Decarbonisation of the Foundry Sector – Phase 1: Establishing a Carbon Emissions Baseline

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Strategic objectives of project

- The foundries sector contributes to greenhouse gas (GHG) emissions in South Africa through direct CO2eq and other GHGs emissions (scope 1) and electricity related GHG emissions (scope 2)
- The need to decarbonize arises from mainly three considerations:

1) **Mitigate potential negative impacts of CBAM in the foundry sector**
2) **The need achieve Nationally Determined Contribution targets**
3) **Improve the energy efficiency and energy security of the country**

The first objective therefore is to establish a baseline for emissions in phase 1

Scope of current work

- To quantify the GHG emissions associated with the Foundry Industry (Iron and steel, aluminum, brass, bronze, zinc) based on available published data and published GHG emission factors.

- The GHG emissions are estimated for the various foundry operations, based on the tonnage of product. (annual production rates of foundries were sourced from literature as primary data collection was not part of the scope of this project)

Approach

- Organizational boundaries: operations where the foundry business has direct control are included in the determination of GHG emissions

- Operational boundaries: Typical foundry processes involving mould preparation for casting, melting, pouring metal into mould, heat treatment and finishing the casting

- Emissions boundaries: Priority given to scope 1 and scope 2 emissions, since they fall under the business' direct control.

Methodology

Establishing emission factors:

- The data relating to energy consumption required to produce a unit weight of product is the primary determining factor for emissions.

- Where this data is unavailable, appropriate proxies will need to be used. Due to data scarcity of the foundry sector as a whole, this study relies predominantly on peer-reviewed published data to determine the emission factors from a localized perspective and follows the guidance of the IPCC (2006) to describe all quality control and quality assurance measures.

Methodology

Determining productivity of foundries:

- Data regarding the production volumes (tons of finished products) of the foundries, as well as energy requirements for producing a ton of product are central to the determination of the GHG emissions

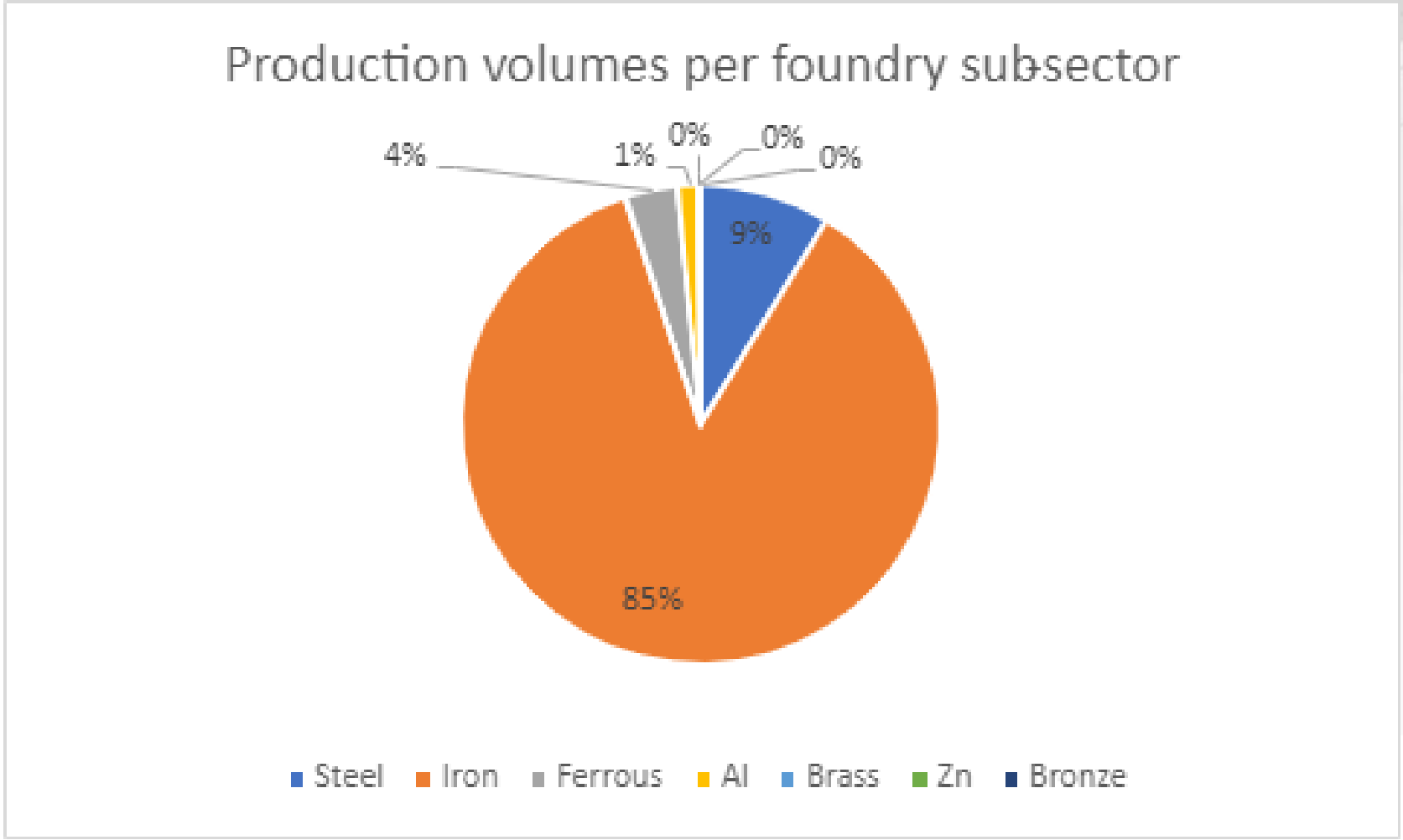
- The most recent data used within this study and is sourced from the CSIR's National Foundry Technology Network (CSIR, 2020).

