

Griffin Energy

BLUEWATERS EXPANSION (Bluewaters 3 and 4)

Greenhouse Gas Emission

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1. Approach

The Greenhouse Gas Emission Inventory for the Bluewaters Project was estimated using relevant factors and methodologies based on the expected operations for each year of the life of the project.

In accordance with EPA Guidance Statement for Minimising Greenhouse Gas Emissions (No. 12 October 2002) it contains an estimate of the gross emissions of greenhouse gases that are likely to be emitted from the proposed project for each year of its operation in absolute and in carbon dioxide equivalent figures (CO₂-e), calculated in accordance with the methodologies outlined in the National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006, and its proxy the National Greenhouse Accounts (NGA) Factors, for the full life cycle emissions associated with this project.

In accordance with the NGGI and NGA Factors full life-cycle emissions for the project are characterised as Scope 1: Direct Combustion Emissions and Scope 3: Indirect Emissions associated with the mining and transport of power station fuel.

2. Project Lifecycle Greenhouse Gas Emissions Inventory

2.1 Direct Emissions (Scope 1)

2.1.1 Absolute Emissions

The principal greenhouse gases likely to be emitted during the operation of the Bluewaters Project are Carbon Dioxide (CO₂), Methane (CH₄) and Nitrous oxide (N₂O).

As presented in Table 1, it is estimated Bluewaters 3 and 4 will each emit approximately 1.54 Mt of CO₂, 15 t of CH₄, and 13 t of N₂O per year during their operational life without any additional mitigation measures. .

Based on the NGGI greenhouse gas accounting methodology the quantity of emissions of greenhouse gases other than CO₂ are not statistically or materially relevant in the case of the Bluewaters project, because they represent a very small proportion of the overall greenhouse emissions from the project.

Table 1: Summary of Absolute Emissions from Bluewaters Power Station (Per Stage per annum)

Bluewaters Power Station (Per Stage)/annum¹	
Bluewaters Power Station Capacity (MW)	208
Availability (%)	0.92
Production (MWh)	1,676,314
Average Efficiency of Power Station	36.40%
Power Station Fuel Input (GJ)	16,578,926
CO ₂ Emissions Factor (kg CO ₂ /GJ)	92.9
CH ₄ Emissions Factor (Mg CH ₄ /PJ)	0.9
N ₂ O Emissions Factor (Mg N ₂ O/PJ)	0.8
CO₂ Emissions (t CO₂)	1,539,552
CH₄ Emissions (t CH₄)	15
N₂O Emissions (t N₂O)	13
Total CO₂ Equivalents (Mt)	1.54

Notes

1) Emission factors sourced from NGGI Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks: Energy (Stationary sources) (2006).

2.1.2 CO₂ Equivalent Emissions

The equivalent CO₂ emissions (CO₂-e) are an appropriate measure of the total greenhouse gas emissions from direct combustion at the Bluewaters project. These equivalent emissions include the individual contributions of each absolute greenhouse gas recognised by the NGGI.

It is estimated Bluewaters 3 and 4 will each emit approximately 1.54 Mt of CO₂-e per annum during their operational life without any additional mitigation measures.

2.1.3 Commissioning Assumptions

This assessment of greenhouse gas emissions is based on the following commissioning assumptions:

- **Bluewaters 3:** Commissioning during 2012 with 4 months of normal full operation during August to December 2012 (33%). It is assumed that Bluewaters 3 will be fully operational between 2013 and 2042.
- **Bluewaters 4:** Commissioning during 2013, with 6 months of normal full operation during July to December 2013 (50%). It is assumed that Bluewaters 4 will be fully operational between 2014 and 2042.

2.1.4 Direct Emissions Calculations

Estimated total direct emissions per annum for the life of Bluewaters 3 and Bluewaters 4 are presented in Tables 2, 3 and 4 below.

