CDP Technical Note: Guidance methodology for estimation of Scope 3 category 11 emissions for coal mining companies

CDP Climate Change Questionnaire

Contents

Version

Version	Revision date	Revision summary
1.0	2018	First published version.
1.1	April 6, 2020	Minor update to “Introduction” section to align with the 2020 CDP climate change questionnaire.
1.2	January 7, 2021	Minor editorial changes

Acknowledgments

CDP would like to acknowledge Richard Heede of the Carbon Accountability Institute for his advice and feedback from the beginning of and throughout the development of this document. CDP also sought the feedback of coal mining companies. The guidance provided in this document does not necessarily reflect the views of industry representatives.

Nomenclature and units

Btu	British thermal unit
C	Carbon content
E	Emission
EF	Emission factor
EFc	Emission factor (physical flow allocated and complete combustion)
EFce	Emission factor (energy allocated and complete combustion)
GJ	Gigajoule
GR	Gas ratio
HV	Heating value
Kcal	Kilo-calorie
kWh	Kilo-Watt hour
mmbbl	Million British thermal units
mmts	Million short tons
Mt	Megaton
NEU	Non-energy use
OE	Effective oxidation rate
OF	Oxidation factor
p	Coal product
S	Sales (physical)
SF	NEU storage factor
t	Ton (metric ton)
tce	Tons of coal equivalent
TJ	Terajoule
Toe	Tons of oil equivalent
ts	Short ton

1. Introduction

Fossil fuel combustion releases carbon dioxide (CO_2) and is the principal source of anthropogenic greenhouse gas (GHG) emissions worldwide [1]. These emissions result primarily from the use of coal, oil and gas products. The WRI/WBCSD Greenhouse Gas Protocol [2] sets the standard for reporting direct company emissions (Scope 1), indirect emissions deriving from purchased energy carriers (Scope 2), and value chain emissions (Scope 3). Scope 3 encompasses 15 distinct categories covering all emissions along the corporate value chain. The use of sold products is category 11 of Scope 3 and typically accounts for over 95%[1] of total GHG emissions associated with coal mining companies.

Company accountability for Scope 3 emissions is less obvious than for Scopes 1 or 2 and, without direct control over value chain activities, companies are less likely to estimate them as accurately or as consistently. This document is a guide for standardizing the estimation of Scope 3 category 11 emissions from the coal mining assets of companies. The methodology described herein will assist company analysts in improving the quality, transparency, and consistency of Scope 3 emissions reporting and disclosure to CDP.

Typically, a company will begin its GHG inventory by calculating its Scope 1 and 2 emissions; these direct and indirect emissions are not covered by this methodology. Similarly, guidance on calculating emissions related to other Scope 3 categories has been excluded. Many coal producing companies have additional business activities in other industries, some of which may also result in category 11 emissions. Company analysts are advised to consult GHG Protocol guidance on Scope 3 reporting [3-4] for approaches to quantifying a company's full emissions inventory.

The GHG accounting questions in CDP's climate change questionnaire are aligned with the GHG Protocol. Corporate Scope 3 emissions should be reported under question C6.5. Column 1 of the table question ("Scope 3 category") are directly related to the GHG Protocol Scope 3 categories.

Established under the GHG Protocol is a set of reporting principles: relevance, completeness, consistency, transparency, and accuracy [2, p.6]. These principles form the wider context within which this methodology is applicable and should first be assessed before a company commences with measuring its GHG emissions.

[1]Based on analysis of company report data and 2015 company disclosures to CDP.

2. Boundaries

The boundaries stated in this section are based on the reporting guidance of the GHG Protocol [2-4]. Where appropriate, they have been customized to reflect the characteristics of the coal mining industry.

