scheme as it progresses to OBC and FBC stage to ensure the carbon impacts/benefits of the scheme are captured.

Project information		Screening assessment			
Project Name	**Project Description**	**Operational carbon (tCO2e)**	**Capital carbon (tCO2e)**	**Induced demand screening**	**Comments**
Huddersfield Station Gateway (Phase 1)	Huddersfield Station Gateway will connect the railway station to St George's Warehouse through extension of the station subway and new western entrance, a lift/stair tower, shared parking, new taxi hub, and development of the buildings. Phase 1 will provide an additional eastern entrance at the station by re-opening an historic doorway, highway improvements and acquisition of the warehouse and car park.	Operational carbon not provided	2,502	Not enough information available to determine if induced assessment is required	Huddersfield Station Gateway has been subsumed into TCF - Huddersfield Rail Station Access, which has been reviewed. The TCF-Huddersfield Rail Station Access is currently at SOC stage and there are no references to the outcome or methodology for either a capital or operational assessment, which is expected at SOC stage. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the estimated construction cost of the core scenario of the project. It should also be noted that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The proposed scheme interventions include active travel and streetscape improvements, mobility hub (multi-modal interchange and community facilities) and station entrance improvements. It would be recommended that the active travel aspects of the scheme are assessed through AMAT to determine the number of vehicle kms reduced by the scheme and allow the potential carbon benefits of modal shift to be calculated. Currently there is not enough information available to determine if an induced demand assessment should be carried out for the scheme, as more data/modelling becomes available this should be investigated. While it would also be recommended that a full operational and capital carbon impact assessment is carried out for the scheme as it progresses to OBC and FBC stage to ensure the carbon impacts/benefits of the scheme are captured.
Leeds Inland Port	"PIPELINE - DP2 28/06/19. A new wharf facility at Stourton to enable the transportation of non-perishable freight such as aggregates, timber, oil and steel from the Humber estuary into Leeds. It is anticipated that the project will support the development of flagship projects such as Leeds Southbank and High Speed 2 by enabling construction materials to be transported on water. Located on 3acres of land owned by the Canal & River Trust, will entail: the construction of a concrete apron ; installation of 80m of sheet piling to establish a mooring; dredging to improve the navigability of the waterway.	-894	189	Induced assessment not applicable	FBC indicates that the scheme is predicted to reduce carbon emissions by 894t saved by year three of the scheme by reducing road congestion. It is noted that this is an estimate and accurate modelling is required. No capital carbon assessment was mentioned in the FBC, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the three acre hardstanding area associated with the scheme. Note that this approach is a high level estimate as it does not include the piling or dredging associated with this scheme and is subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
Leeds Station Gateway - Leeds Integrated Station Masterplan	The project will deliver a study to determine station requirements etc post HS2 delivery, to feed into work being undertaken by High Speed 2 Ltd in Autumn 2017. The study is required to develop Leeds Station/ the Yorkshire Hub bringing all elements of rail, transport, regeneration and place-making into one plan and is likely to include modelling, surveys, development of the business case and consultation.	878	240	Not enough information available to determine if induced assessment is required	Scheme has no been subsumed into the TCF -Leeds Station Sustainable Travel Gateway Scheme. The scheme proposes a number of interventions including improvements to the stations external concourse, installation of segregated cycle lanes and pedestrian improvements around the station. There are also potential plans for a retail space to be constructed within the station. A capital carbon assessment has been calculated using a high level benchmark according to the scheme type. In this case, a carbon intensity benchmark has been applied based on the assumed floor area of the potential retail space (200m2). The assessment only focuses on the buildings themselves and does not account for wider impacts of increased travel to/from the site, nor does it account for any emissions from the landscaping and other infrastructure works. Note that this approach is a high-level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. A bottom-up calculation using a bill of quantities would provide a much more reflective result, however this is not available, given that the project is still in optioneering stages. It was also possible to calculate some of the emissions associated with the operational energy of the retail space which may be utilised as part of the scheme. Operational carbon emissions were calculated based on CIBSE Guide F 'Typical practice' benchmarks for retail space. However, it was not possible to calculate the potential scheme benefits associated with modal shift to active and shared travel as a result of the scheme. It would be recommended that the active travel aspects of the scheme are assessed through AMAT to determine the amount of vehicle kms reduced by the scheme and allow the potential carbon benefits of modal shift to be calculated. Currently there is not enough information available to determine if an induced demand assessment should be carried out for the scheme, as more data/modelling becomes available this should be investigated. It would be recommended that a full operational and capital carbon assessment are carried out for the scheme at FBC stage to ensure the carbon impacts/benefits are captured.
