Attachment 4 (RSD) -Appendix F

Greenhouse Gas Assessment Summary Report

PROPOSED WIND FARM IN SCOTT RIVER, WESTERN AUSTALIA

GREENHOUSE GAS ASSESSMENT SUMMARY REPORT

Version 1.5

Prepared by **Greenbase Pty Ltd**

For **Eco Logical Australia Pty Ltd** on behalf of **Synergy Renewable Energy Developments Pty Ltd**

Prepared August 2024

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Rounding of Amounts

All CO_2-e amounts included in this document have been rounded to the nearest tonne except when rounding would result in a zero.

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Table 1 Document History

VER.	DATE	DETAILS	NAME	STATUS
1.5	20/09/2024	Finalised report	Greenbase (A.Feng)	Final
1.4	11/09/2024	Capital goods, upstream transportation, and waste generated emissions updated	Greenbase (A.Feng)	Draft
1.3	13/08/2024	Eco Logical Review	Eco Logical (A.Bowley)	Draft
1.2	08/08/2024	Employee commuting emissions updated	Greenbase (A.Feng)	Draft
1.1	02/08/2024	Greenbase internal review	Greenbase (H.Ko)	Draft
1.0	01/08/2024	Initial document prepared	Greenbase (A.Feng)	Draft

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1 Summary

Synergy Renewable Energy Developments Pty Ltd (SynergyRED) is the proponent for the Proposed Wind Farm in Scott River (Project), located approximately 15 kilometres northeast of Augusta, Western Australia.

This greenhouse gas (GHG) assessment has been prepared to support the referral under section 38 of the *Environmental Protection Act 1986* (EP Act), taking into account the requirements of the Environmental Protection Authority's (EPA) Environmental Factor Guideline for Greenhouse Gas Emissions (EPA, 2023).

Total scope 1 emissions are estimated as 8,492 tCO_2-e over the life of the project (3,799 tCO_2-e in the construction phase and 4,693 tCO_2-e in the operation phase). Total scope 2 emissions are estimated as 4,179 tCO_2-e (149 tCO_2-e in the construction phase and 4,030 tCO_2-e in the operation phase).

Total scope 3 emissions are estimated as 101,911 tCO_2-e (99,958 tCO_2-e in the construction phase, 1,205 tCO_2-e in the operation phase, and 747 tCO_2-e in the closure phase). Scope 3 emissions have been assessed with the following emissions sources: capital goods, fuel- and energy-related activities, waste generated in operations, and employee commuting.

The scope 1, 2, and 3 emissions intensity is estimated as 0.00987 tCO_2-e/MWh electricity generated, based on the forecast electricity generation over the life of the project.

2 GHG Inventory

2.1 Project Description

Synergy Renewable Energy Developments Pty Ltd (SynergyRED) is proposing a wind farm (the Project) in the Scott River region of Western Australia, approximately 15 kilometres northeast of Augusta.

The wind farm will have an electricity generation capacity of 100 MW. There will be a maximum of twenty wind turbines installed in the wind farm, the final number dependent on the model of turbines selected for the Project.

The development envelope is primarily farmland, with some small areas of native vegetation present.

2.2 Project Activities

The key infrastructure and principal activities to be undertaken by the Project have been identified and outlined below:

- Wind turbines (the GHG assessment is based on the maximum number of turbines),
- Connection to existing transmission line,
- Possible clearing of native vegetation (the GHG assessment is based on the 'worst case' scenario of maximum hectares cleared).

2.3 GHG Emissions Calculation

GHG emissions can include both *direct* and *indirect* emissions, i.e. scope 1, scope 2 and scope 3 emissions. Sources of emissions identified for the Project, and how they are calculated in the GHG assessment, are described in the following sections.

2.3.1 Scope 1 GHG Emissions Calculation

Scope 1 GHG emissions are *direct* emissions from sources within the boundary of the facility, e.g. fuel combusted on site.