2.1 Organizational

Organizational boundaries refer to assets that fall inside the company inventory boundary and the attribution of emissions from those assets to the company. Company operations are variable in their legal and operational structures [2, p.16]. Company operations may be wholly owned, incorporated or non-incorporated, joint ventures, subsidiaries, and so on. Consolidating GHG emissions for corporate reporting has two separate approaches: equity share and control. Where a company has joint ownership with a nation state, the same consolidation rules apply as with private/private partnerships. For the equity share approach, emissions are attributed according to the share of equity the company has in an operation. Equity is measured by the company's economic interest in the operational asset, which is the company's right to the asset's risks and rewards. Typically, this share aligns with the company's percentage ownership of the asset. Where this is not the case, the economic substance of the relationship takes precedence over the legal ownership form so that equity share reflects the economic interest [2]. The analyst preparing the emissions estimation may therefore need to consult the company's accounting or legal staff to ensure the appropriate equity share is applied.

For the control approach, emissions are fully attributed to the company that has control and are not attributed if the company has an interest but no control. Control is defined as financial or operational[2]. The definitions of control are detailed in the GHG Protocol [2, p.16-23]. Whichever the applied approach, the choice should be consistent throughout organizational levels and between partner organizations.

2.2 Operational

Operational boundaries refer to emission Scopes and are categorized as direct or indirect relative to the organizational boundary. Fifteen reporting categories of Scope 3 emissions are defined under the GHG Protocol. These are represented in Figure 1 alongside Scope 1 and Scope 2 [3, p.31]. The six greenhouse gases agreed under the Kyoto Protocol are included.

Scope 1 emissions are direct GHG emissions from sources owned or controlled by the company. Scope 2 emissions are indirect GHG emissions and derive from the generation of electricity, steam, heating and cooling purchased by the company for its own consumption. Scope 3 emissions are all indirect GHG emissions other than those identified for Scope 2. Indirect emissions are from activities that are linked to the company but are not owned or controlled by the company. Scope 3 categories cover the full life cycle of a product's emissions including steps before and after the product's position in the cycle.

Category 11 'use of sold products' relates to direct use-phase emissions of sold products over the expected product lifetime [3, p.48, 4, p.113]. GHG Protocol guidance on Scope 3 emissions reporting [3-4] identifies three general sources of category 11 emissions: those related to a product's direct energy demand; those occurring from the product's use as a fuel or feedstock; and, those that relate to other forms of GHG emission during use. The products sold by coal companies are relevant only to the second of these three sources. The use-phase lasts until the

[2] Operational control is an organizational boundary and should not be confused with operational boundaries, which are the subject of section 2.2.

product is finally depleted, or disposed of, after which any further emission falls under category 12 ‘end-of-life treatment of sold products’.

Priority is given to category 11 because it typically represents over 95% of all GHG emissions (Scopes 1-3) relating to the coal mining industry.

2.3 Temporal

Temporal boundaries are defined here as relating to the period over which the company reports emissions and the consideration of emissions over time. Companies disclose their emissions to CDP on an annual basis and should specify their reporting period. Companies need only disclose Scope 3 emissions for the reporting year.