Table 2: Summary of Direct GHG Emissions from Bluewaters 3 Unit on Average During Each Year over 30 Years

Bluewaters 3 Unit Direct Average GHG Emissions Each Year			
	2012	2013	2014 - 2042
Bluewaters 3 Power Station Capacity (MW)	208	208	208
Availability (%)	92	92	92
Production (MWh)	553,183	1,676,314	1,676,314
Average Efficiency of Power Station	36.4%	36.4%	36.4%
Power Station Fuel Input (GJ)	5,471,045	16,578,926	16,578,926
Equivalent Volume of Coal (t)	274,927	833,112	833,122
Scope 1 GHG Emissions Factor (kg CO ₂ -e/GJ)	93.1	93.1	93.1
Direct GHG Emissions (t CO ₂ -e)	509,512	1,543,977	1,543,977

Notes

Emission factors sourced from (a) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 Absolute Emission Factors for black coal electricity generators in Western Australia 2005-06 (kg CO₂/GJ, kg CH₄/GJ, kg N₂O/GJ) (b) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 oxidation factor for black coal electricity generators in Western Australia 2005-06 (c) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) direct emission factor (kg CO₂-e/GJ) and (d) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) indirect emission factor (kg CO₂-e/GJ).

Table 3: Summary of Direct GHG Emissions from Bluewaters 4 Unit on Average During Each Year over 30 Years

Bluewaters 4 Unit Direct Average GHG Emissions Each Year			
	2012	2013	2014 - 2042
Bluewaters 4 Power Station Capacity (MW)	0	208	208
Availability (%)	0	92	92
Production (MWh)	0	838,157	1,676,314
Average Efficiency of Power Station	0	36.4%	36.4%
Power Station Fuel Input (GJ)	0	8,289,463	16,578,926
Equivalent Volume of Coal (t)	0	416,556	833,112
Scope 1 GHG Emissions Factor (kg CO ₂ -e/GJ)	0	93.1	93.1
Direct GHG Emissions (t CO ₂ -e)	0	771,989	1,543,977

Notes

Emission factors sourced from (a) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 Absolute Emission Factors for black coal electricity generators in Western Australia 2005-06 (kg CO₂/GJ, kg CH₄/GJ, kg N₂O/GJ) (b) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 oxidation factor for black coal electricity generators in Western Australia 2005-06 (c) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) direct emission factor (kg CO₂-e/GJ) and (d) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) indirect emission factor (kg CO₂-e/GJ).

Table 4: Summary of Direct Cumulative GHG Emissions from Bluewaters 3 and 4 Units on Average During Each Year over 30 Years

Bluewaters 3 and 4 Units Direct Average GHG Emissions Each Year			
	2012	2013	2014 - 2042
Bluewaters 3 and 4 Power Stations Capacity (MW)	208	416	416
Production (MWh)	553,183	2,514,470	3,352,627
Power Stations Fuel Input (GJ)	5,471,045	24,868,389	33,157,851
Equivalent Volume of Coal (t)	274,927	1,249,668	1,666,224
Total Direct GHG Emissions (t CO ₂ -e)	522,096	2,514,470	3,164,217

Notes

Emission factors sourced from (a) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 Absolute Emission Factors for black coal electricity generators in Western Australia 2005-06 (kg CO₂/GJ, kg CH₄/GJ, kg N₂O/GJ) (b) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 oxidation factor for black coal electricity generators in Western Australia 2005-06 (c) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) direct emission factor (kg CO₂-e/GJ) and (d) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) indirect emission factor (kg CO₂-e/GJ).

The total direct GHG emissions from Bluewaters 3 and 4 over each year of plant operation for 30 years are shown in Figure 1.