The significant sources of scope 1 emissions resulting from the activities at the Project are as follows:

- Fuel consumption by construction and maintenance vehicles,
- Fuel consumption from the transport of wind turbines,
- Leakage of sulphur hexafluoride in switchgear (SF_6), and
- Possible clearing of native vegetation (loss of sequestration potential and decomposition of organic matter).

Fuel Consumption

Diesel will be consumed by construction vehicles in the construction phase. Diesel will also be consumed by maintenance vehicles in the operational phase, as well as emergency diesel generators for unforeseen outages.

Emissions from diesel are estimated using methods and emission factors from Schedule 1 of the National Greenhouse and Energy Reporting (NGER) Determination, applicable to the 2023-24 financial year. The emission factors, as shown in Table 2, are provided in carbon dioxide equivalents (CO_2-e) and include global warming potentials (GWPs).

Table 2 Scope 1 GHG Emission Factors for Fuel Consumption

FUEL	ENERGY CONTENT	EMISSION FACTOR ($kgCO_2$-e/GJ)			
		CO_2	CH_4	N_2O	Total
GWP		1	28	265	
Diesel (stationary)	38.6 GJ/kL	69.90	0.10	0.20	70.20
Diesel (transport)	38.6 GJ/kL	69.90	0.10	0.40	70.40

Transport of Turbines

Diesel will be consumed by trucks delivering the wind turbines to site. It is assumed that the turbines will be delivered by trucks from Bunbury Port.

Emissions from the transport of turbines are estimated using freighting emission factors from the UK Department for Business, Energy & Industrial Strategy's *Conversion Factors 2023*. The emission factor of 0.1186 $kgCO_2$-e/t.kilometre for heavy rigid vehicles is applied to the tonnes of turbines transported from Bunbury Port.

Sulphur Hexafluoride (SF_6)

Sulphur hexafluoride (SF_6) will be used as an electrical insulator for circuit breakers and switches (switchgear).

Emissions from switchgear leakages are estimated using methods and emission factors from Schedule 1 of the NGER Determination, applicable to the 2023-24 financial year. Switchgear has a default annual leakage rate of 0.0089 and SF_6 has a GWP of 23,500 tCO_2-e/t.

Land Clearing

The current design of the Project does not require clearing of native vegetation, however, land clearing emissions have been calculated as a 'worst-case scenario' in the GHG assessment. The 'worst-case scenario' is based on 2 hectares of native vegetation cleared: 1 hectare of open woodland and 1 hectare of open forest.

Emissions from land clearing are estimated using emission factors from the *Greenhouse Gas Assessment Workbook for Road Projects*, published by the Transport Authorities Greenhouse Group (TAGG, 2013).

It is assumed that all cleared vegetation will be converted into CO_2 emissions and released into the atmosphere over the life of the project.

Table 3 Scope 1 GHG Emission Factors for Land Clearing (TAGG, 2013)

VEGETATION CLASS	EMISSION FACTOR (tCO_2-e/ha)
Open woodland	307
Open forest	316

2.3.2 Scope 2 GHG Emissions Calculation

Scope 2 GHG emissions are *indirect* emissions from the consumption of purchased electricity, steam, or heat produced by another organisation.

Electricity will be purchased in the construction phase for dewatering. Electricity will also be purchased in the operational phase to keep the operations running during downtime. The Project will purchase electricity from the South West Interconnected System (SWIS) grid.

Emissions from electricity purchased from the grid are estimated using methods from the NGER Determination and projected emission factors from the DCCEEW's *Australia's Emissions Projections 2023*. The projected emission factors are shown in Table 4. Because emission factors are only projected up to 2035, the emission factor for 2035 is used to calculate the following years of operation.

Table 4 Scope 2 and 3 GHG Emission Factors for the SWIS Grid (DCCEEW, 2023)

GRID	EMISSION FACTOR ($kgCO_2$-e/kWh)										
	2025	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Scope 2	0.47	0.44	0.34	0.29	0.27	0.18	0.18	0.16	0.15	0.15	0.14
Scope 3	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01

2.3.3 Scope 3 GHG Emissions Calculation

Scope 3 emissions are all other *indirect* emissions that are of a consequence of an organisation's activities but are not from sources owned or controlled by the organisation, e.g., the emissions associated with the extraction, refinement, and delivery of diesel to site.