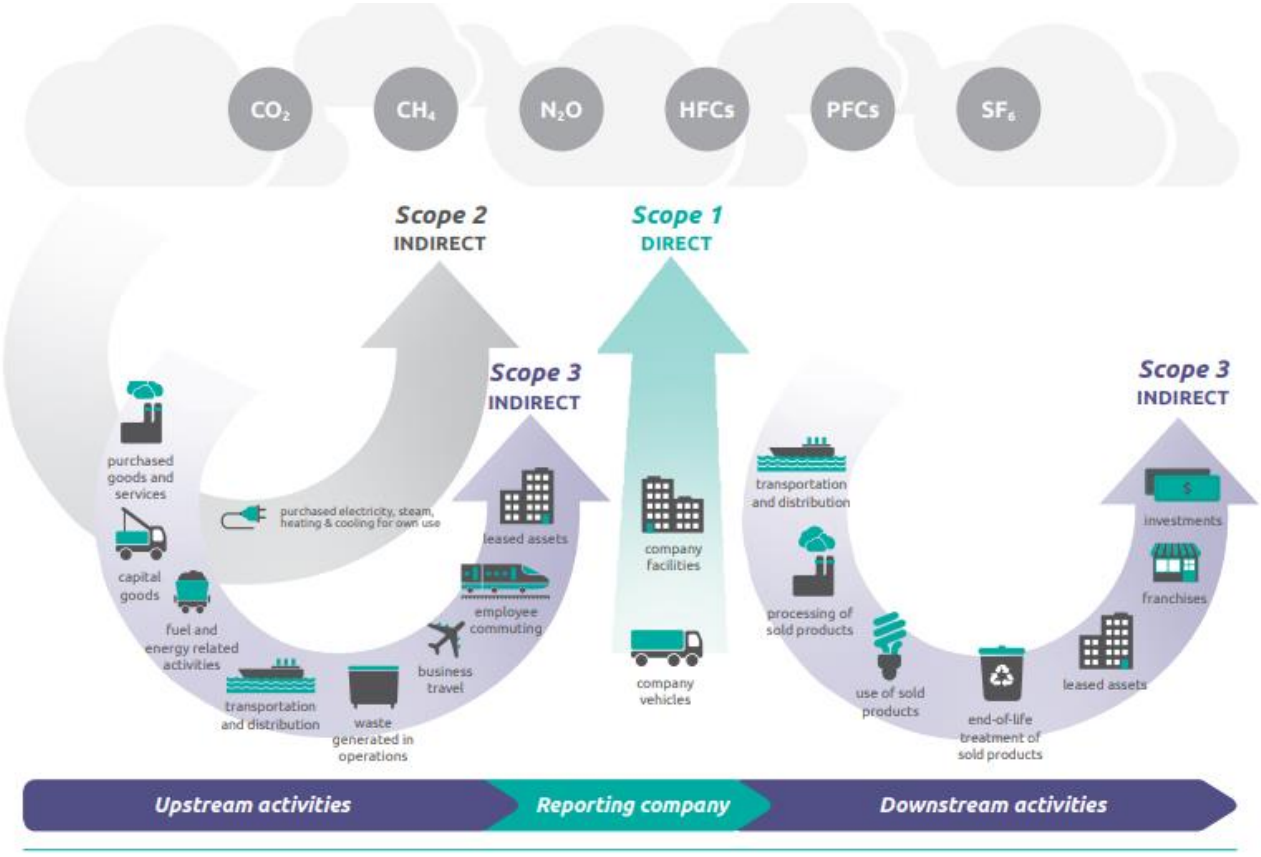

Figure 1: Value chain representation of company emissions

It is acknowledged that the use of sales data in estimating Scope 3 category 11 emissions is open to error because emissions result from product consumption and not product sale. The delay between product sale and consumption varies but is not typically significant; therefore, this methodology assumes that all sold coal products are consumed, or ‘used’, in the same reporting year. For a product used for non-energy purposes, total emission may not occur initially but over the course of a prolonged lifetime. Category 11 includes emissions occurring in the present and in the future [3, p.33].

3. Relevance

GHG Protocol guidance on Scope 3 reporting [2-3] defines a set of criteria for identifying relevant Scope 3 categories. As stated at the end of section 2.2, this guidance applies to the estimation of category 11 emissions only; this focus is applied because of the size of these emissions associated with the coal mining industry. As shown in Table 1, this represents one in a set of relevancy criteria.

Criteria	Description of activities
Size	They contribute significantly to the company's total anticipated Scope 3 emissions.
Influence	There are potential emissions reductions that could be undertaken or influenced by the company.
Risk	They contribute to the company's risk exposure (e.g., climate change related risks such as financial, regulatory, supply chain, product and technology, compliance/litigation, and reputational risks).
Stakeholders	They are deemed critical by key stakeholders (e.g., customers, suppliers, investors or civil society).
Outsourcing	They are outsourced activities previously performed in-house, or activities outsourced by the reporting company that are typically performed in-house by other companies in the reporting company's sector.
Sector guidance	They have been identified as significant by sector-specific guidance.
Spending or revenue analysis	They are areas that require a high level of spending or generate a high level of revenue (and are sometimes correlated with high GHG emissions).
Other	They meet any additional criteria developed by the company or industry sector.