Methodology

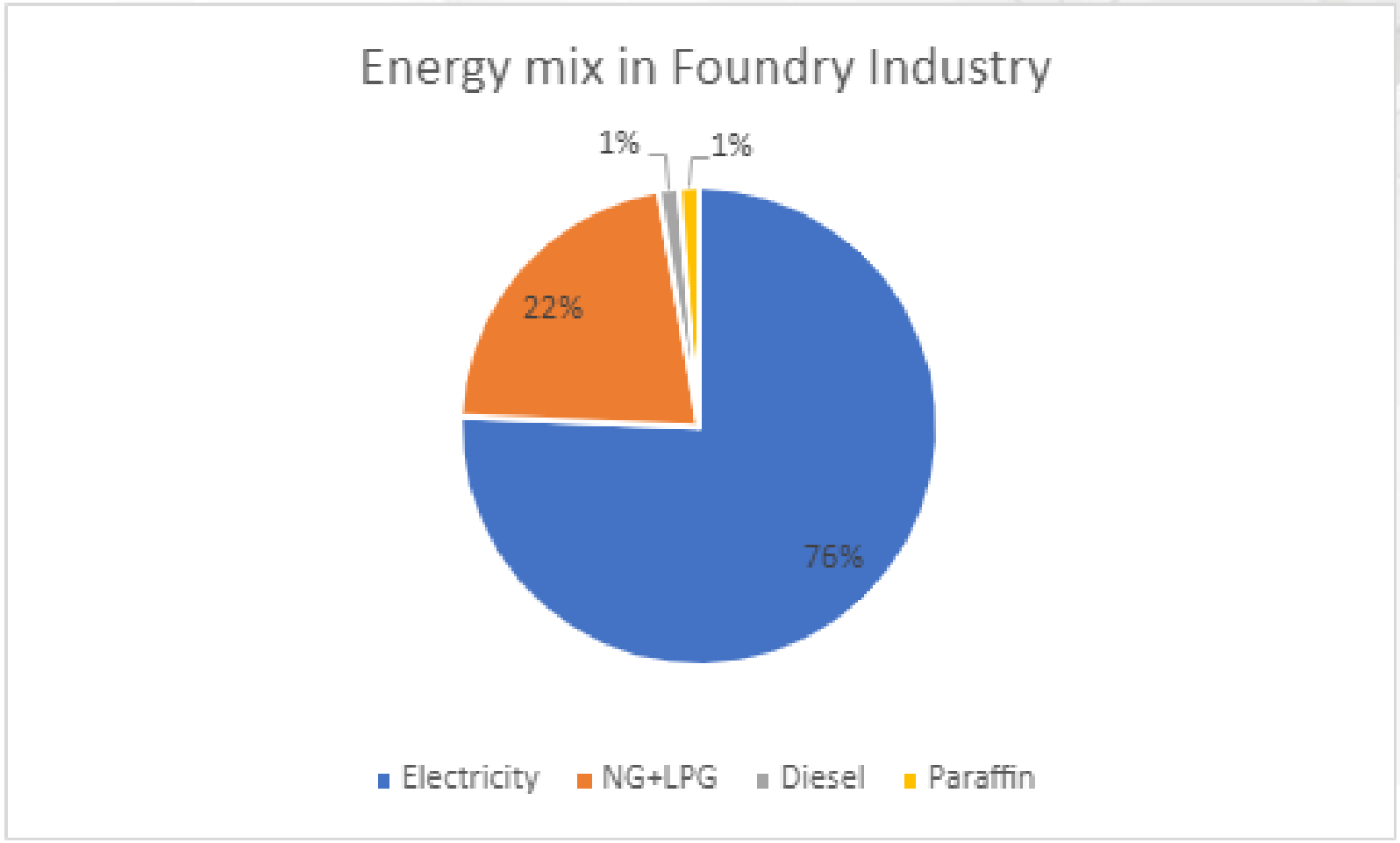
Determining GHG emissions:

