Greenhouse Gas Assessment

10.1 Introduction

This chapter presents an assessment of the potential greenhouse gas emissions associated with the Simandou Mine and evaluates the significance of these in comparison to total greenhouse gas emissions from Guinea. Greenhouse gas emissions are of concern because of their contribution to global climate change. A combined assessment of the overall Simandou Project including the Mine, Railway and Port has been undertaken and the findings presented in this chapter draw from the Project-wide assessment of emissions. The overall Project assessment will be presented in Volume IV of the SEIA Report.

Greenhouse gas emissions will arise from various sources: principally the use of fossil fuels to generate electricity and power diesel fuelled vehicles and equipment, and from clearance of vegetation from the mine site. Clearance of vegetation will contribute to emissions through the release of the organic carbon from vegetation into the atmosphere. Release of carbon from land clearance will be countered to some extent by uptake of carbon from the atmosphere during revegetation of land through site rehabilitation and this is also taken into account in the assessment.

This chapter quantifies the estimated emissions of greenhouse gases from these sources over the Project lifetime, evaluates these against the background of other greenhouse gas emissions arising in Guinea, and outlines a range of measures which will be implemented to reduce emissions.

The remainder of this chapter is organised as follows:

- Section 10.2 Approach;
- Section 10.3 Baseline Greenhouse Gas Emissions in Guinea;
- Section 10.4 Assessment of Project Emissions;
- Section 10.5 Mitigation of Greenhouse Gas Emissions; and
- Section 10.6 Summary of Findings.

10.2 Approach

10.2.1 Study Area

The study area for the assessment is defined according to international guidance on greenhouse gas reporting provided by the World Business Council for Sustainable Development and the World Resources Institute Greenhouse Gas Reporting Protocol (1). This establishes standard methods for the accounting and reporting of six greenhouse gases covered by the Kyoto Protocol: carbon dioxide (CO₂); methane (CH₄); nitrous oxide (N₂O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF₆). It categorises emissions within three system boundaries, described as Scope 1, Scope 2 and Scope 3:

- Scope 1 describes 'direct' greenhouse gas emissions from sources that are owned by or under the direct control of the reporting entity;
- Scope 2 describes 'indirect' greenhouse gas emissions associated with the Project but occurring at sources owned or controlled by another organisation and therefore not under the direct control of the reporting entity; and
- Scope 3 describes wider greenhouse gas emissions occurring upstream and downstream of the reporting entity and typically associated with the 'life cycle' of its product. Scope 3 emissions are not under the direct control of the reporting entity.

The reporting entity may be a company or organisation, a product or, as in this case, a project.

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(1) Available at www.ghgprotocol.org
Rio Tinto internal guidance on greenhouse and energy reporting (1) further defines sources to be included in Scope 1 and 2 as follows.

- **Scope 1 emissions.** Direct greenhouse gas emissions that are owned or controlled by the company including fuel use, on-site electricity generation, process emissions, land management and on-site livestock emissions.

- **Scope 2 emissions.** Emissions from imports of electricity, heat or steam from third parties (indirect emissions).

The sources of emissions associated with the Simandou Project and its product are illustrated in Figure 10.1. These comprise Scope 1 and 3 emissions only. There are no Scope 2 emissions associated with the project as there will be no imports of electricity, heat or steam from third parties. All electricity for the Project will be generated on site and resulting emissions will therefore be Scope 1 emissions owned or controlled by the Project.

Scope 3 emissions are not covered by this assessment as they relate to upstream supply of equipment and materials for construction and operation and downstream transport, processing and use of the iron ore produced by the Project. These activities are outside of the scope of the SEIA. In line with the guidance set out in IFC Performance Standard 3, and consistent with other guidance and standards referenced in Section 10.2.2, accounting for these activities is outside of the scope of the SEIA. As a result, the SEIA focuses on Scope 1 emissions from the project (coloured green in Figure 10.1).

Figure 10.1 Project Greenhouse Gas Emissions Sources Categorised by Scope

(1) Rio Tinto (2010); Guidance for the 2010 Greenhouse and Energy Workbook
10.2.2 Legal and Other Requirements

10.2.2.1 National Legislation

There is no specific legislation in force in Guinea relating to the control of greenhouse gas emissions. However, Guinea is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) (1) and is a ‘non Annex 1’ party to the Convention. Non-Annex 1 Parties are mostly developing countries. Certain groups of developing countries are recognised by the Convention as being especially vulnerable to the adverse impacts of climate change, including countries with low-lying coastal areas and those prone to desertification and drought. Other countries that rely heavily on income from fossil fuel production and associated commerce are more vulnerable to the potential economic impacts of climate change response measures. The Convention emphasises activities that address the special needs and concerns of these vulnerable countries, such as investment, insurance and technology transfer (2).

10.2.2.2 International Guidance and Standards

The following international guidelines are relevant to the approach adopted for calculating greenhouse gas emissions, as described further below.

- World Business Council for Sustainable Development (WBCSD) / World Resources Institute (WRI) Greenhouse Gas Protocol (see Section 10.2.1).

- IFC Performance Standard 3: Resource Efficiency and Pollution Prevention.

- IFC General EHS Guidelines.

- IFC EHS Guidelines for Mining.

10.2.2.3 Rio Tinto Environment Standards

The following Rio Tinto corporate guidance and standards have also been referenced in undertaking the assessment:

- Rio Tinto Environment Standard E4: Greenhouse Gas Emissions;

- Rio Tinto Greenhouse Gas Emissions Standard E4: Guidance Note September 2011; and


10.2.3 Methodology for Quantification of Greenhouse Gas Emissions

IFC Performance Standard 3: Resource Efficiency and Pollution Prevention requires greenhouse gas emissions from developments supported by IFC to be estimated for all projects that are expected to generate emissions of more than 25 000 tonnes per year. This must include all significant sources of greenhouse gas emissions, project-induced changes in soil carbon content or above ground biomass, and off-site generation by a third party of electricity, heating and cooling energy used in the project. The quantification, monitoring and reporting of GHG emissions is also required under Rio Tinto Environment Standard E4: Greenhouse Gas Emissions.