Table 1: Criteria for identifying relevant Scope 3 activities [adapted from ref. 3, p.61]

It should be acknowledged that double counting between companies is an inherent characteristic of Scope 3 emissions. This is because Scope 3 emissions occur outside of the company's organizational boundary and, thus, inside the boundary (Scope 1) of other emitting entities or companies. Double counting may also occur between categories within Scope 3. For example, if two companies simultaneously account for third-party transportation of goods between them [3, p.108].

4. Methodology

The estimation methodology builds on the tier approach established under the 2006 IPCC Guidelines for National Greenhouse Gas Inventories [6]. The fundamental form of estimation combines data on the extent to which a human activity takes place (activity data) with coefficients that quantify the emissions, or removals, per unit of activity (emission factors). This relationship is expressed in Equation (1).

$$\text{Emissions} = \text{Activity data} \bullet \text{Emission factor} \quad (1)$$

The level of methodological complexity is represented by three tiers: tier 1 (basic), tier 2 (intermediate), and tier 3 (advanced). Tier 1 is generally designed for the application of readily available, or aggregate, company activity data with default emission factors, which are available, for example, from IPCC default parameter tables [6, p2. 7]. Tier 2 and tier 3 are designed for the use of more granular activity data and emission factors and for a wider inclusion of process parameters. Tier 2 and tier 3 are referred to as higher tier methods.

This guidance distinguishes between tier 1 and higher tier estimation complexity. The company analyst should choose estimation complexity based on the time and resources available. If attempting higher tier estimation, the analyst should refer to sections on both tier 1 and higher tier.

4.1 Tier 1

The tier 1 emissions calculation is expressed in Equations (2-3).

$$E_{S3.11} = \sum_{p=1} S_p \cdot EF_p^c \quad (2)$$

or,

$$E_{S3.11} = \sum_{p=1} S_p \cdot HV_p \cdot EF_p^{ce} \quad (3)$$

Where:

$E_{S3.11}$	= *Scope 3 category 11 GHG emissions, units: metric tons (t) of CO_2e*
p	= *coal product*
S	= *quantity sold, units: t_s, t, Mt, mmt, kg, etc.*
HV	= *heating value, units: GJ/kg, TJ/Gg, tce/t, mmBtu/t_s, etc.*
EF^c	= *full combustion emission factor, units: tCO_2e/t, tCO_2e/t_s, etc.*
EF^{ce}	= *full combustion energy emission factor, units: tCO_2e/TJ, tCO_2e/tce, etc.*

Note:

a: *Product totals shall be disaggregated by rank, e.g. anthracite, coking, other bituminous, sub-bituminous, lignite.*

IPCC default EFs for coal are separated into: anthracite, coking, bituminous, sub-bituminous, and lignite. The analyst should use activity data to at least this level of granularity. Before applying default EFs it may be necessary to convert coal sold from mass units to energy units. This is done through the use of heating value (HV), such as those tabulated in the IPCC inventory guidance for energy [6]. Other publicly available sources relate EFs directly to the physical quantity, in which case it is not necessary to involve energy in the calculation.

Some companies do not publish coal output by coal rank but by coal use. Coal use refers to the application for which the coal is intended. Designations include thermal, metallurgical, steelmaking, PCI, coking, and so on. Metallurgical, steelmaking, PCI are generally best represented as

bituminous. However bituminous, along with sub-bituminous and lignite, is also sold for thermal applications. It is expected that the analyst has access to physical coal sales by rank; where this is not the case, the analyst should seek further product information before assigning HV or EFs by rank.

Many companies already publish average HVs at a regional level. Carbon content in coals is strongly correlated with energy content so the use of more accurate HVs improves the emissions estimation. The analyst may wish to apply company HVs, or a weighted average of company HV, with EF_{ce} to improve estimation accuracy.

