

TECHNICAL MEMORANDUM

To	Michael Hartley, michael.hartley@cleanaway.com.au
From	Craig Miller, craig.miller@katestone.com.au
Client name	Cleanaway Operations Pty Ltd
Deliverable No.	D24577-6
Subject	Bromelton Energy and Resource Centre: Response to OCG Information Request – Greenhouse Gases
Date	15 June 2026

Dear Michael,

Katestone Environmental Australia Pty Ltd (Katestone) has reviewed the comments received 8th May 2026 from The Office of the Coordinator-General (OCG) relating to the *Bromelton Energy from Waste Facility – Greenhouse Gas Assessment Rev C Issued for Approval* (Katestone Document Reference D24577-4, December 2025).

This technical memorandum addresses the response to the comments received. The revised report is *Bromelton Energy from Waste Facility – Greenhouse Gas Assessment Rev D Issued for Approval* (Katestone Document Reference D24577-5, June 2026)

Please do not hesitate to contact the undersigned if you have any questions.

Regards,



Dr Craig Miller

Team Leader – Climate Change, Greenhouse Gases, and Environment

ATTACHMENT A RESPONSE TO OCG INFORMATION REQUEST

Item 37 Scope 1 emissions factors and inventory

Information Requested

The GHGA submitted as part of the application material (reference D24577-4, Rev C) applied method 1, as outlined in Part 5.5 (Waste incineration) of the NGER (Measurement) Determination and Table 28 of the 2025 Australian National Greenhouse Accounts Factors, to derive a CO₂ emission factor based on waste composition characteristics (Appendices A and B of Greenhouse Gas Assessment). It is noted that this method does not apply to incineration for energy production (see Section 5.51 of the NGER (Measurement) Determination). Method 1 or 2 in Part 2.2 should be adopted for this estimation. Nevertheless, for assessment of this application, the chosen method is accepted. Methane and nitrous oxide (N₂O) emissions from incineration were not considered. Emission factors of 1.8 kgCO₂-e/GJ (i.e., items 9 and 14 of Part 1 of Scheme 1 of the NGER (Measurement) Determination) should be applied. Energy contents of 12.2 and 15.7 GJ/t as described in the Waste Feedstock Report can be used as estimates for municipal solid waste (MSW) and commercial and industrial (C&I) residual waste, respectively. Inclusion of these factors would result in an additional 18,126 t CO₂-e of Scope 1 emissions. In Table 8, the 2025-30 period is included in the calculation for the operational phase, which is unlikely given the 39-month construction period. Scope 1 emissions from urea consumption in the Selective Non-Catalytic Reduction (SNCR) process must be considered for two reasons: 1) CO₂ is directly released during urea decomposition (0.733 t CO₂-e/t urea, 1,128 t CO₂-e in total) 2) N₂O is generated as a by-product. For example, assuming 10% NO_x is converted into N₂O (see BAT reference document for Waste Incineration, 150 t N₂O may be generated, resulting in Scope 1 emissions of 39,750 t CO₂-e. These emissions vary depending on operational parameters and process optimisation conditions. Using ammonia instead of urea in the SNCR process can significantly reduce these N₂O emissions. It is noted that all reference facilities in the Technical Process Description use ammonia solutions.

The proponent is requested to submit a revised GHGA including:

- 1) Review and include emission factors for methane and nitrous oxide emissions from waste incineration in Table 7.
- 2) Review and update the Scope 1 emissions associated with urea use in the SNCR process.
- 3) Provide justification for the use of urea instead of ammonia in the SNCR process.
- 4) Update the Scope 1 emission factors/inventory to reflect any changes.
- 5) Remove the calculations for the 2025-30 period.

Response

1) Katestone has added the emission factors (EF) for CH₄ and N₂O from the NGER Determination to Table 7 and has retained the CO₂ EF derived from the actual waste composition.

2) The EF for urea has been updated in Table 7 to 733 kg CO₂-e/t for Scope 1 and 320 kg CO₂-e/t for Scope 3.

3) The use of urea in the SNCR process has been adopted for the purposes of the assessment based on safety, operational flexibility and conservatism in emissions estimation

- **Safety and handling considerations**

Ammonia is classified as a dangerous good for transport and storage, requiring additional controls and presenting greater safety risks to personnel. In contrast, urea is not classified as a dangerous good, making it simpler and safer to store and handle on-site.