Mirfield to Dewsbury to Leeds (M2D2L)	Increasing transport capacity along the A653 corridor to deliver journey time savings between Dewsbury and Leeds. The main objectives of the scheme are to promote viability of several housing and development sites in North Kirklees (5,500+ homes); kick start the transformation change of Dewsbury town centre; and, improve access to M62 and M1.	Operational carbon not provided	1,638	Induced assessment not applicable	Only qualitative comments provided within the OBC, stating that there may be a slight benefit associated with reduced congestion however no calculated value was reported. No capital carbon assessment was mentioned in the FBC, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the CAPEX of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
Rail Parking Package - Outwood	To increase car parking capacity and improve rail connectivity. Car park extension.	Operational carbon (tCO2e) not provided. Saving of £18.550 in greenhouse gas present value calculated from WebTAG MEC approach.	30	Induced assessment not applicable	OBC indicates that for operational carbon, due to the reduction in car journeys from a increased attraction to rail associated with the car parking extension, a saving of £18.550 in greenhouse gas present value has been calculated based on the WebTAG MEC approach. No capital carbon assessment was mentioned in the OBC, therefore a high level carbon assessment has been carried out using a carbon intensity benchmark based on the number of car parking space associated with the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
TCF - A629 Wakefield Road Sustainable Travel Corridor	Was part of 'Huddersfield Major Walking and Cycling Routes'. May be dropped from TCF.	Operational carbon not provided	Not possible to quantify based on information available	<select>	Subsumed into TCF- Huddersfield Rail Station Access. Please see Huddersfield Station Gateway for high level screening.
TCF - Halifax Park Ward Streets for People	Scheme to provide walking improvements to address barriers to accessing Halifax Town Centre for Park Ward residents. The project will provide a community led urban realm and placemaking within these deprived neighbourhoods.	- 198	71	Induced assessment not applicable	An environmental assessment has been carried out for the scheme at OBC stage. The carbon emissions associated with the scheme were quantified using Carbon Zero Appraisal Framework, which comprises a compilation of tools and methods developed by WSP to support appraisal and management of climate change impacts of transport development. The improved facilities for pedestrians and cyclists are anticipated to deliver carbon savings. Reductions in vehicle kms were calculated through the AMAT. GHG emissions relating to this input data were calculated using TAG data on fuel consumption and took into account the proportions of the vehicle type, fuel type, forecast fuel consumption parameters and emission factors. Capital carbon was calculated using material estimates produced as part of the cost estimation process. These material estimates were input to the Highways England tool to estimate emissions associated with key materials. A 20% uplift was applied to account for other items such as waste and construction processes that it were not possible to quantify. No significant induced demand is expected given the nature of the proposed scheme. The assessment undertaken is in line with the stage 2 guidance.
Transformational - Bradford Interchange Station Gateway (Phase 2)	N/A	Operational carbon not provided	2,054	Induced assessment required	Subsumed into TCF - Bradford Interchange Station Access. Only EOI available on PIMS. The TCF - Bradford Interchange Station Access is currently at SOC stage and there are no references to the outcome or methodology for either a capital or operational assessment, which is expected at SOC stage. A high level carbon assessment has been carried out using a carbon intensity benchmark based on the estimated construction cost (delivery cost in EOI) of the project. It should also be noted that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The scheme description provided within the EOI is relatively vague and describes only that the goal is to create a high quality gateway into the city that enhances the user experience. It would be recommended that if there are active travel aspects of the scheme they are assessed through AMAT to determine the amount of vehicle kms reduced by the scheme and allow the potential carbon benefits of modal shift to be calculated. Dependent on the modelling undertaken an induced demand assessment may be required. As the scheme progresses to OBC and FBC stage it is recommended that a full operational and capital carbon assessment is undertaken for the scheme.
TCF - Brighouse Cycling and Walking Improvements	Scheme to provide improvements on priority pinch points/junctions from the north of Brighouse to Brighouse town centre as identified through the phase one Calderdale LCWIP. This will transform access by bike to Brighouse rail station, improving safety and legibility.	An Active Mode Appraisal has been undertaken in line with WebTAG Unit A5-1 at SOC stage which indicates a monetised cost benefit of £2,000 for greenhouse gases.	Not possible to quantify based on information available	Induced assessment not applicable	Only SOC on PIMS. An Active Mode Appraisal has been undertaken in line with WebTAG Unit A5-1 at SOC stage which indicates a monetised cost benefit of £2,000 for greenhouse gases but no additional assessment has been undertaken. There is not enough information at this stage to complete a capital carbon assessment.