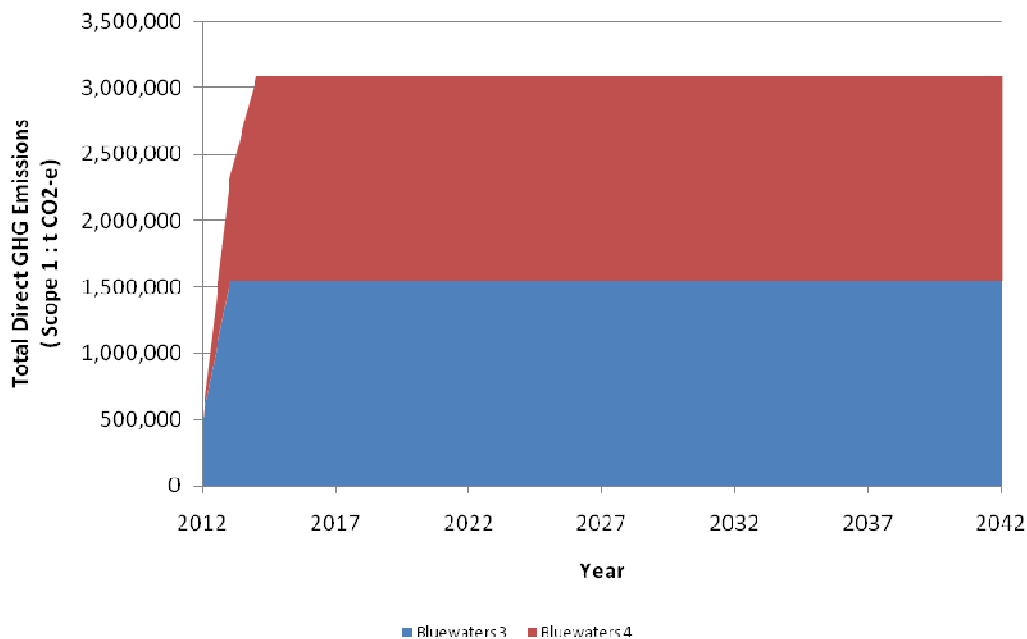


Figure 1: Summary of Total Direct GHG Emissions Each Year from Bluewaters 3 and 4

2.2 Indirect Emissions (Scope 3)

In accordance with EPA Guidance Statement No. 12 full lifecycle emissions for the Bluewaters project have been estimated. In the context of this project, these lifecycle emissions are characterised by Scope 3: Indirect Emissions associated with the extraction and transport of power station fuel, which are additional to the Scope 1 Direct emissions provided above.

As presented in Table 5, Bluewaters 3 and 4 will each be indirectly responsible for the Scope 3 emissions of approximately 38 kt of CO₂-e per year during their operational life without any additional mitigation measures.

Table 5: Summary of Scope 3 Average Annual Emissions from Bluewaters Power Station (Per Stage)

Bluewaters Power Station (Per Stage)/annum	
Bluewaters Power Station Capacity (MW)	208
Availability (%)	92
Production (MWh)	1,676,314
Average Efficiency of Power Station	36.40%
Power Station Fuel Input (GJ)	16,578,926
Equivalent Volume of Coal (t)	833,112
Indirect GHG Emissions – extraction and transport of coal (t CO ₂ -e)	38,132

Notes

Emission factors sourced from (a) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 Absolute Emission Factors for black coal electricity generators in Western Australia 2005-06 (kg CO₂/GJ, kg CH₄/GJ, kg N₂O/GJ) (b) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 oxidation factor for black coal electricity generators in Western Australia 2005-06 (c) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) direct emission factor (kg CO₂-e/GJ) and (d) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) indirect emission factor (kg CO₂-e/GJ).

The total indirect emissions per annum for the life of Bluewaters 3 and Bluewaters 4 are presented in Tables 6, 7 and 8 below.

Table 6: Summary of Average Annual Scope 3 GHG Emissions from Bluewaters 3 Unit During Each Year of Life over 30 Years

Bluewaters 3 Unit Indirect Average Emissions Each Year			
	2012	2013	2014 - 2042
Bluewaters 3 Power Station Capacity (MW)	208	208	208
Availability (%)	92	92	92
Production (MWh)	553,183	1,676,314	1,676,314
Average Efficiency of Power Station	36.4%	36.4%	36.4%
Power Station Fuel Input (GJ)	5,471,045	16,578,926	16,578,926
Equivalent Volume of Coal (t)	274,927	833,112	833,112
Scope 3 GHG Emissions Factor (kg CO ₂ -e/GJ)	2.3	2.3	2.3
Indirect GHG Emissions (t CO ₂ -e)	12,583	38,132	38,132

Notes

Emission factors sourced from (a) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 Absolute Emission Factors for black coal electricity generators in Western Australia 2005-06 (kg CO₂/GJ, kg CH₄/GJ, kg N₂O/GJ) (b) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 oxidation factor for black coal electricity generators in Western Australia 2005-06 (c) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) direct emission factor (kg CO₂-e/GJ) and (d) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) indirect emission factor (kg CO₂-e/GJ).