- **Design flexibility**

The facility is being designed to accommodate the use of either urea or ammonia. The final selection of reagent will be confirmed during detailed design, considering safety, cost, availability and supply chain considerations. This approach ensures flexibility to adopt the most appropriate reagent at the time of procurement.

- **Conservative greenhouse gas assessment**

Urea has been adopted in the greenhouse gas assessment as it represents a more conservative scenario. As such, its use ensures that emissions are not underestimated at the assessment stage.

4) The emissions from urea decomposition have been retained in the assessment in preference to ammonia.

5) The assessment has been revised to consider emissions from 2030 – 2050 (net zero) and 2051 – 2065 (facility end of life). Scope 2 calculations apply the latest DCCEW annual projections for Queensland.

Item 38 Biodiesel usage

Information Requested

*Section 5.2 of the GHGA states that biodiesel would be used for boilers only; however, Table 10 applies total diesel emissions (i.e. 3,841 t CO₂-e) from stationary diesel consumption, including emissions from both machinery and generator (890 t CO₂-e) and boilers (2,951 t CO₂-e). Diesel usage for the boilers can be inferred from Table 8 (2951/0.0702=42,037 GJ). Therefore, emissions from biodiesel would be 42,307*0.028=1,177 t CO₂-e, rather than 901 t CO₂-e as presented in Table 10. The emissions reduction from using biodiesel is 1,774 t CO₂-e.*

The proponent is requested to submit a revised GHGA having reviewed and clarified the applicability of biodiesel use and updated relevant results.

Response

The emissions reductions attributable to biodiesel use for boiler black starts have been clarified in Table 11 and Section 5.2.2, demonstrating a potential saving of 2,940 t CO₂-e.

Item 39 Scope 3 emissions factors and inventory

Information Requested

*In Table 7 of the GHGA report, a Scope 3 emission factor of 17.3 kg CO₂-e/GJ for Diesel (Stationary) should be included. In Table 11, calculations for Category 3 (diesel) appear incorrect. Taking BC for example, Scope 3 emissions from diesel should be (1,595+1,417+90)*38.6*0.0173=2,071 t CO₂-e rather than 1,954 t CO₂-e as presented. The Scope 3 emission factor of 105 kg CO₂-e/t for bottom ash cannot be verified and appears high, resulting in an overestimation of the avoided emissions from recycling bottom ash. For comparison, fly ash has an emission factor of 14.5 kg CO₂-e/t as per the AusLCI database. The Scope 3 emission factor of 320 kg CO₂-e/t for urea appears low, as it can be as high as 1,500 kg CO₂-e/t (see AusLCI database). As a result, the Scope 3 emissions are underestimated. The Scope 3 emission factor of 790 kg CO₂-e/t for quicklime is underestimated, as it only accounts for process emissions (i.e., decomposition of calcium carbonate), and excludes emissions from fossil fuel combustion. For example, 1,150-1,400 kg CO₂-e/t have been reported by Adbri (see Table 7).*

The proponent is requested to submit a revised The proponent is requested to submit a revised GHGA with updated Scope 3 emission factors and inventory.

Response

1) The Scope 3 EF for diesel has been included in Table 7 and emissions reported in Table 12.

2) Katestone notes that bottom ash and fly ash are not the same thing. The figure of 105 kg CO₂-e/t applied for bottom ash is at the lower end of values derived by research into the carbonation potential of MSW incineration bottom ash for industrial reuse (i.e., ~102 – 115 kg CO₂-e/t) (e.g., Chang *et al.*, 2015, Julcour *et al.*, 2025 – cited in assessment). The actual values depend on final use, e.g. coarse aggregate for roading vs binder vs mineral extraction. It is assumed that higher value applications will be technically and commercially feasible by 2030.

3) Katestone has amended the cradle-to-gate emissions factor for urea to 1.3 t CO₂-e/t of urea. This aligns with life-cycle assessments of natural-gas-based urea production^{1,2}.

