

# Technical Note

Project: SST WRMP24

Subject: Carbon Assessment Reporting

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## Document history

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# 1. Context and background

As part of the supply-side feasible option progression for South Staffs Water (SST) WRMP24, Atkins were requested to calculate each option's carbon net present value (NPV). The provision of this data allows for consideration of each option in comparison of its whole life carbon impact on the wider environment, customers affordability, assessment for mitigation measure requirement, and to ensure the schemes meet government net zero commitments.

This technical note describes the methodology applied to produce the whole life carbon of each option, through estimation of both the embodied (construction) and operational carbon expected to be produced by the option. The data is initially derived in metric tonnes and then converted to TOTEX carbon by NPV estimations. A list of the relevant associated documents for data sources to this methodology are provided for reference.

Lastly, this technical note acknowledges the limitations identified and provides potential next steps to allow for further progress of the options datasets.

# 2. Embodied carbon methodology

To produce the embodied carbon for each option, SST requested that the Water Research Centre Limited (WRc) TR61 tool be used as the appropriate method. Through the input of the option's asset-specific sizing details, the WRc TR61 tool provides the option's assets carbon data in tonnes. It was however identified for specified assets, i.e. the dams and reservoirs assets represented in 4 Nr options (options 2.2.1.1, 2.2.2.1, 2.3.1 and 2.3.2), that WRc's TR61 tool did not have the appropriate data available to produce an output. Therefore, a secondary method was established to compliment the WRc TR61 tool outputs. This also ensures that these options' large asset carbon outputs are represented, and that the options can be compared appropriately. The method to calculate the embodied carbon for these 4 Nr specified schemes has therefore used assumptions based on asset activities breakdown and the associated kg CO<sub>2</sub> emission factors.

Once all assets had been quantified in the weighted value metric (tonnes), conversion to the monetary traded central carbon value (£/tCO<sub>2</sub>e) was undertaken. The method for this is detailed in Section 4.

WRc have produced an integrated cost and carbon estimation tool, known as TR61. It has been identified for use by the UK water industry to assess water and wastewater assets and has been certified for use in periodic review activities. TR61 produces up-to-date option estimates of capital (CAPEX), operating (OPEX) and whole life costs; and also provides estimates of embodied (construction) and operational carbon emissions with their monetary equivalents in a manner consistent with Ofwat's requirements, whilst also following water industry guidance for carbon accounting developed by UK Water Industry Research (UKWIR).<sup>1</sup>

SST provided Atkins with the TR61 tool in version 14 to undertake this assessment.

To make use of the TR61 tool and derive each option's embodied carbon, the assets identified for each option needed to be input. To ensure comparison with the option's costed assets, the assets represented in the options costing workbook (on the INPUT sheet as provided in 5209396-ATK-CA-7.6-020-V1 SSW Options - Capital Works listing WRMP24) were reviewed against their appropriate representation in the WRc TR61 tool and input where an appropriate match could be identified.

Several assumptions were made to identify an appropriate match to allow the options data to be input to the WRc TR61 tool. These included:

- 1) Where an exact match was identified between the option's asset description and the WRc TR61 tool asset description, the option's asset information was simply input like-for-like into TR61. The TR61 tool then produced an output sheet from this information that included each input asset's carbon data in CO<sub>2</sub>e tonnes.
- 2) Where there was no obvious, direct alignment between the option's asset as described and the TR61 asset descriptions (either due to asset type or unit) the option's asset was reviewed for an alternative

<sup>1</sup> [Modelling Software for Carbon Emissions and Costs | WRc \(wrcgroup.com\)](#)

appropriate representation in TR61. This means that there is an identified risk that the embodied carbon produced by the tool may not be representing the same scale of work, or asset, as was costed for in the options affected. As an example, for some assets TR61 has a requirement for megalitres (Ml), but the option's asset data identified from the costing workbook is provided in kg/d. To allow for representation of these affected assets, conversion of the units been undertaken, and the assumptions applied to undertake the conversion are detailed in the embodied carbon workbook (*5209396-ATK-CA-9-030 SST embodied carbon data*). Additionally, similar assumptions have been made for pipeline assets exceeding 400mm external diameter. This is because the limitation was noted that any pipes larger than 400mm diameter produce an embodied carbon output of zero in TR61. Therefore, to allow for representation of these larger than 400mm pipeline assets, all pipes sized over 400mm have been represented in TR61 as 400mm diameter (i.e. the maximum diameter available in TR61 which gives a meaningful output).