Some companies only publish physical data on coal production and not on coal sales. However, difference between the two is typically low. Based on a sample[3] of 13 companies publishing both production and sales data, CDP found a weighted average difference of sales to production of ±2%. The difference is primarily down to the movement of coal stocks to or from inventories. It is expected that the company analyst will have access to physical coal sales data; where this is not the case, the analyst should use the production figure and state that this value has been used in lieu of sales. Production should be the net of a company's own use of gross production. So if the company is vertically integrated or uses significant amounts of produced coal for other operations, e.g. power generation, then double counting with the company's Scope 1 emissions is avoided. If the company purchases significant amounts of coal for resale, then coal production should not be used as a proxy for sales. Economic sales data, e.g. revenue from sales, should not be used in place of physical sales under any circumstances. Some companies, particularly in the United States, measure coal mass in short tons. Before using activity data with HV or EF, the analyst must ensure that each has the same physical unit. Equation (4) expresses the relationship between different units, where t is tons and ts is short tons.

$$t = ts \bullet 0.9072 \qquad (4)$$

It is common for companies to analyze energy by higher heating value (HHV), as opposed to lower heating value (LHV)[4]. LHV is lower than HHV by the latent energy of vaporization of the water product of combustion. For fossil fuel solids the LHV/HHV ratio is typically 0.95, and for gasses it is typically 0.9. Default ratios are shown in Table A-1 of the Appendix. The analyst should be consistent with the use of either HHV or LHV. For example, if EF^{ce} represents emissions per LHV, then the analyst should use activity data in LHV or convert activity data to LHV from HHV or physical unit.

The analyst should not use carbon dioxide (CO_2)[5] EFs as a proxy for greenhouse gas EFs. When used together, GHGs are measured in carbon dioxide equivalent (CO_2e). Relevant GHGs include CO_2, methane (CH_4), and nitrous oxide (N_2O). To convert from non-CO_2 to CO_2e, the analyst should apply global warming potential (GWP) factors. GWP relates the radiative forcing of a greenhouse gas over a certain period of time to that of CO_2. Where necessary, the analyst should apply the 100-year GWPs published in the IPCC Fifth Assessment report [1, Table 8.7]; for CH_4 and N_2O these are 34 and 298 respectively. Alternatively, the analyst may apply a default conversion factor defined here as the gas ratio (GR). The ratio of CO_2e and CO_2, GR for coals is typically around 1.005. For further detail refer to Table A-1 of the Appendix.

[3] This sample excludes Chinese companies which were found to have larger differences.
[4] LHV may also be referred to as the net calorific value (NCV), and HHV the gross calorific value (GCV).
[5] If necessary, carbon content (C) should be converted to CO_2 using the molecular ratio (CO_2 = 44/12 C).

4.2 Higher tier

The higher tier emissions calculation is expressed in Equations (5-8).

$$E_{S3.11} = \sum_{p=1} S_p \cdot EF_p^c \cdot EO_p \quad (5)$$

or,

$$E_{S3.11} = \sum_{p=1} S_p \cdot HV_p \cdot EF_p^{ce} \cdot EO_p \quad (6)$$

or,

$$E_{S3.11} = \sum_{p=1} S_p \cdot C_p \cdot {}^{44}/_{12} \cdot GR_p \cdot EO_p \quad (7)$$

where,

$$EO_p = OF_p \cdot (1 - NEU_p) + NEU_p \cdot (1 - SF_p) \quad (8)$$

Where[6]:

$E_{S3.11}$	= *Scope 3 category 11 GHG emissions, units: metric tons (t) of CO_2e*
p	= *coal product*
S	= *quantity sold, units: t_s, t, Mt, mmt_s, kg, etc.*
C	= *Carbon content*
GR	= *GHG gas ratio (CO_2e/CO_2)*
EF^c	= *full combustion emission factor, units: tCO_2e/t, tCO_2e/t_s, etc.*
EF^{ce}	= *full combustion energy emission factor, units: tCO_2e/TJ, tCO_2e/tce, etc.*
EO	= *effective oxidation rate*
OF	= *oxidation factor*
NEU	= *non-energy use fraction*
SF	= *storage factor*

Note:

a: *Product totals shall be disaggregated by rank and area.*

b: *Effective oxidation rate should be determined for each product or product application.*

For higher tier calculation, the analyst should disaggregate product sales to the level of coal mining region, basin, bed, or mine. If there is significant variability in coal properties at the chosen level, then the analyst should ensure that coal data is representative of the average for that area. If the analyst has access to company HVs then these may be combined with default EF^{ce} data. Otherwise the analyst should access company data on EF^c or C data.