- The production tonnages for each of the Foundry Sectors were extracted from the 2020 NFTN report (PG 58).
- The energy mix as provided in the status report (page 64).
- The calculation of emission factors for each of the energy sources provided in sheet 2 of the spreadsheet (See Annexure A).
- Using the energy intensities of Steel, Iron , Al, Zn, Brass, the energy intensity for Bronze was assumed as being similar to brass due to similar melting point of the components of brass and bronze.
- Thereafter, average figures were used to estimate the average tons of CO2eq emissions for each sub sector.

Carbon Baseline Emissions



Energy mix of Foundry Industry



Establishing Emission Factors

GEF tCO_{2eq}/MWh	NG+LPG EF tCO_{2eq}/MWh	Diesel EF tCO_{2eq}/MWh	Paraffin EF tCO_{2eq}/MWh
0.92	0.215	0.268	0.265

- These emission factors were used in conjunction with production rates and energy intensities to determine the baseline emissions.

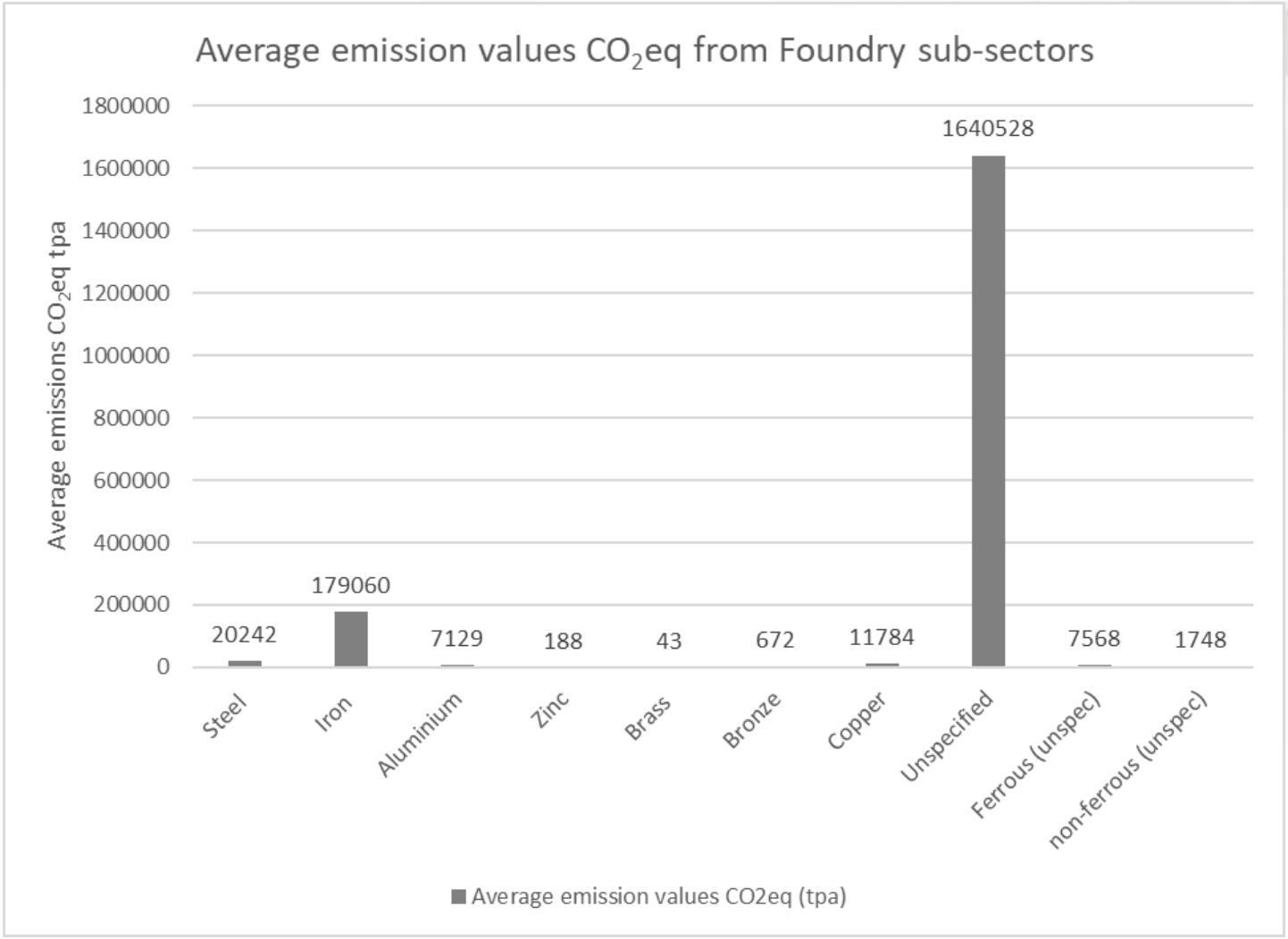
Establishing Production

Foundry sub-sector	Energy production intensity GJ/ton	Energy intensity MWh/ton	2020 Production (Tonnes)	Total energy MWh
Steel	11.6	3.225	8370	26991
Iron	10.5	2.919	81799	238771
Ferrous (unspecified)	10.775	2.995	3369	10091
Al	25.575	7.110	1337	9505
Brass	52	14.456	4	57.824
Zn	15	4.170	60	250.2
Bronze (av assumed similar to Brass)	52	14.456	62	896.2
Copper (av assumed similar to brass n bronze)	52	14.456	1087	15713
Unspecified (average is based on weighted production scales)	11.32	3.146	695 391	2 187 595
Non-ferrous (unspecified)	37.27	10.362	225	2331