Project information		Screening assessment			
Project Name	**Project Description**	**Operational carbon (tCO2e)**	**Capital carbon (tCO2e)**	**Induced demand screening**	**Comments**
TCF - Harrogate Railway Station Gateway - Active Travel Improvement Scheme	Scheme to address congestion and journey time unreliability on the current road network in the centre of Harrogate by promoting sustainable transport accessibility. The project will incoporate active travel corridors, cycling infrastructure improvements, enhancements to Harrogate Railway Station, and enhanced access together with provision of improved active travel infrastructure to better connect Harrogate and Knaresborough.	1,356	745	Induced assessment required	OBC indicates that operational carbon has been calculated using WSP's "Carbon Zero" tool. The methodology for this is summarised in Appendix M of the OBC and compares the approach to TUBA and MEC methods. The results of the assessment indicate the project will have slight adverse benefits over the 60 year appraisal period as carbon savings due to the modal shift and planting benefits being offset by changes to traffic speeds and journey lengths. Embodied carbon has also been assessed using the Carbon Zero tool which indicates that embodied carbon will also result in a carbon impact and is presented in appendix M.
TCF - Network Navigation	Scheme tp make it easier for people to identify an enhanced network of services, navigate the bus system across priority corridors within West Yorkshire, and contribute to an overall target of 25% more trips made by bus by 2027. This project rolls out the existing Network Navigation (Leeds) project out across priority corridors in West Yorkshire districts, Kirklees, Calderdale, Bradford and Wakefield	Operational carbon (tCO2e) not provided, however the project is forecast to reduce car kms by 1,351,367 kms each year as a result of modal switch from car to bus and active modes.	Not possible to quantify based on information available	Induced assessment not applicable	The OBC indicates that the scheme is predicted to result in a beneficial impact to carbon as a result of modal shift from personal vehicles to buses. WebTAG guidance has been used to provide monetary values for each of the scheme options. Capital carbon has not been assessed but is likely to be minimal based on the deliverables of the project including; updating bus stops, maps and online resources.
TCF - Skipton Railway Station Gateway - Active Travel Improvement Scheme	Scheme to implement enhancements to public realm and access arrangements at Skipton railway station. The project will deliver enhancements to the footpath between the railway station, college campus and employment areas in Skipton town centre. The project will also deliver road junction improvements, as well as pedestrian improvements at Gas Street and Cross Street. A replacement of the Gallows footbridge will be put in place through the	-220	272	Induced assessment not applicable	WSP's "Carbon Zero" tool. The methodology for this is summarised in Appendix G of the OBC and compares the approach to TUBA and MEC methods. The results of the assessment indicate the project will have slight beneficial benefits over the 60 year appraisal period as carbon savings due to the modal shift from encouraging active and shared travel modes over private transport. Embodied carbon has also been assessed using the Carbon Zero tool which indicates that embodied carbon will result in a carbon impact due to the materials used to implement the scheme.
Transformational - West Yorkshire Mass Transit	Early feasibility design development for a mass transit system which will offer a new public transport option and an attractive alternative to car travel. Mass transit will support and facilitate a low emission, low carbon future; sustainable development and regeneration of neighbourhoods, district centres, towns and cities; a bigger, stronger and rebalanced economy; delivery of new housing and enhanced quality of life for West Yorkshire's residents and visitors.	Operational carbon not provided - there is limited data available. The Capital Spending and Project Approvals document explains that "The scheme will reduce carbon emissions by reducing energy and waste consumption"	Not possible to quantify based on information available	Induced assessment not applicable	No operational carbon assessment has been undertaken. However, an induced traffic assessment not likely required, rather a UDM &VDM would be applicable to this scheme type. Furthermore, it has not been possible to quantify the impact from capital carbon due to limited information at this stage on what the project will consist of.
York Northern Outer Ring Road - Future Phases	The York Outer Ring Road (YORR) upgrade project includes improvements to seven existing Outer Ring Road roundabouts between the Wetherby Road and Monks Cross junctions. The aim is to, where possible, upgrade junctions to a similar standard as the recently enhanced A19 and A59 roundabouts: i.e. approaches widened to 3 lanes, exits widened to 2 lanes, minor arm approaches widened to suit traffic flows, provision of walking and cycling improvements. Phase 1 was at the Wethervy Road Rounabout, Phase 2 at Monks Cross and Phase 3 at CLifton Moor. Information on these schemes is held in their individual project sites.	No operational value provided - only at stage of change request approval. Limited information available.	3,742	Induced assessment required	Note - the only available information on PIMS is a change request approval, indicating that the total scheme cost is 29.7 million. A high level capital carbon assessment has been provided based on a benchmark applicable to the scheme construction cost. Note that the construction cost was not available, and therefore the calculation uses the full scheme cost, this is likely a slight overestimation. However, the approach is an estimation and subject to large uncertainties. Based on the information available, no modelling has taken place to date and therefore no operational carbon value can be reported. It would be anticipated that a scheme of this type should include an induced demand assessment,
York Northern Outer Ring Road - Phase 2 (Monks Cross)	Upgrade to the existing Monks Cross roundabout on the York Outer Ring Road	The overall impact on Greenhouse Gases is assessed as being "Slight Beneficial". The greenhouse gas assessment shows a benefit of £0.89mover the 60 year appraisal period.	380	Operational assessment includes induced demand	A TUBA model has been completed to understand the operational transport impacts. The results have only been presented economically within the business case. The transport modelling undertaken includes a variable demand model, and therefore it can be assumed that an induced traffic assessment is not required as it is already captured by the modelling. A high level capital carbon assessment has been provided based on a benchmark applicable to the scheme construction cost. Note that the construction cost was not available, and therefore the calculation uses the full scheme cost, this is likely a slight overestimation. However, the approach is an estimation and subject to large uncertainties.