The GHG Protocol (2011) categorises scope 3 GHG emissions into fifteen categories, divided into two groups depending on the financial transactions of the company:

- Upstream indirect emissions related to purchased or acquired goods and services,
- Downstream indirect emissions related to sold goods and services.

Table 5 outlines all scope 3 categories and their relevancy to the Project and indicates those included in the GHG assessment. A full list and description of the scope 3 categories, as well as definitions of their relevancy, are outlined in Appendix B.

Table 5 Scope 3 GHG Emissions Categories (Greenhouse Gas Protocol, 2011)

CATEGORY	RELEVANCY	INCLUDED IN ASSESSMENT
1. Purchased goods and services	Purchase of goods and services other than fuel and energy. Not material, but directly influenced by the company.	Combined with scope 3 category 2
2. Capital goods	Purchase of wind turbines and concrete. Material and directly influenced by the company; should be calculated.	Included
3. Fuel- and energy-related activities (not included in scope 1 or scope 2)	Consumption of fuel and electricity. Material and directly influenced by the company; should be calculated.	Included
4. Upstream transportation and distribution	Transport of wind turbines to site. Material and directly influenced by the company; should be calculated.	Calculated as scope 1 for this project
5. Waste generated* *originally named 'waste generated in operations', but renamed, because only end-of-life waste is considered in calculation	Recycling and disposal of wind turbine components at the end of the project. Material and directly influenced by the company; should be calculated.	Included
6. Business travel	Not material.	Not calculated
7. Employee commuting	Not material, but directly influenced by the company.	Included
8. Upstream leased assets	Use of hired vehicles for construction and maintenance. Material and directly influenced by the company; should be calculated.	Calculated as scope 1 for this project
9. Downstream transportation and distribution	Transmission of electricity to the grid. Material, but not directly influenced by the company.	Not calculated
10. Processing of sold products	Not material.	Not calculated
11. Use of sold products	Not material.	Not calculated
12. End-of-life treatment of sold products	Not applicable.	Not calculated
13. Downstream leased assets	Not applicable.	Not calculated
14. Franchises	Not applicable.	Not calculated
15. Investments	Not applicable.	Not calculated

To calculate scope 3 GHG emissions, the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011) has been consulted and the GHG Protocol Technical Guidance for Calculating Scope 3 Emissions (2013) referenced where required.

The two main methods of quantifying scope 3 GHG emissions are direct measurement and calculation. Direct measurement involves monitoring, mass balance or stoichiometry to quantify emissions, while calculation uses an emission factor and activity data to calculate emissions. Due to the difficulty in direct measurement the calculation method is typically used. The general formula for calculating emissions is outlined below:

$$GHG\ emissions = activity\ data \times emission\ factor$$

A variety of emission factor sources were used, including but not limited to:

- Australia DCCEEW's *National Greenhouse Accounts Factors* (NGA, 2023),
- UK Department for Business, Energy & Industrial Strategy's *Conversion Factors* (UK BEIS, 2023), and
- Various scientific studies.

When estimating the scope 3 emissions, fuel-based or goods and distance-based methods are considered the most appropriate. These methods involve tracking the quantity of fuel, or goods used and the distance they travel, respectively. However, in cases where the necessary data is not available, spend-data methods are used. Spend-data methods involve estimating scope 3 emissions based on the expenditure involved for a given activity. While spend-data methods may not be as accurate as fuel-based or goods and distance-based methods, they still provide a useful estimate for calculating scope 3 emissions when the required data is not available.

The methods selected for scope 3 emissions calculations are shown in Table 6.