If the analyst has data at the area level by production, and not sales, then these production figures may be used as a proxy for estimating proportions of total sales. However total production may not be used as a proxy for total sales.

As with tier 1, the analyst should ensure not to use activity data and coefficients that mix metric tons with short tons, nor LHV with HHV. The analyst should not use carbon dioxide (CO_2) EFs as a proxy for greenhouse gas EFs; where necessary, the analyst may use the gas ratio (GR). For further details on conversion refer to section 4.1 and Table A-1 of the Appendix.

The analyst should also take account of product oxidation. Imperfect combustion is accounted for by the product's oxidation factor (OF), which is typically between 0.99 and 1. The OF is applied to the non-NEU fraction of product p. Within the NEU fraction of product p, a portion of carbon is stored. This portion is accounted for by the product's storage factor (SF). Taking these factors into account, the analyst may estimate a product's effective oxidation rate (EO). This EO is defined here as the ultimate proportion of a product that is emitted over its lifetime. For default oxidation factors refer to Table A-2 of the Appendix.

[6] For unit descriptions refer to the Nomenclature

Weighted average OFs are displayed for China and other countries, where the latter is based on data from national inventories submitted to the UNFCCC [7]. Default factors for NEU and SF are not provided here as these are highly variable. Instead the analyst should obtain the relevant data, but in the absence of such data the analyst may assume an NEU of 0 (i.e. EO = OF).

For coking and PCI coal, SF may be considered negligible. The carbon extracted in the manufacture of coke is ultimately released via the combustion of coke oven gas, and most of the carbon in coke and PCI coal is released via the combustion of blast furnace gas. Of the carbon sequestered in pig iron (3-4%), most is released via the combustion of steel furnace gas. The carbon remaining in carbon steel is <1% [8], with medium carbon steel containing 0.3-0.6% [9].

5. Production method

A CDP technical note for Scope 3 category 11 emissions estimation is also provided for oil and gas companies. Due to certain structural aspects of the oil and gas production industry, a method based on the use of net production, as opposed to sales, is detailed in the oil and gas guidance. This approach is not recommended for the coal mining industry, though if net production is similar to sales then the analyst may use it as proxy activity data in the tier 1 calculation (see section 4.1). If the reporting company produces oil and gas products as well as coal products, then the analyst should refer to both technical notes.

6. Disclosure

For general guidance on the disclosure of Scope 3 emissions to CDP, the reader is referred to module C6 of the CDP climate change reporting guidance. The reporting company is required to disclose an estimation of Scope 3 emissions in question C6.5 along with information on the methodology with which the figure was estimated. An effective disclosure of the estimation methodology for Scope 3 category 11 emissions should include:

Information	Description	Disclosure
Methodological approach	Confirmation that the guidance provided in this document has been adhered to. The reporter may also wish to state whether the estimation was tier 1 or higher tier. If the method used does not follow the above methods, then the reporter should state this and describe the adopted methodology or differences from the above.	Calculation follows CDP guidance; Tier 1.
Coverage	Confirm that all activity inside the organizational boundary is included. No activity inside the organizational boundary should be excluded. [Note: the reporting company should already have disclosed the boundary definition, e.g. equity share, in question C0.5, and the estimation should apply this boundary]	All activity within the organizational boundary is included.
Activity data	State activity data type: 'net production' or 'sales'. The reporter should state if production or sales differs in any way to the definitions outlined in this report, and justify if proxy data [tier 1 only] has been used.	Activity data is net production. Net production is similar (within a few percent) of sales figure.
Product information	State all products included and relevant calculation information so that the estimation can be reproduced. This includes the product name and amount produced/sold. The reporter may also wish to include calculation parameters: EF and, if used, LHV/HHV and oxidation rate information. If the calculation parameters are taken directly from literature, then the literature source may be referenced instead. If company emission factors or activity data are deemed sensitive information, then an approximate or aggregated form of activity disclosure enabling a rough reproduction of the estimation is sufficient.	Products include: Bituminous coal (12.3 million tons; 29.5 GJ/t HHV); Lignite…
Sources	Reference the source(s) of activity data, emission factors, and any other sources used. Citing the references where they are used; or listing them at the end stating what they were used for.	Emission factors from US EPA 2014 – Emission Factors for Greenhouse gas inventories
Other	Any other pertinent information.	