York Northern Outer Ring Road - Phase 3	PIPELINE PROJECT - Upgrade to the Clifton Moor roundabout on the York Outer Ring Road between Wetherby Road and Monks Cross.	The greenhouse gas assessment shows a benefit of £1.7m over the 60-year appraisal period. The CO2 value has not been reported.	3,620	Operational assessment includes induced demand	The operational carbon value has only been reported in economic terms. The transport modelling undertaken includes a variable demand model, and therefore it can be assumed that an induced traffic assessment is not required as it is already captured by the modelling. A high level capital carbon assessment has been provided based on a benchmark applicable to the scheme construction cost. This is an estimation and subject to large uncertainties.
Beech Hill Phase 2 Group Repair & Regeneration Scheme	Beech Hill Phase 1 is for construction of 106 new affordable homes on a strategic site for the Calderdale and Together Housing Investment Partnership (CTHIP). The development is located on a cleared site formerly occupied by 3x high rise blocks and the Council's Stannary Depot. The project is funded and is moving forward, but the Council would like to invest further in the area to round off this exciting scheme. Adjacent to the site is a 1960s ex-council mixed tenure estate of 70 low rise, flat roof, cross wall homes. The properties are generally in a poor condition, roofs are beginning to fail, and they are expensive to heat. Phase 2 of the Beech Hill project will see an energy efficiency led group repair programme provide insulated pitched roofs, new rainwater goods, new doors and windows with an external render finish and new boundary treatments. The estimated cost for the full package of work is £2.255m. The Council has earmarked £400k towards the overall cost and Together Housing has indicated it will fund the works to its 16 properties, as long as the overall funding package can be assembled. A further £1.2m is still required. It is also anticipated that the project will attract £190k in private match funding from private landlords. (Analysis shows the owner occupiers are on very low incomes and are unable to contribute towards the cost). Phase 2 will bring numerous health and financial benefits to the residents and property owners. EPC ratings will be improved to C for each home with an estimated 52 out of the 70 lwo income households taken out of fuel poverty. By reducing domestic CO2 emissions, the scheme will help to tackle the climate emergency. Furthermore, the scheme is part of a wider investment programme for the surrounding area which will see an investment of c£35m in total through the conversion of Martins Mill, the 107 new homes in phase 1 and planned improvements to the local highway network, local shopping centre, and police station.	- 3,705	3,220	Induced assessment not applicable	An operational energy use carbon assessment has been provided for the OBC. The methodology appears robust: "The lifetime of the different improvement measures is determined by BRE RdSAP calculations which is used to calculate Energy Company Obligation (ECO) rates and is set at 12 years for replacement boilers and 42 years for loft and cavity wall insulation. The individual carbon savings are determined by typical annual savings per measure type per year, which is then calculated up using a predetermined 'indicative uplift factor' (IUF) to provide a lifetime total figure." The methodology could consider factoring in future projected decarbonisation to provide a more indicative projected difference between the do-minimum and do-something. The capital carbon assessment provides a very high level estimation of construction effort to refurbish the housing. Note that unless there are significant new build components of the scheme it is unlikely that industry standard benchmarks will be suitable for use in refurbishment projects. This is because the benchmarks typically include parts of the building such as the foundations. This high level assessment assumes there will be significant new build components, given that the works will consist of new pitched roofing and external walls. Therefore, the calculation uses the benchmark for construction of new housing (based on the 70 homes within the business case). An average of 92m2 per home has been deducted from the Ministry of Housing, Communities & Local Government. The 'best practice' benchmark has been used as opposed to 'typical', as this presents a lower carbon impact, which would be expected from a refurbishment rather than a full new build. This approach is subject to uncertainties and is expected to provide a conservative estimate.