Table 6 Calculation Methodologies for Scope 3 Categories

CATEGORY	CALCULATION METHODOLOGY	EXPLANATION
2. Capital goods	Goods-based	Industry average emission factors for the manufacture of wind turbines are applied to the total electricity generated over the life of the project.
3. Fuel and energy related activities	Fuel-based	Fuel and energy are aggregated by type (diesel, electricity, etc.), and industry average emission factors are applied.
5. Waste generated	Goods-based	Wind turbines are broken down into components that are disposed and components that are recycled, and industry average emission factors for disposal and recycling are applied. It is assumed that 80% of the turbine will be recycled.
7. Employee commuting	Distance-based	Industry average emission factors are applied to drive-in drive-out (DIDO) passenger kilometres.

2.4 Limitations and Exclusions

The following emissions sources have been excluded from the assessment as they were deemed either minor sources or no use was identified (exclusions from the scope 3 are outlined in Table 5):

- Oils and greases,
- Hydro fluorocarbons (HFCs), and
- Perfluorocarbons (PFCs),

Whilst the estimates in this assessment have been calculated using the best available information, it should be noted that potential for technology change (implementation of best available technology) and updates to costing over the life of the project may result in adjustments to emission estimates.

2.5 GHG Emissions Estimates

GHG emissions have been estimated for the Project activities over the expected life of the project. The key inputs used to calculate the GHG emissions are outlined in Table 7.

Table 7 Key Project Inputs

INPUT	VALUE (OVER LOP)
LOP - construction + operation + closure	Construction: 2 years (2026-2028) Operation: 30 years (2028-2057) Closure: 1 year (2057)
Total electricity generation	11,608,802 MWh
Total electricity consumption	26,718 MWh
Total diesel consumption	1,309 kL
Cleared area of native vegetation	2 ha

2.5.1 Scope 1 GHG Emissions Estimates

Fuel Consumption

The estimated scope 1 emissions for the Project are shown in Table 8. Emissions have been broken down into the construction phase and operation phase.

The average annual scope 1 emissions in the operation phase are 156 tCO_2e/year.

Table 8 Estimated Scope 1 GHG Emissions

PHASE	ACTIVITIES	EMISSIONS OVER LOP (tCO_2-e)	ANNUAL EMISSIONS (tCO_2-e)[1]
Construction	Construction diesel	2,937	N/A
	Transport diesel	240	N/A
	Land clearing	623	N/A
	Total	3,799	N/A
Operation	Maintenance diesel	614	20
	SF_6 leakage	4,078	136
	Total	4,693	156
Combined	Total	8,492	265

[1]Average operation emissions are calculated from 2028-2057. Average combined emissions are calculated from 2026 to 2057.

2.5.2 Scope 2 GHG Emissions Estimates

The estimated scope 2 emissions for the Project are shown in Table 9. Emissions have been broken down into the construction phase and operation phase.

The average annual scope 2 emissions in the operation phase are 134 tCO_2e/year.

Table 9 Estimated Scope 2 GHG Emissions

ACTIVITIES	EMISSIONS OVER LOP (tCO_2-e)	ANNUAL EMISSIONS (tCO_2-e)[1]
Construction	149	N/A
Operation	4,030	134
Combined	4,179	131

[1]Average operation emissions are calculated from 2028-2057. Average combined emissions are calculated from 2026 to 2057.

2.5.3 Scope 3 GHG Emissions Estimates

Four categories of scope 3 emissions are determined to be material for the GHG assessment, as specified in Section 2.3.3.

The estimated scope 3 emissions for the Project are shown in Table 10. Emissions have been broken down into the construction phase, operation phase, and closure phase.

Table 10 Estimated Scope 3 GHG Emissions

PHASE	CATEGORIES	EMISSIONS OVER LOP (tCO_2-e)	ANNUAL EMISSIONS (tCO_2-e)
Construction	2. Capital goods	98,270	N/A
	3. Fuel- and energy-related activities	737	N/A
	7. Employee commuting	952	N/A
	Total	99,958	N/A
Operation	3. Fuel- and energy-related activities	440	15
	7. Employee commuting	765	26
	Total	1,205	40
Closure	5. Waste generated	747	N/A
	Total	747	N/A
Combined	Total	101,911	2,380

[1]Average operation emissions are calculated from 2028-2057. Average combined emissions are calculated from 2026 to 2057.