Table 7: Summary of Average Annual Scope 3 GHG Emissions from Bluewaters 4 Unit During Each Year of Life over 30 Years

Bluewaters 4 Unit Indirect Average Emissions Each Year			
	2012	2013	2014 - 2042
Bluewaters 4 Power Station Capacity (MW)	0	208	208
Availability (%)	0	92	92
Production (MWh)	0	838,157	1,676,314
Average Efficiency of Power Station	0	36.4%	36.4%
Power Station Fuel Input (GJ)	0	8,289,463	16,578,926
Equivalent Volume of Coal (t)	0	416,556	833,112
Scope 3 GHG Emissions Factor (kg CO ₂ -e/GJ)	0	2.3	2.3
Indirect GHG Emissions (t CO ₂ -e)	0	19,066	38,132

Notes

Emission factors sourced from (a) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 Absolute Emission Factors for black coal electricity generators in Western Australia 2005-06 (kg CO₂/GJ, kg CH₄/GJ, kg N₂O/GJ) (b) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 oxidation factor for black coal electricity generators in Western Australia 2005-06 (c) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) direct emission factor (kg CO₂-e/GJ) and (d) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) indirect emission factor (kg CO₂-e/GJ).

Table 8: Summary of Average Annual Scope 3 Cumulative GHG Emissions from Bluewaters 3 and 4 Units During Each Year of Life over 30 Years

Bluewaters 3 and 4 Units Average Indirect Emissions Each Year			
	2012	2013	2014 - 2042
Bluewaters 3 and 4 Power Stations Capacity (MW)	208	416	416
Production (MWh)	553,183	2,514,470	3,352,627
Power Stations Fuel Input (GJ)	5,471,045	24,868,389	33,157,851
Equivalent Volume of Coal (t)	274,927	1,249,668	1,666,224
Total Indirect GHG Emissions (t CO ₂ -e)	12,583	57,197	76,263

Notes

Emission factors sourced from (a) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 Absolute Emission Factors for black coal electricity generators in Western Australia 2005-06 (kg CO₂/GJ, kg CH₄/GJ, kg N₂O/GJ) (b) National Greenhouse Gas Inventory Committee (NGGI) Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 oxidation factor for black coal electricity generators in Western Australia 2005-06 (c) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) direct emission factor (kg CO₂-e/GJ) and (d) National Greenhouse Accounts (NGA) Factors (2008) black coal for electricity (Western Australia) indirect emission factor (kg CO₂-e/GJ).

The total indirect GHG emissions from Bluewaters 3 and 4 over each year of plant operation for 30 years are shown in Figure 2.

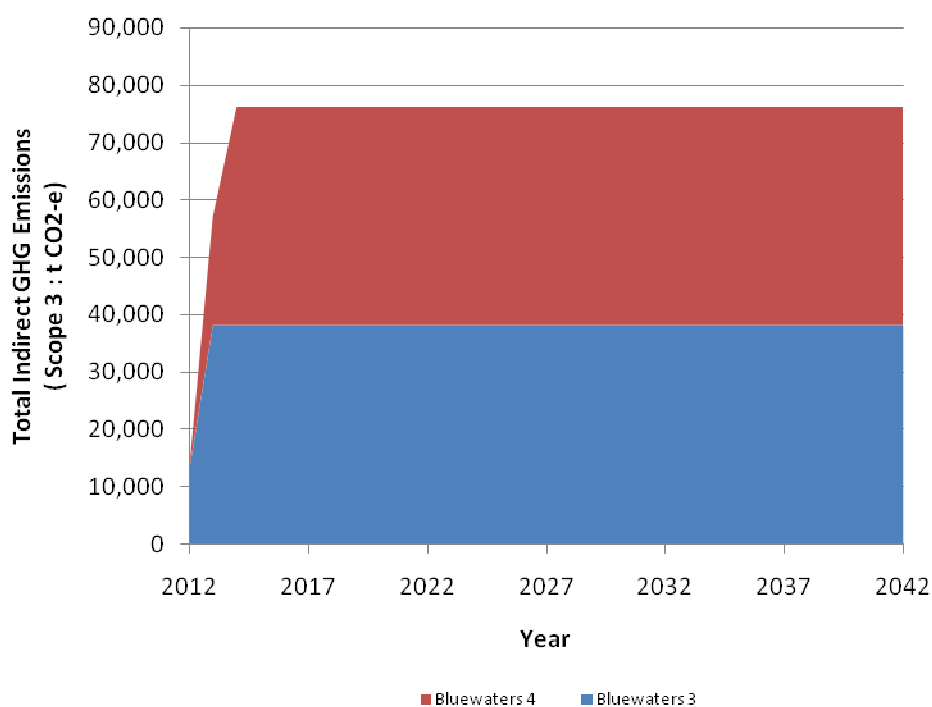


Figure 2: Summary of Total Indirect GHG Emissions Each Year from Bluewaters 3 and 4

2.3 Total Equivalent Lifecycle Emissions

As presented in Table 9, the total equivalent lifecycle emissions for the Bluewaters project are estimated to be approximately 3.16 Mt of CO₂-e per year during the operational life without any additional mitigation measures.