Table 2: Recommended items to include in 'Emissions calculation methodology' disclosure for question C6.5

7. References

[1] IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

[2] WRI/WBCSD, 'The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard. Revised Edition', World Business Council for Sustainable Development and World Resources Institute, Geneva and Washington DC, 2004.

[3] WRI/WBCSD, 'Greenhouse Gas Protocol: Corporate Value Chain (Scope 3) Accounting and Reporting Standard', World Business Council for Sustainable Development and World Resources Institute, Geneva and Washington DC, 2011.

[4] WRI/WBCSD, 'Greenhouse Gas Protocol: Technical Guidance for Calculating Scope 3 Emissions', World Business Council for Sustainable Development and World Resources Institute, Geneva and Washington DC, 2013.

[5] IPCC, '2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 1: General Guidance and Reporting', IGES, Japan, 2006.

[6] IPCC, '2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy', IGES, Japan, 2006.

[7] UNFCCC, 'Table 1.A(b) Sectoral Background Data for Energy: CO2 from Fuel Combustion Activities - Reference Approach', National Inventory Submissions 2014: Common Reporting Format. 2014.

[8] IPCC, '2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 3: Industrial Processes and Use', IGES, Japan, 2006.

[9] Total Materia, 'Classification of Carbon and Low-Alloy Steels', 2001. [Online]. Available: http://www.totalmateria.com/articles/Art62.htm [Accessed: 2015].

[10] Z. Liu, D. Guan, W. Wei, S. J. Davis, P. Ciais, J. Bai, S. Peng, Q. Zhang, K. Hubacek, G. Marland, R. J. Andres, D. Crawford-Brown, J. Lin, H. Zhao, C. Hong, T. A. Boden, K. Feng, G. P. Peters, F. Xi, J. Liu, Y. Li, Y. Zhao, N. Zeng, and K. He, 'Reduced carbon emission estimates from fossil fuel combustion and cement production in China', Nature, vol. 524, no. 7565, pp. 335–338, Aug. 2015.

Appendix

A1 Default parameters

Coal product	EF, tCO_2e/ TJ (HHV)	EF (lower), tCO_2e/ TJ (HHV)	EF (upper), tCO_2e/ TJ (HHV)	GR, CO_2e/ CO_2	HHV, GJ/ ton	HHV (lower) GJ/ ton	HHV (upper), GJ/ ton	LHV/ HHV
Anthracite	93.8	90.0	97.4	1.0048	28.1	22.7	33.9	0.95
Coking Coal	90.3	83.1	97.4	1.0050	29.7	25.3	32.6	0.95
Other Bituminous Coal	90.3	85.2	96.2	1.0050	27.2	20.9	32.1	0.95
Sub-Bituminous Coal	91.7	88.3	96.5	1.0049	19.9	12.1	27.4	0.95
Lignite	96.4	86.5	110.7	1.0047	12.5	5.8	22.7	0.95

Table A-1: IPCC default coal EFs, GRs, HVs, and LHV/HHV ratios [6]

Coal product	World[7], exc. China	China[8]	World[9] (average)
Anthracite	0.983	0.973	0.978
Coking Coal	0.987	0.97	0.979
Other Bituminous Coal	0.992	0.97	0.981
Sub-Bituminous Coal	0.999	0.97	0.985
Lignite	0.991	0.96	0.975

Table A-2: Default oxidation factors [7, 10]

[7] World exc. China is represented as the weighted average of OFs from national inventories submitted to the UNFCCC [7].
[8] Is the effective OR of Chinese coal sold for thermal uses (NEU = 0) [10], where coking coal, other bituminous, and sub-bituminous has been assumed as bituminous.
[9] Average assumes 50% of global coal production is from China.