2.6 GHG Emissions Trajectories

The following figures show the trajectory of emissions over the life of the project, including emissions from the construction, operation, and closure phases.

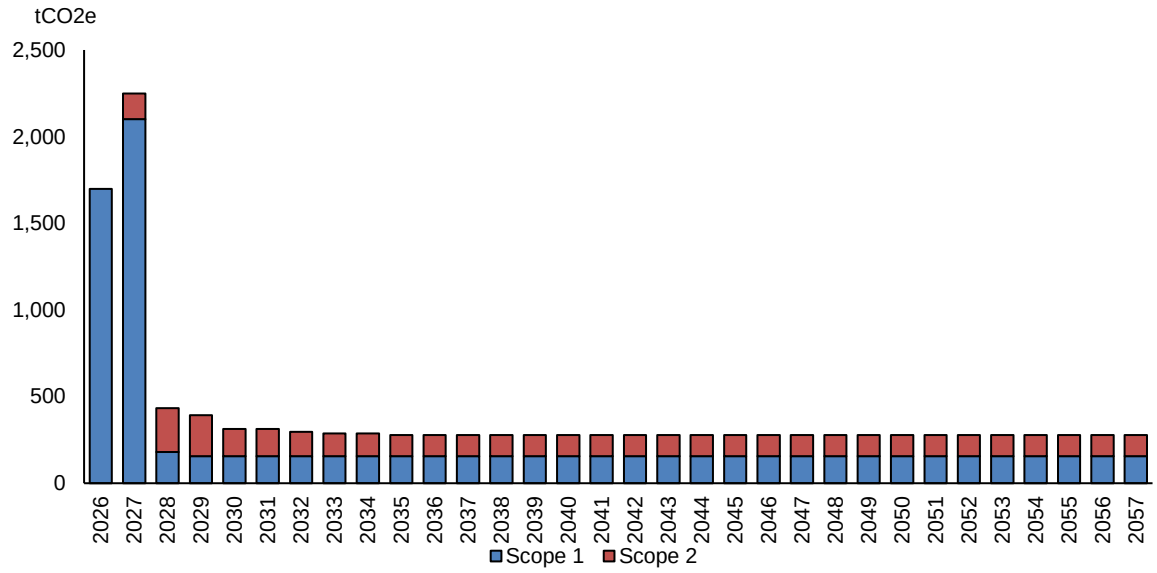

Figure 1 Estimated Scope 1 and 2 GHG Emissions Trajectory

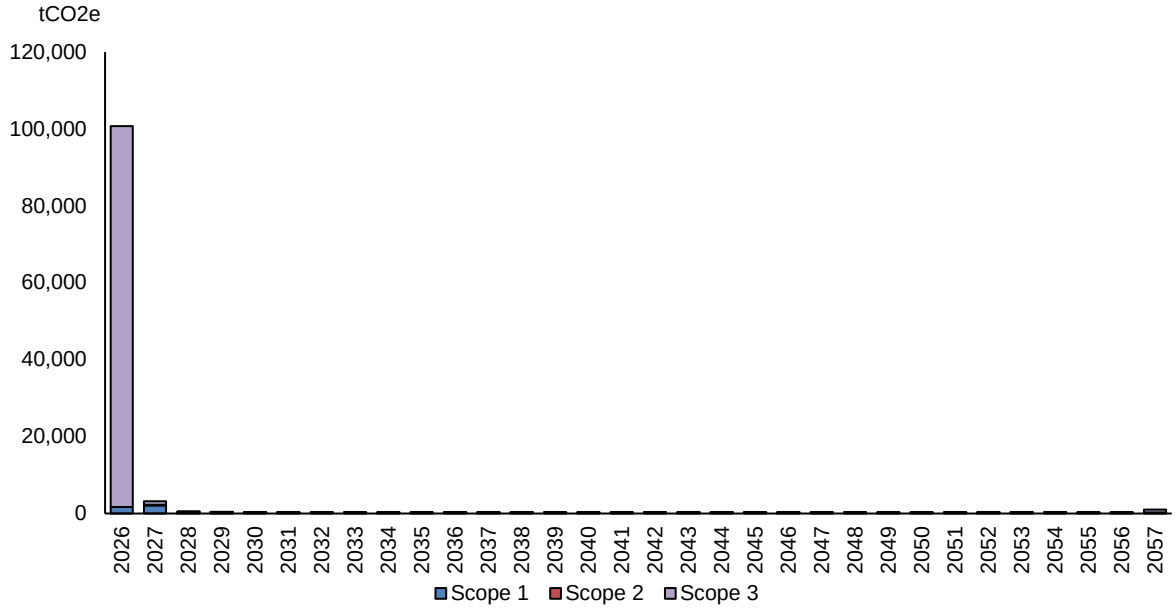

Figure 2 Estimated Scope 1, 2, and 3 GHG Emissions Trajectory

3 GHG Emissions Intensity and Benchmarking

The emissions intensity is estimated based on forecasted electricity generation.

$$emission\ intensity = \frac{GHG\ emissions}{electricity\ generated}$$

The scope 1 emissions intensity for the Proposal is estimated as 0.00073 tCO_2-e/MWh electricity generated, including emissions from construction. The average scope 1 and 2 emissions intensity is estimated as 0.00109 tCO_2-e/MWh, including emissions from construction. The average scope 1, 2, and 3 emissions intensity is estimated as 0.00987 tCO_2-e/MWh, including emissions from construction and closure.

The operational scope 1 and 2 emissions intensity of the Project, excluding emissions construction, is estimated as 0.00075 tCO_2-e/MWh. The operational emissions intensity is compared with other wind farms in Western Australia in Table 11. The emissions intensities for the wind farm are calculated from the published NGER electricity sector data for the 2022-23 financial year.

Table 11 GHG Emission Intensities Benchmark

PROJECT	ELECTRICITY GENERATION (MWh/year)	SCOPE 1 + 2 EMISSIONS (tCO_2-e/year)	EMISSIONS INTENSITY (tCO_2-e/MWh)
Badgingarra Wind Farm	444,705	195	0.00044
Yandin Wind Farm	772,393	568	0.00074
Scott River Wind Farm	**386,960**	**291**	**0.00075**
Emu Downs Wind Farm	239,254	179	0.00075
Albany Windfarm	85,783	69	0.00080
Mumbida Wind Farm	223,597	242	0.00108
Warradarge Wind Farm	582,602	665	0.00114
Collgar Wind Farm	669,912	1,240	0.00185