Project information		Screening assessment			
Project Name	**Project Description**	**Operational carbon (tCO2e)**	**Capital carbon (tCO2e)**	**Induced demand screening**	**Comments**
Bradford 'City Village' Phase 1	The project proposes the delivery of a first phase of a 10 year plan to deliver the Bradford 'City Village' by repurposing and revitalising a failing area of the city centre that was previously the beating heart of its commercial and retail sectors. 'City Village' will create an area where people will choose to live and businesses will invest and grow and provide 1,000 new homes. A first phase of our vision is to develop an attractive, inviting and vibrant city centre retail market that offers a diverse range of goods to meet the community's needs by providing a dynamic, vibrant and diverse shopping experience. In addition, the purpose designed modern market building will provide business opportunities for fresh food, non-food and hot food traders and also deliver environmental highway improvements and an area of high quality public realm for events and other commercial and leisure activities. The Project will replace the existing outdated 70's market hall which will in turn release a 3.5Ha site council site that will be the primary development opportunity within the City Village delivering 350-400 new homes whilst also starting the process of creating the right sustainable environment to accommodate the new City Village community.	No operational assessment has been undertaken, but the FBC document states it is expected there would be a significant decrease in emissions due to the energy efficiency measures (e.g. PV solar, Air Source Heat Pump, LED lighting etc.)	3,420	Induced assessment not applicable	An operational carbon assessment has not been quantified for this scheme. The FBC states an anticipated decrease in emissions. The capital carbon assessment provides a very high level estimation of construction effort for: -1000 new homes -4,000m2 market building -700m2 of public realm space, which will provide new outdoor leisure and commercial floor space The emissions are calculated using floor area benchmarks for the construction of new housing and retail spaces . The 'best practice' benchmark has been used as opposed to 'typical', given that the scheme has a low carbon focus. Note that other construction impacts are not considered, such as the demolition of the market hall, however this is expected to be minimal. This approach is subject to uncertainties and is expected to provide a conservative estimate.
Bradford One City Park	The scheme includes the development of over 5000 square metres new Grade 'A' office space at the heart of Bradford's City Centre Business and Cultural district. Project could be accelerated by off-set funding to reduce the Council's risk of dealing with potential letting voids currently being managed by provisions of significant floorspace pre-letting conditions. This scheme is critical to Bradford's economic recovery and establishing a strong commercial sector in the city centre.	Operational carbon emissions not provided.	3,000	Induced assessment not applicable	carbon intensity benchmark for the construction of new offices based on the area of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The business case mentions qualitatively that the scheme will reduce the energy consumption of the completed building through efficient systems and a highly thermally protected building envelope. A detailed capital carbon assessment should be carried out for the scheme as emissions associated with the construction of the
Business Expansion Fund	£13.45 million business support fund to meet identified gaps in provision (e.g. assisting large companies and providing an improved incentive package to attract inward investors and support exporters) and to respond to economic shocks and/or opportunities	Operational carbon emissions not provided.	Not possible to quantify based on information available	Induced assessment not applicable	The FBC does not mention an operational or capital carbon assessment. Operational and capital carbon assessments are not considered relevant to this scheme as there are no material or traffic changes associated with the project. The business case mentions qualitatively that the scheme has limited scope to improve carbon however that specific elements to be considered
EZ - Wakefield - South Kirkby Business Park	"PIPELINE PROJECT (was part of Programme Line LGFLEE122) Enterprise Zones (EZs) work to include branding, marketing and communications package; site feasibility/investigations and master planning; and, on and off-site capital works."	Operational carbon emissions not provided.	3,651	Induced assessment not applicable	The OBC notes that a WebTAG assessment will be completed at FBC to assess carbon, however no assessment has been completed at this stage. A high level carbon assessment has been carried out using a carbon intensity benchmark for the construction of new offices, which was the most relevant benchmark available for the scheme, based on the area of the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. Assessments of both operational and capital carbon should be completed as there is the potential for significant carbon impacts associated with both due to the construction and operation of industrial units.
GPF LEP Loan - Glasshoughton Colliery Site (Waystone 32) - 201	Completion of earthworks and reclamation to create the development platforms, construction of access and distribution roads within the business park, provision of utilities, services and sewerage, creation of new footpaths, open space and cycleways.	Operational carbon emissions not provided.	3,142	Induced assessment not applicable	The FBC does not mention an operational or capital carbon assessment. A high level carbon assessment has been carbon out using a carbon intensity benchmark based on the area (m2) of proposed earthworks for "development platforms" for the scheme. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. The business case mentions qualitatively that the scheme has the potential to benefit carbon as the proximity of the scheme to the centre of Castleford and its bus interchange could increase the uptake of public transport use and reduce journey times of commuters. Additionally, housing and commercial premises will be built to the highest energy efficiency standards and the development will seek to minimise the use of resources during construction. A detailed capital and operational carbon assessment should be carried out for the scheme as emissions associated with the construction and operation of the large mixed use are likely to have a significant carbon impact.