Table 9: Summary of Total Direct and Indirect Average GHG Emissions from Bluewaters 3 and 4 Units During Each Year over 30 Years

Bluewaters 3 and 4 Units Total Direct and Indirect Average GHG Emissions Each Year			
	2012	2013	2014 - 2042
Bluewaters 3 and 4 Power Stations Capacity (MW)	208	416	416
Production (MWh)	553,183	2,514,470	3,352,627
Power Stations Fuel Input (GJ)	5,471,045	24,868,389	33,157,851
Scope 1 Direct Emissions (t CO ₂ -e)	509,512	2,315,966	3,087,954
Scope 3 Indirect Emissions (t CO ₂ -e)	12,583	57,197	76,263
Total CO ₂ Equivalent GHG Emissions (t CO ₂ -e)	522,096	2,373,163	3,164,217

The total indirect and direct GHG emissions from Bluewaters 3 and 4 over each year of plant operation for 30 years are shown in Figure 3.

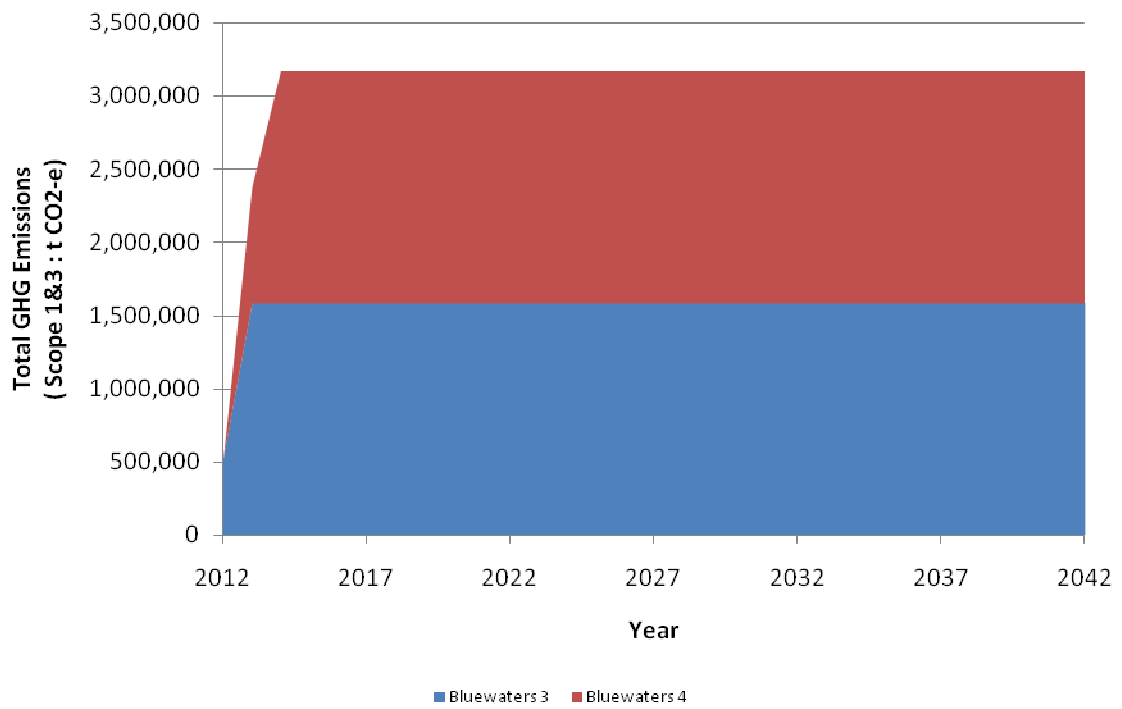


Figure 3: Summary of Total Equivalent GHG Emissions Each Year from Bluewaters 3 and 4

3. Greenhouse Gas Intensity of Project

In the context of the Bluewaters project the greenhouse gas intensity of the project is calculated as the direct equivalent greenhouse gas emissions (1,543,977 t CO₂-e) divided by the sent out electricity (1,676,314 MWh).

The carbon intensity of power generated by Bluewaters 3 and Bluewaters 4 has been calculated at 921 kg CO₂-e/MWh sent out.