- 3) Where an asset was still found to not be representable in TR61, the asset data was progressed using a different methodology where possible. This was identified to apply to two groups of assets: 2 Nr specific pump options (options 7.1.5 and 8.3.1) and the dams and reservoir options (options 2.2.1.1, 2.2.2.1, 2.3.1 and 2.3.2).
  - For the specific pump assets, the asset data was not in the same format as TR61 data parameters. Therefore, these were converted to the same parameters (details of the conversion are provided in the embodied carbon workbook (*5209396-ATK-CA-9-030 SST embodied carbon data*)) and then input to TR61 to produce the embodied carbon data as described in point 1 above.
  - For the dams and reservoir options assets (options 2.2.1.1, 2.2.2.1, 2.3.1 and 2.3.2), the assessment of the embedded carbon emissions for materials was based on the bill of quantities developed for the option cost estimation, multiplied by a set of carbon emission rates derived from industry experience of equivalent reservoir assets. The assets' itemised materials were then associated with a relevant emission factor for vehicle movement, assuming specified lorry carrying capacities and emission types per lorry using diesel freight transport emission factors. This produced an output in kg CO<sub>2</sub> that was then converted to tonnes. The transport emissions were particularly significant for the assessment of the carbon emissions associated with the cohesive fill material (clay) used in raising embankments, since embedded carbon rates do not apply where the clay is obtained on site. These workings can be viewed in the embodied carbon workbook (*5209396-ATK-CA-9-030 SST embodied carbon data*). Carbon intensity (kgCO<sub>2</sub>) and vehicle movements (kgCO<sub>2</sub>) make up the total construction phase carbon emissions (kg CO<sub>2</sub>). This data was then converted to tonnes and incorporated to the embodied carbon output.
- 4) Where no methodology was identified to be applicable, and therefore the embodied carbon could not be calculated in the WRc TR61 tool, the affected options currently omit these assets data from the final options carbon summary. These assets have been identified in the embodied carbon workbook (*5209396-ATK-CA-9-030 SST embodied carbon data*).

Once the carbon (tonnes) data was output following the above methodologies, the embodied carbon tonnes data was required to be profiled over the 80-year option lifespan. This included the initial option delivery periods (years 5 to 10 depending on option requirement) and then inclusion of capital renewals over the 80-year assessment period. The capital renewals have been profiled to compliment the costed capital renewal profiles, with mechanical and engineering (M&E) renewals every 25 years and buildings and civil (B&C) renewals every 40 years.

### 3. Operational carbon (tonnes) methodology

To produce the operational tonnes of carbon over an option’s lifespan, each option’s total power (kWh/yr) data was required, to ensure comparability to the costed operational activities. This data, along with the option delivery period, was taken directly from the options costing workbook OUTPUT sheet (as provided in 5209396-ATK-CA-7.6-020-V1 SSW Options - Capital Works listing WRMP24). Each option’s data was then profiled over the 80-year timespan (the assumed option lifespan for costing) by multiplying the option’s power (kWh) per year by the grid carbon factor (tonnesCO<sub>2</sub>e/kWh) taken from the UK Government’s grid carbon factor per year dataset.

Year 1 was assumed to start at 2025, with the initial option delivery periods (years 5-10 depending on option) assumed as 0 for operational carbon.