Huddersfield George Hotel acquisition and remedial works	The George Hotel is a Grade 2 listed building closed since 2013. It strategic location adjacent to the Railway station and gateway to Huddersfield affords an opportunity to redevelop the Hotel as a mixed use facility including offices and leisure facilities. The Hotel plays a prominent role in the delivery of the Huddersfield Blueprint, a ten year masterplan to modernise our town centre. Acquisition and essential remedial works for the George will provide an investment opportunity to deliver a better balanced town centre, new and improved Grade A office space, and act as a catalyst for the wider regeneration of the town centre.	Operational carbon emissions not provided.	Not possible to quantify based on information available	Induced assessment not applicable	The FBC does not mention an operational or capital carbon assessment. A high level carbon assessment has not been carried out as carbon benchmarks are not suitable for refurbishment schemes. A detailed capital carbon assessment should be carried out for the scheme as emissions associated with the redevelopment have the potential to have a significant carbon impact. The operational carbon emissions associated with the scheme should also be investigated although they are likely minimal in comparison.
Knottingley Skills, Business and Services Hub	The scheme is to develop and upgrade the existing Kellingley Club to create a central Skills, Business and Services Hub which will deliver the following - A centralised Skills, Business and Services facility that will support skills and employability, create growth and jobs and community led economic development within the local area. - Enterprise advise and business mentoring to new start businesses. The facility will provide a base for businesses to undertake learning from industry experts and peers. There is currently a void in this provision based locally within Knottingley. - A venue that will promote and educate through a range of community based active lifestyles and sport initiatives, increasing health and wellbeing within the area. - A facility that will bring together a range of existing and new businesses, community groups and Council services that will work collectively to support the community and surrounding areas. - To provide a building that is sustainable and have minimum impact on the environment which assists in supporting the Councils Climate and Environment agenda. The building is in a poor state of repair with outdated electrical, heating and access issues and so the project will deliver sustainable heating, lighting and Equality Act or Accessible work such as lifts and ramps in order to make the building fit for all users from the community. Knottingley is currently among the most deprived wards in Wakefield having a pre-COVID unemployment rate of 20% more than the district average. The recent implementation of the STEP UP pilot has shown that whilst there is the will among residents to learn, there are no suitable premises in which to provide this learning. The nearest suitable learning location is Castleford which is not an easy journey given the need to use public transport. The refurbishment and remodelling of this building to provide a kept Skills, Business and Services Hub will support the development of multifunctional training rooms that will allow health and beauty training which would attract a significant number of currently disenfranchised residents, such as single parents into learning and also into self employment. The current Kellingley Club is seen as the centre of the community and is noted for its work with the Community, but currently is limited by the building layout and a lack of skilled staff to providing community and family events. The project will support	Operational carbon emissions not provided.	972	Induced assessment not applicable	The FBC does not mention an operational or capital carbon assessment. A high level carbon assessment has been carried out using a carbon intensity benchmark for the new build of construction of education (best practice) based on the area of the scheme. Note that this is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances. A detailed capital and operational carbon assessment should be carried out for the scheme as emissions associated with the redevelopment and improvements to heat and electricity generation from the existing coal fired boilers have the potential to have a significant carbon impact.

Project information		Screening assessment			
Project Name	**Project Description**	**Operational carbon (tCO2e)**	**Capital carbon (tCO2e)**	**Induced demand screening**	**Comments**
Leeds City College - Printworks	Now closed. The £25 million, state-of-the-art campus now houses specialist vocational subjects, including the Hairdressing & Beauty Therapy, Catering, and Hospitality & Food Manufacture provision. The campus offers a diverse range of courses in Catering, Hospitality, Bakery, Butchery, Hair and Beauty in levels to suit all abilities and experience through to Level 4 and Apprenticeships.	Operational carbon emissions not provided.	Not possible to quantify based on information available	Induced assessment not applicable	Project is now closed. Could not locate FBC on PIMS and no carbon assessments are referenced in the available documents. A high level carbon assessment could not be completed as benchmarks for refurbishments are not available. Note that this approach is a high level estimate and subject to uncertainties, given that benchmarks do not reflect project specific circumstances.
New Bolton Woods	Remediation work to address viability gap and enable delivery of 145 new homes by 2021. New Bolton Woods is a mixed-use regeneration scheme to create an urban village with over 1,000 new homes in the central segment of the Bradford Shipley Canal Road Corridor regeneration area.	Operational carbon emissions not provided.	Not possible to quantify based on information available	Induced assessment not applicable	The FBC does not mention an operational or capital carbon assessment. A high level carbon assessment has not been carried out as there is no relevant capital carbon benchmark available for land remediation. A detailed capital and operational carbon assessment should be carried out for the scheme as emissions associated with the remediation work, construction and operation of the new homes have the potential to have a significant carbon impact.