Alinta Wind Farm	266,793	636	0.00238

Appendix A Glossary

TERMS	DEFINITIONS
CER	Clean Energy Regulator
CH_4	Methane
CO_2	Carbon Dioxide
CO_2-e	Carbon dioxide equivalence, the amount of the gas multiplied by a value specified in the regulations in relation to that kind of greenhouse gas.
Determination	The NGER Determination 2008
Downstream emissions	Indirect GHG emissions related to sold goods and services
EPA	Western Australian Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
Facility	Is a single enterprise that undertakes an activity, or a series of activities that involve greenhouse gas emissions, the production of energy or the consumption of energy.
GHG	All greenhouse gases mentioned in the NGER Act
LOP	Life of Project
N_2O	Nitrous Oxide
NGER	National Greenhouse and Energy Reporting
NGER Act	The National Greenhouse and Energy Reporting Act 2007 as it applies to the current reporting year
Non-transport	Includes purposes for which fuel is combusted that do not involve transport energy purposes, see Sections 2.20, and 2.42 of the Determination.
Regulations	The NGER Regulations 2008
Scope 1	Emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility.
Scope 2	Emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility.
Scope 3	Indirect emissions of greenhouse gas, that are not included in scope 2, that occur in the value chain of the reporting company.
SF_6	Sulphur Hexafluoride – a gas used in switchgear and circuit breakers for insulation.
Transport	Includes purposes for which fuel is combusted for transport by vehicles registered for road use, rail transport, marine navigation, and air transport, see Sections 2.20, and 2.42 of the Determination
UNFCCC	United Nations Framework Convention on Climate Change
Upstream emissions	Indirect GHG emissions related to purchased or acquired goods and services