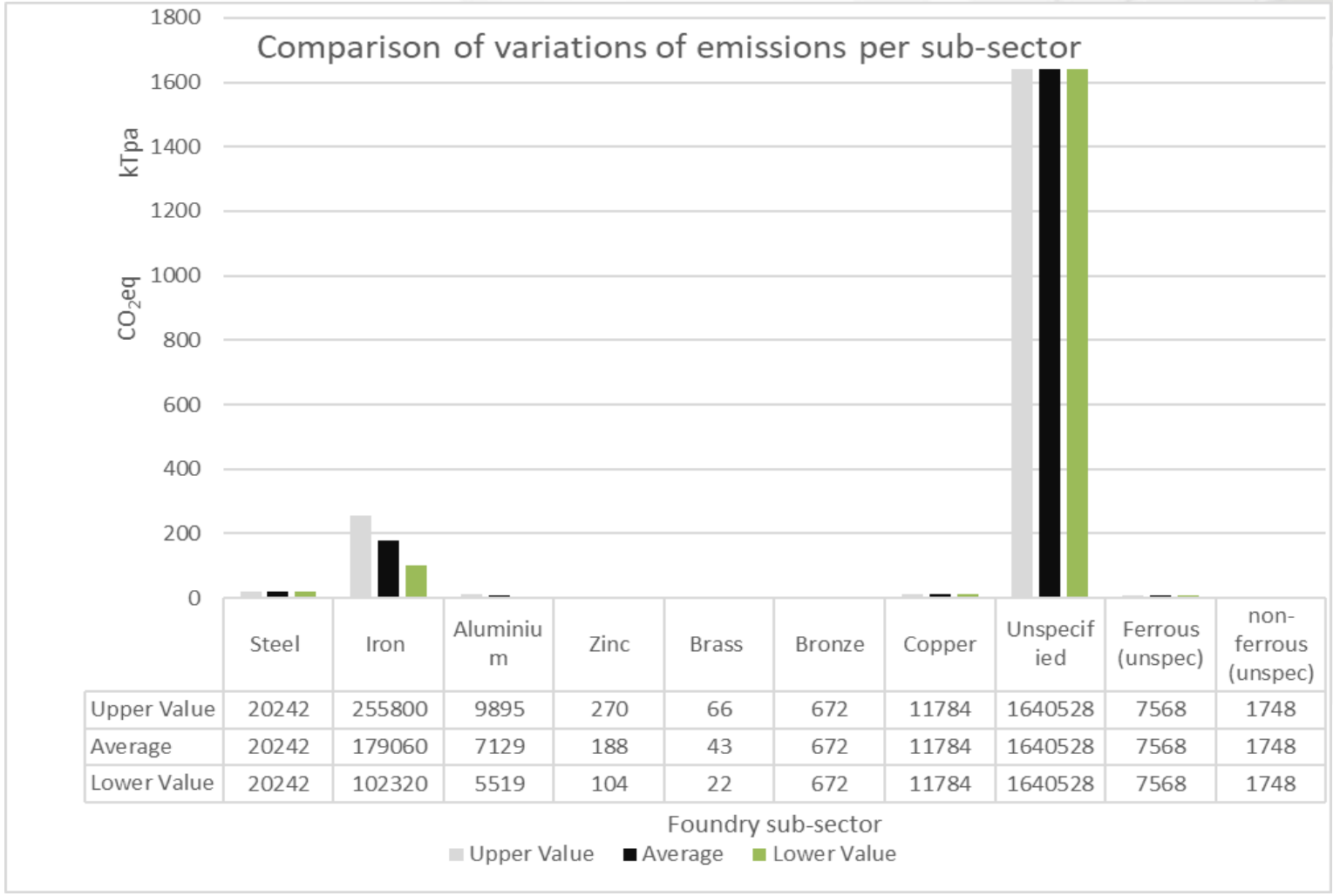
Baseline Emissions

Foundry sub-sector	Average emission values CO_2eq (tpa)	Upper emissions value CO_2eq (tpa)	Lower emissions value CO_2eq (tpa)
Steel	20 242	20 242	20 242
Iron	179 060	255 800	102320
Aluminium	7 129	9895	5519
Zinc	188	270	104
Brass	43	66	22
Bronze	672	672	672
Copper	11 784	11784	11 784
Unspecified	1 640 528	1 640 528	1 640 528
Ferrous (unspec)	7 568	7 568	7 568
Non-ferrous (unspec)	1748	1748	1748
Total (tpa)	1 868 961	1 948 572	1 790 506

Average CO2-eq emissions (tons) in sub-sectors



Comparison of variations of emissions.



	Steel	Iron	Aluminium	Zinc	Brass	Bronze	Copper	Unspecified	Ferrous (unspec)	non-ferrous (unspec)
Upper Value	20242	255800	9895	270	66	672	11784	1640528	7568	1748
Average	20242	179060	7129	188	43	672	11784	1640528	7568	1748
Lower Value	20242	102320	5519	104	22	672	11784	1640528	7568	1748

Assumptions, limitations, and way forward

The compilation of the baseline emissions for the foundry sector is based on several assumptions:

- Production volumes obtained from the NTFN report are indicative of production volume at a point in time and may not be reflective of trends of a longer period.
- In the absence of local emission factors for certain fuel types, international emission factors are applicable to a South African context.
- Energy consumed per unit production is taken into consideration.

Assumptions, limitations, and way forward cont.

- These assumptions were necessary as the primary data for current production volumes were not available during the period of this project. As such a breakdown of emissions by processes within the sub-sectors was not possible.

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