Wakefield Warm Homes Fund	The Warm Homes Fund will provide support for vulnerable, low income, fuel poor homeowners to switch from inefficient solid fuel or electric heating to gas central heating for the first time or to imporve their heating system to more efficient models. It also provides loft and cavity wall insulation where applicable to provide a 'whole house' solution. The scheme would be targetted at deprived, fuel poor households off the gas network and in old energy inefficient properties using local intelligence and stock energy efficiency data.	- 2,000	Not possible to quantify based on information available	Induced assessment not applicable	An operational energy use carbon assessment has been provided for the OBC. The methodology appears robust: "The lifetime of the different improvement measures is determined by BRE RdSAP calculations which is used to calculate Energy Company Obligation (ECO) rates and is set at 12 years for replacement boilers and 42 years for loft and cavity wall insulation. The individual carbon savings are determined by typical annual savings per measure type per year, which is then calculated up using a predetermined 'indicative uplift factor' (IUF) to provide a lifetime total figure."
CA Accommodation Project	Refurbishment of Wellington House	No operational value provided	2,245	Induced assessment not applicable	There has currently been no operational carbon impact assessment undertaken. An operational assessment would be recommended to calculate the energy use of the refurbished building, the do-minimum case would be reflect the existing operational energy use of the building. The capital carbon assessment provides a very high level estimation of construction effort to refurbish the building. Note that unless there are significant new build components of the scheme it is unlikely that industry standard benchmarks will be suitable for use in refurbishment projects. This is because the benchmarks typically include parts of the building such as the foundations. This high level assessment assumes there will be significant new build components, and therefore uses the benchmark for construction of new office space (based on m2 of Wellington House). The 'best practice' benchmark has been used as opposed to 'typical', as this presents a lower carbon impact, which would be expected from a refurbishment rather than a new build. This approach is subject to uncertainties and is expected to provide a conservative estimate.
Superfast West Yorkshire and York - Contract 3	The project will deploy broadband infrastructure across the West Yorkshire and York geography within some of the hardest to reach urban and rural areas, areas not already targeted through a commercial roll out and areas not targeted by the previous phases.	No operational value provided	1,054	Induced assessment required	The FBC+ document claims scheme benefits of reduced carbon impacts from fewer commuter miles due to increased opportunities for home and/or flexible working, however this has not been quantified. As a result, it is suggested that an induced demand assessment is required, to clarify, this would be as assessment of the induced travel behaviours as a result of increased teleworking. However, the scheme should also consider the operational energy impact in contrast to the commuter miles saved. A high level capital carbon assessment has been completed based on a benchmark applicable to highways schemes. Construction work to roads is expected to be one impact of the scheme and could therefore be somewhat representative of the scale of impacts anticipated. Note that the assessment is subject to large uncertainties.

E. Mitigation workshop outputs

Task 1: Idea Generation

Carbon Reduction Hierarchy Stage	Prompt Question	Opportunities	Challenges to Implementation
Build Nothing	Does the scheme align with the wider combined authority strategic goals? Is there an alternative approach to meet the identified needs? Can the output be achieved by maximising the use of the existing assets? Have you engaged with suppliers early on alternative solutions?	Consequences of taking no action is clearly presented to stakeholders and decision makers Political buy-in Disused Rail Line to act as active travel route Need to address behavioural aspects as well as infrastructure Re-visit project mandate more regularly. Different priorities may mean a scheme is less viable now than say 5 years ago when it was originally conceived Multi-modal optioneering at early business case development stages Consider the lifespan of a scheme. A larger intervention now might save CO2 compared to serval smaller interventions. Strategic case: connectivity, is growth still needed. Signal optimisation can make better use of existing assets. Travel planning and demand management can reduce the need for new infrastructure. Reduce car use reliance using other strategic tools rather than building to increase capacity e.g. road user charging	Reducing the scope of construction would not deliver the scheme objectives. Doing less would water down the benefits Local public and political pressures (note PAS 2080 cultural and leadership links) Scheme identified as a Policy in Local Plan Quantitative evidence (modelling outputs) that demonstrate the need for change to fit with policy Old infrastructure currently in place Different types of projects require different appraisal periods and approaches, how to standardise? We are capital rich but revenue poor so can't access the full range of interventions to tackle carbon especially around behaviour NIMBY businesses happy with the idea of schemes but not if it affects their trade. Programme pressures don't give time/ funding to follow process in meaningful manner Need to ensure this is justified in alignment with strategic drivers which may prove to be difficult Requires longer term approach to planning decisions to change