### 4. Carbon tonnes to TOTEX carbon (NPV) conversion

Due to the high-level nature of the option development process and the potential for variable construction start times, the most appropriate representation of carbon TOTEX production was deemed to align it with the cost expenditure profiling. To align the embodied and operational methods as described above, the tonnes of carbon have been merged over the 80-year profile. This data has then been multiplied by the Traded Central Carbon values (£/tCO<sub>2</sub>e) taken from the UK Government tables<sup>2</sup> on a year-by-year basis.

Discount factors have also been produced over the 80 years, assuming 3.5% for the first 2 to 30 years, progressing to 3% in years 31-75 and finishing with 2.5% for years 76-80.

Once all 80 years had been converted from tonnes to monetary pounds, the data and the discount factor were applied to create option TOTEX carbon NPV.

### 5. Limitations and next steps

Having developed and reviewed the methodologies described above, a summary of limitations and recommended next steps is presented in Table 1.

**Table 1 – summary of limitations and next steps**

Methodology	Limitation and next steps
Embodied	<p>It is worth nothing here that the WRC TR61 input and output tabs provided within this workbook, as part of the embodied carbon data production, also produce costing data. This costing data is not deemed appropriate for use as part of the option costing. This is because of a different methodology being applied to that agreed for options costing, and the fact that option assets have been represented differently in some instances to how they are represented in the costing workbook. The assets are represented differently in some instances due to the specific nature of the WRC TR61 tool data input requirements.</p> <p>For options costing data, please refer to the latest versions of the Supply-side Option CAPEX OPEX uplift &amp; OB workbook and the Supply-side Option NPC estimation workbook.</p>

<sup>2</sup> [CARBON VALUES BEYOND 2050 \(publishing.service.gov.uk\)](https://publishing.service.gov.uk)

Embodied	The WRc TR61 tool has a limitation of producing a value of zero for carbon tonnes for any pipe sizes exceeding 400mm. Therefore, all options with pipe sizes over 400mm have been represented as the maximum 400mm to allow for some representation and consistency across the carbon estimation of the large pipe sized options. This limitation means there is an under representation of the amount of carbon produced for the embodied carbon of each option with a pipe size exceeding 400mm, however this approach has remained consistent across the options. For future iterations, the approach could potentially be revised, with carbon estimates being generated outside of TR61.
Operational	Although acknowledged that chemical usage is a requirement of PAS2080, this has not been included in the operational carbon methodology undertaken and therefore does not factor into the option TOTEX carbon. This is due to the limited information about the chemical usage of the options at this high-level stage of development. It is recommended that this is revisited as the option is progressed.
Dams and reservoir option carbon methodology	This assumes that there is no significant operational carbon expenditure associated with the raised dams. This is based on the assumption that the extent of maintenance of the dams once they are raised will be the same as for the existing design.
Sensitivity analysis	With reference to Section 8.3.2 of the WRMP guidance ( <a href="#">Water resources planning guideline - GOV.UK (www.gov.uk)</a> ) it is suggested that sensitivity analysis is undertaken. To date this has not been undertaken due to the high-level nature of the option data, however it is recommended that this is revisited as the options and data availability progresses.
Mitigation measures	With reference to Section 8.3.2 of the WRMP guidance ( <a href="#">Water resources planning guideline - GOV.UK (www.gov.uk)</a> ) mitigation measures for high yielding carbon option should ideally be taken into account, e.g. renewable energy or carbon off-setting. When the options are finalised for the WRMP development and work is identified to deliver options further, this consideration could be reviewed.

## 6. Data sources

Table 2 provides a summary of data sources that have been used to inform the methodology.

**Table 2 – relevant data sources**

Workbook name	Description
Costing workbook on the INPUT sheet as provided in 5209396-ATK-CA-7.6-020-V1 SSW Options - Capital Works listing WRMP24	All options costing data inclusive of renewal and profile expenditure.
Embodied carbon workbook (5209396-ATK-CA-9-030 SST embodied carbon data)	TR61 data sheet inputs, dams and reservoir option methodology and final output sheet
5209396-ATK-CA-7.10.2-036 SST carbon NPV workbook	Operational carbon production Embodied tonnes