4) Katestone previously applied the IPCC stoichiometric EF for quicklime calcination and assumed that the transport component was included in Category 4 – trucking of freight. The EF has been raised to 1,050 kg CO₂-e/t quicklime for cradle-to-gate quicklime production accounting for the processing and fuel and electricity used. This is consistent with Australian lime-sector emissions data and international LCA datasets and is applied as a conservative measure^{3,4}.

Katestone has also amended the EF for powdered activated carbon from 22 t CO₂-e/t activated carbon to 10 t CO₂-e/t^{5,6}. This represents the current upper-midpoint of published cradle-to-gate life-cycle assessments for commercially produced activated carbon, where values range from ~8–11 kg CO₂-e/kg for commercial activated carbon and up to 18 kg CO₂-e/kg for coal-derived activated carbon.

¹ https://www.massey.ac.nz/~flrc/workshops/11/Manuscripts/Ledgard_2011.pdf

² <https://pubmed.ncbi.nlm.nih.gov/40086355/>

³ https://cement.org.au/wp-content/uploads/2023/06/Decarbonisation_Pathways_Australian_Lime_Sector.pdf

⁴ <https://adelaidebrighton.com.au/wp-content/uploads/sites/7/2023/04/Adbri-EPD-Lime.pdf>

⁵ <https://apps.carboncloud.com/climatehub/product-reports/id/2249085474186>

⁶ <https://upcommons.upc.edu/entities/publication/424e46a8-73f1-40ea-9f6f-9ad9db9f7d89>

Item 40 Avoided emissions

Information Requested

Table 7 of the GHGA presents Scope 1 emission factors for landfill; however, it is unclear how the Scope 1 emission factors were derived. It also appears that these factors were not used in the calculations in Section 4.4.2. Furthermore, the equation used to estimate landfill emissions is incorrect. As shown in the Table below, an emission factor of 1.62 t CO₂-e/t waste can be derived based on the waste composition and Table 15 of the Australian National Greenhouse Gas Accounts Factors for the 2030-50 period. The GWP term should be removed, as it is already embedded in the emission factors. A GWP of 28 (not 27) should be applied for methane where relevant. Moreover, captured landfill gas may also be used for electricity generation, reducing the net GHG benefit attributed to the project. Emission factor (t CO₂-e/t waste) 1.62 Avoid emissions from landfill (AE, t CO₂-e) $1.62 \times 760,000 \times 0.25 = 307,800$ t CO₂-e Potential electricity generation from landfill (MWh) $1.62 \times 760,000 \times 0.75 / 28 \times 50 \times 0.35 / 3.6 = 160,312$ MWh (methane LHV: 50GJ/t, engine efficiency of 35%) Emissions from electricity displacement $160,312 \times 0.19 = 30,459$ t CO₂-e In Section 4.43, the avoided emissions from electricity displacement were calculated using coal-fired power stations as the benchmark, which significantly overestimates the emissions reductions. Grid emission intensity should be applied to reflect the ongoing decarbonisation of the grid. Using a projected average grid emission intensity of 0.19 t CO₂-e/MWh for 2030–2034 (see Appendix D of Australia's Emissions Projections 2025 by DCCEEW (<https://www.dcceew.gov.au/climate-change/publications/australias-emissions-projections-2025>)), the average annual emissions reduction is estimated to be 14,645 t CO₂-e (calculated as $(307,800 - 160,312 \times 0.19) - (369,489 + 2,951 - 577,600 \times 0.19)$). This only accounts for avoided methane emissions and electricity displacement compared to landfill. This value is significantly lower than that presented in Table 12. The data in Table 13 appears reasonable; however, it cannot be verified without detailed activity data. For Example, Table 3 of Appendix E (Technical Process Description report) shows that the recovered ferrous and nonferrous metals are 12,000 and 4,700 tpa, respectively, corresponding to avoided Scope 3 emissions of 20,400 and 79,900 t CO₂-e/y. To better assess the project's GHG impact, net emissions should be provided and can be benchmarked against a landfill scenario. At a minimum, it should include both avoided emissions and Scope 3 emissions associated with consumption of quicklime, activated carbon, urea, and cement. Table 12 currently lacks a direct comparison with landfill operations, which is necessary given the project's significant Scope 1 and 3 emissions.