Build Less	Has the asset been assessed for optimal operating during the use phase? Have maintenance requirements been minimised? Has optimal longevity of assets been achieved to minimise replacement vs initial carbon? Can you design for disassembly and re-use during end of life of the asset? Have you engaged with suppliers early to fully understand low carbon solutions that would enable optimised whole life carbon? (especially operational carbon) Can you integrate cost-effective small scale renewable energy systems to reduce operational carbon?	early engagement with contractors have wider benefits to scheme scope and delivery, and so combining this with carbon management kills two birds Understand key objectives in first instance On line improvements to roads rather than off line alignments, to avoid tree removal and reduce new materials. Option appraisals Reuse of electric vehicle batteries for local storage Dewsbury Bus Station project being designed to introduce energy saving features not currently in existence/use Comprehensive refurbishment of existing Dewsbury Bus Station building rather than rebuild	Can you achieve the project objectives which have already been agreed? Opportunities in transport projects to complement traditional transport interventions with landscaping, visual amenity and sustainable urban drainage Different parts of the building are owned by different parties and there are also tenancies. Maintenance carbon costs due to change in use of vehicles Delivery within the existing highway, no additional capacity 'Saleable projects' are often active travel type corridor schemes. Being asked to scale back at the bid stage often impacts quality, reach and impact - happened with cycle schemes on TCF Lower potential benefits - maybe lower CBA - more difficult to attract funding
Build Clever	Has the scheme considered the provision of active transport / public transport / mass transit / integrated transport systems? Has the offsite manufacture been considered, from the perspective of reducing waste? Has near site assembly / manufacture been considered to minimise transport requirements Have you considered optimal material logistics to reduce unnecessary transport during construction? Have you considered alternative low carbon fuels for construction plant? Have you considered energy efficient site cabins? Has packaging been optimised with the supply chain i.e. re-usable / returnable packaging Have you developed site materials management plans to ensure optimal use of all ordered materials and reduce waste? Have you considered new construction techniques that minimise the construction time, resulting in less temporary works or a reduction in fuel consumption? Have you adequately planned for re-use and /or recycling of on-site aggregates and spoil?	Use of BIM and new technology Undertake modelling to determine network resilience, seeking the best use of traffic management and phasing of schemes to keep traffic moving Use P&R sites as transport hubs, not just car park > city centre Can infrastructure be made more flexible to account for more future uses possibilities. Integrate bus station refurbishment design with peripheral town centre highway schemes to encourage walking & cycling and using bus station Local procurement of materials Can different modes be integrated. i.e. smart ticketing and bus timetables matching rail timetables. Can you re-furbish rather than re-build (demolishing is carbon intensive)	Local suppliers cannot always provide the specific material required Care not to improve one low carbon at expense of another e.g. Want car drivers to use bus or cycle. But may find bus users may cycle instead > poorer bus service. Need the economic case / BCR calculation to not too negatively impact appraisal outcomes for active travel schemes taking highway space from cars Lack of overarching CA policy to ensure consistency across schemes/District Partners The role of 'place' is still too poorly considered in the assurance process. Does the carbon agenda do enough to help? (requires more in-depth and earlier stakeholder engagement/ management) No clear internal expertise to be able to drive this agenda Market availability of some greener construction methodology & materials A number of scheme types are major revenue sinks (e.g. bike hire) - revenue just isn't available to the required amount Review of schemes will take time and require resources Public perception and stakeholder engagement is tricky to do right but essential for many schemes. The 'low hanging fruit' early adopters of new low carbon modes are often more well to do and not the areas of deprivation we are often compelled to target
Build Efficiently	Have you developed comprehensive asset management plans to monitor and record asset operational carbon performance and feedback lessons learnt? Have you put systems in place to monitor and record asset operational performance against design values and inform design teams and product / material suppliers for future improvement?	Incentivise the contractor through environmental targets Has the whole life cycle been considered? CO2 for decommissioning a project to be considered in the design. Off-site manufacturing can be more easily controlled and reduce CO2 for steel and concrete structures. There are opportunities to build this into procurement of the contractors and decisions around contract mechanisms - who you procure and what procurement/contract routes are applied e.g. innovation / efficiencies Operational feedback cycle - understand how the project performed against the objectives	Difficult to implement on project level basis - need a wider strategic approach Robust asset management tools would be resource intensive - difficult for most districts to provide this Financing longer term management obligations Influencing role can depend on the size of the scheme (larger schemes tend to have earlier engagement)
Other	Have suppliers been engaged with to discuss any innovations that may be able to provide carbon savings - relating to materials, transport or resources to be used in the project (both in the capital project itself and any future O&M and disposal)? Has whole life approach been taken at design stage? With respect to carbon; cost and efficiency; or both?	Opportunities to write into tenders	Difficult until contractor is on board CA is not the Commercial Client on some projects, therefore may have no relationship with suppliers Whilst engagement of local contractors will have plenty of carbon benefits, they are not always the best for the task, particularly complex schemes

Task 2: Prioritisation

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