A2 Standard unit conversions

Energy conversion						
unit per:	Million Btu	GJ	toe	tce	kWh	kcal
Million Btu	1.000E+00	9.478E-01	3.968E+01	2.778E+01	3.412E-03	3.968E-06
GJ	1.055E+00	1.000E+00	4.187E+01	2.931E+01	3.600E-03	4.187E-06
toe	2.520E-02	2.388E-02	1.000E+00	7.000E-01	8.598E-05	1.000E-07
tce	3.600E-02	3.412E-02	1.429E+00	1.000E+00	1.228E-04	1.429E-07
kWh	2.931E+02	2.778E+02	1.163E+04	8.141E+03	1.000E+00	1.163E-03
kcal	2.520E+05	2.388E+05	1.000E+07	7.000E+06	8.598E+02	1.000E+00

Mass conversion					
unit per:	Short Tons	Kilograms	Metric Tons	Long Tons	Pounds
Short Tons	1.000E+00	1.102E-03	1.102E+00	1.120E+00	5.000E-04
Kilograms	9.072E+02	1.000E+00	1.000E+03	1.016E+03	4.536E-01
Metric Tons	9.072E-01	1.000E-03	1.000E+00	1.016E+00	4.536E-04
Long Tons	8.929E-01	9.842E-04	9.842E-01	1.000E+00	4.464E-04
Pounds	2.000E+03	2.205E+00	2.205E+03	2.240E+03	1.000E+00

Volume conversion					
unit per:	Barrels	U.S. gallons	Liters	Cubic feet	Cubic meters
Barrels	1.000E+00	2.381E-02	6.290E-03	1.781E-01	6.290E+00
U.S. gallons	4.200E+01	1.000E+00	2.642E-01	7.480E+00	2.642E+02
Liters	1.590E+02	3.785E+00	1.000E+00	2.832E+01	1.000E+03
Cubic feet	5.615E+00	1.337E-01	3.531E-02	1.000E+00	3.531E+01
Cubic meters	1.590E-01	3.790E-03	1.000E-03	2.832E-02	1.000E+00

Table A-3: Standard conversion tables for energy, mass, and volume

A3 Worked example

In this worked example, activity data is defined as sales. For tier 1, net production may be use as a proxy for sales provided that the company does not purchase significant amounts of coal for resale.

Worked example

Tier 1 – Sales data

In 2015 Company A sold 20 million short tons (mts) of coking coal, 40mts of bituminous coal, 120mts of sub-bituminous coal, and 10mts of lignite coal. What was company A's Scope 3 category 11 emissions from coal in 2015?

Convert sales volume to energy

Coking	$2\times10^{7}t_{s} \times 0.9072 \times 29.7GJ/t\ (HHV) = 5.39\times10^{8}GJ$
Bituminous	$4\times10^{7}t_{s} \times 0.9072 \times 27.2GJ/t\ (HHV) = 9.86\times10^{8}GJ$
Sub-bituminous	$1.2\times10^{8}t_{s} \times 0.9072 \times 19.9GJ/t\ (HHV) = 2.17\times10^{9}GJ$
Lignite	$1\times10^{7}t_{s} \times 0.9072 \times 12.5GJ/t\ (HHV) = 1.14\times10^{8}GJ$

Convert energy to emissions

Coking		$5.39\times10^{8}GJ \times 0.0903tCO_2e/GJ\ (HHV) = 4.86\times10^{7}tCO_2e$
Bituminous	+	$9.86\times10^{8}GJ \times 0.0903tCO_2e/GJ\ (HHV) = 8.90\times10^{7}tCO_2e$
Sub-bituminous	+	$2.17\times10^{9}GJ \times 0.0917tCO_2e/GJ\ (HHV) = 1.99\times10^{8}tCO_2e$
Lignite	+	$1.14\times10^{8}GJ \times 0.0964tCO_2e/GJ\ (HHV) = 1.10\times10^{7}tCO_2e$
	=	$347\times10^{6}tCO_2e$

Answer should be reported in metric tons of CO_2e with no commas: **347000000**