Appendix B Scope 3 Emission Categories and Relevancy

CATEGORY	DESCRIPTION
1. Purchased goods and services	All emissions from the production of products and services purchased or acquired by the reporting company in the reporting period. *Example: The emissions associated with the extraction, production and transportation (between suppliers) of copper that is purchased by the reporting company to create bronze.*
2. Capital goods	All upstream emissions from the production of capital goods purchased by the company in the reporting period. *Example: Emissions associated with the production of excavators used by the reporting company.*
3. Fuel- and energy-related activities (Not included in scope 1 or scope 2)	All emissions related to the production (extraction, processing, transport etc.) of fuel and energy purchased by the reporting company, that are not included in the company's scope 1 and scope 2 emissions. *Example: The emissions from extracting crude oil, processing it to form diesel and transporting it to a site run by the reporting company.*
4. Upstream transportation and distribution	All emissions resulting from the transportation and distribution of purchased products, between a company's tier 1 suppliers and its own operations, in vehicles not owned by the reporting company, as well as any third-party transportation and distribution services purchased by the reporting company between a company's own facilities. *Example: Emissions from transportation of purchased copper between the supplier and the reporting company's bronze manufactoring facility.*
5. Waste generated in operations	All emissions from third-party treatment and disposal of waste that is generated by the company in the reporting period. *Example: Waste sent from the reporting company's site facilities for recycling, disposal at landfills, incineration, composting, etc.*
6. Business travel	All emissions from the transportation of employees for business-related activities in vehicles owned or operated by third-parties. *Example: Flights to business conferences and meeting suppliers.*
7. Employee commuting	All emissions from the transportation of employees between their homes and worksites. *Examples: FIFO and DIDO to site.*
8. Upstream leased assets	All emissions from the operation of leased assets that are not included in the company's scope 1 and 2 emissions inventory. *Example: Emissions from leased cars, offices and buildings.*
9. Downstream transportation and distribution	All emissions from third-party transport and distribution of the company's sold products in the reporting period. *Example: Emissions from third-party marine transportation of iron ore sold by the reporting company to be processed by another company.*
10. Processing of sold products	All emissions from processing of sold intermediate products by third-parties, subsequent to the sale of the product by the reporting company. *Example: Emissions from processing of iron ore sold by the reporting company to create steel.*

11. Use of sold products	All emissions from the use of goods and services sold by the reporting company in the reporting period. *Example: Emissions from the combustion of diesel, produced by the reporting company, as fuel for cars.*
12. End-of-life treatment of sold products	All emissions from the waste disposal or treatment of products sold by the company in the reporting period, at the end of their life. *Example: Emissions from recycling of metal cans sold by the reporting company.*
13. Downstream leased assets	All emissions from the operation of assets owned by the company and leased to third-parties in the reporting period, if they are not included in the company's scope 1 and scope 2 emissions. *Example: Emissions from electricity used in offices/buildings leased by the reporting company to other operations.*
14. Franchises	All emissions from the operation of franchises, by franchisees, not included in the franchisor's scope 1 and scope 2 emissions. *Example: Emissions from operations associated with a company's trademark.*
15. Investments	All emissions associated with operating the reporting company's investments in the reporting period. *Example: Emissions associated with a mine a company has a financial investment in but not operational control.*

CRITERIA	DESCRIPTION
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 customer, 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.
Other	They meet any additional criteria for determining relevance developed by the company or industry sector.

Source: GHG Protocol (2011)

Appendix C References

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