The proponent is requested to submit a revised The proponent is requested to submit a revised GHGA including:

- 1) Review and update relevant assumptions and calculations for avoided emissions. Electricity generation from landfill gas and grid decarbonisation should be considered.
- 2) Provide detailed activity data for recyclable materials.
- 3) Provide net GHG emissions of the project relative to a landfill. This analysis must account for both avoided emissions and the project's Scope 3 emissions stemming from the pollutant control process.

Response

- 1) Katestone has clarified the EF for waste incineration and the Scope 3 EF for waste in landfill, in Table 7.

Katestone notes that dispatchable fossil-fuel generation is expected to remain an important component of the Queensland and National Electricity Market (NEM) throughout the Project life.

Queensland Government energy planning indicates that coal-fired generation is expected to remain in the electricity system until at least 2046, while AEMO's Draft Integrated System Plan 2026 identifies an ongoing role for gas-fired generation to support renewable energy integration, peak demand and system security, with approximately 14 GW of flexible gas generation required by 2050.

As the BERC would provide firm, dispatchable electricity with high operational availability, it is reasonable to expect that electricity exported by the facility would primarily offset other dispatchable generation sources within the grid,

including coal-fired and gas-fired generation. While the specific generation displaced will vary over time depending on market conditions and dispatch arrangements, the assumption that EfW generation predominantly displaces fossil-fuel-based generation is considered reasonable for the purposes of assessing potential greenhouse gas benefits.

Nevertheless, the assessment has been updated to adopt the projected average grid emissions intensity over the Project life when calculating avoided electricity emissions. The Project Team considers it is likely to underestimate the greenhouse gas benefits of the Project given the dispatchable nature of the electricity generated and the role it is expected to play in displacing higher-emitting firm generation sources

Katestone has removed avoided emissions from electricity generated from coal combustion. The relative emissions intensity of different generators relative to BERC have been moved to Section 5.1.1

2) Katestone has provided activity data for recyclable materials in Table 6.

3) The calculation of avoided methane emissions is based on the conversion of the organic fraction of 760,000 t waste if it were sent to landfill and if that material decomposed in that year. The avoided emissions are the 25% of fugitive emissions that occur if 75% of the methane is captured and flared or used to generate electricity. KS explains this in Section 4.4.2

Additional Notes: It was requested that a global warming potential (GWP) value of 28 be applied for methane. Katestone notes that the greenhouse gas assessment adopts a GWP value of 27, consistent with current IPCC guidance for methane emissions from biogenic sources. The methane considered in the assessment is associated with the decomposition of the degradable organic fraction of waste (e.g. food, paper and green waste) rather than fossil-derived materials such as plastics. While a GWP value of 28 is commonly applied as a generic methane factor, the use of a GWP value of 27 is considered technically appropriate for the biogenic methane emissions assessed in this study.

Item 41 Risks and likely magnitude

Information Requested

Table 16 of the GHGA presents the project's emissions contribution to Queensland, Australian and global carbon budgets. The reported percentages appear incorrect and should be 0.607% and 0.141% of the remaining Queensland and national carbon budgets, respectively. Additionally, the document does not clearly define the assumptions or references used to estimate these carbon budgets. For example, our internal analysis indicates a national carbon budget of 4,893-5,382 Mt CO₂-e for the 2025-2050 period, assuming a linear emissions reduction trajectory aligned with the 2030 and 2035 NDC targets. These budgets would be even lower given the project is not expected to begin operation until 2030.

The proponent is requested to submit a revised GHGA including:

- 1) Review carbon budget calculations and provide supporting assumptions and references.
- 2) Use 2030-2050 carbon budgets as reference points considering most emissions occur during the operational phase.

Response

The remaining carbon budgets to reach net zero by 2050 have been calculated using a linear decline from the current level of emissions to 2050. The total BERC emissions from 2030 – 2050 (excl. Scope 3) are then presented as a fraction of each budget.

The BERC operational emissions for 2025–2050 are expected to account for >0.61%, >0.20%, and >0.002% of the remaining state, national and global carbon budgets to achieve net zero by 2050, respectively.

The Project Team notes that, in the absence of an officially published emissions budget for Queensland to achieve net zero by 2050, proponents are required to derive indicative budgets for assessment purposes. It is considered that the provision of a state-level carbon budget by DETSI would improve consistency and comparability across project assessments.