This chapter presents the results of that assessment carried out following the internationally accepted approach set out in the WBCSD/WRI Greenhouse Gas Protocol. Detailed guidance on calculation of greenhouse gas emissions from Rio Tinto activities is provided in the Rio Tinto Workbook. This is designed to ensure the collection of consistent inventories of greenhouse gas emissions and energy usage across

(1) Available at http://unfccc.int/2860.php
(2) Available at http://unfccc.int/parties_and_observers/items/2704.php
Rio Tinto operations and is consistent with the WBCSD/WRI approach. The emissions factors used in the assessment are taken from the Rio Tinto Workbook.

The scope of the assessment includes all greenhouse gases and these are represented as CO₂ equivalents (CO₂e), using Global Warming Potential (GWP) factors consistent with reporting under the Kyoto Protocol and the second assessment report of the Intergovernmental Panel on Climate Change (IPCC) \(^{(1)}\). The assessment period covers the construction and operation of the mine, assumed for the purposes of this assessment to be 44 years (5 years construction and 40 years operation with one year of overlap), plus a further 24 years after mine closure for decommissioning, site rehabilitation and regrowth of vegetation, making a total Project lifetime of 68 years to 2079. It should be noted that in practice the mine could continue in operation for more than 40 years possibly extending to 45 – 50 years, but 40 years is taken as the base case for the assessment.

Input data for the calculation of emissions were derived from Project engineering data on quantities and types of fuels consumed for construction and operation. Emissions from land use changes during clearance of land for construction and rehabilitation of land on mine closure were calculated using land cover data presented in Chapter 19: Land Use and Land-Based Livelihoods.

10.3 Baseline Emissions in Guinea

Baseline data on greenhouse gas emissions from Guinea have been derived from data reported under the United Nations Framework Convention on Climate Change (UNFCCC). The most recently reported data are presented in the Initial Communication of Guinea to the UNFCCC \(^{(2)}\). This document, published in 2002, uses a baseline profile developed for 1994, and indicates that total emissions of greenhouse gases in Guinea in 1994 were estimated at 14 266 kilo tonnes of carbon dioxide equivalent (ktCO₂e) per annum. Net removals due to forestry and land use activities were estimated at 17 598 ktCO₂e per annum.

The document states that, on average, the annual increase in greenhouse gas emissions of developing countries was approximately 3.85% over the previous decades. Applying this growth rate, the document estimates, as a ‘reference scenario’, a steady increase in national emissions to approximately 26 100 ktCO₂e in 2010 (or approximately 2.3 tonnes CO₂e per inhabitant per year \(^{(3)}\)). It projects emissions forward to 2025, by which time the ‘reference scenario’ projects national emissions of approximately 46 000 ktCO₂e per annum (based on an increased population of approximately 17.3 million inhabitants and per capita emissions of approximately 2.65 tonnes CO₂e per inhabitant per year.

If this estimated rate of growth in Guinea’s emissions were to persist over the lifetime of the Project, emissions by Year 44 (the assumed year of mine closure) would be approximately 143 000 ktCO₂e pa and by year 68 (the end of the period of vegetation regrowth after closure) would be approximately 354 000 ktCO₂e pa. In reality, it is likely that various measures to limit emissions would be implemented in Guinea over the lifetime of the Project. Some mitigation options (such as introduction of Liquid Petroleum Gas and biogas for domestic energy in place of charcoal, introduction of solar photovoltaic systems, and various afforestation and reforestation options) are considered in the Initial Communication of Guinea to the UNFCCC. These and other measures would have the effect of reducing the growth in Guinea’s national emissions over the lifetime of the Project. However, since the analysis of these options in the Initial Communication is fairly limited, and since this document puts forward no plan for their likely implementation in Guinea, it is considered appropriate to apply the reference scenario.

10.4 Assessment of Project Emissions

The analysis of emissions from the Simandou Mine has been undertaken on the basis of the Project phases presented in Table 10.1.

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\(^{(2)}\) Ministry of Mining, Geology and Environment (Republic of Guinea, 2002). Available at http://unfccc.int/resource/docs/natc/guinc1.pdf

\(^{(3)}\) For comparison greenhouse gas emissions in the European Union are of the order of 10 tCO₂e per capita pa. Available at http://www.eea.europa.eu/publications/ghg-trends-and-projections-2011
Table 10.1 Assumed Project Phases

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Years</th>
<th>Number of years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction and early operations</td>
<td>Year 1-3</td>
<td>3</td>
</tr>
<tr>
<td>Completion of construction (Year 4) and operation – Ouéléba pit</td>
<td>Year 4-43</td>
<td>40</td>
</tr>
<tr>
<td>Operation – Pic de Fon pit</td>
<td>Year 5-28</td>
<td>24</td>
</tr>
<tr>
<td>Decommissioning and start of rehabilitation</td>
<td>Year 44-46</td>
<td>3</td>
</tr>
<tr>
<td>Rehabilitation (re-vegetation)</td>
<td>Year 47-68</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total Number of Years</strong></td>
<td></td>
<td>68</td>
</tr>
</tbody>
</table>

Note: Operational life is assumed to commence with early mining operations in 2013 (Year 2) with operation of both pits overlapping with end of construction to 2016. Full operations are assumed to continue for 24 years for Pic de Fon and 40 years for Ouéléba. In practice actual periods will vary from and are likely to be longer than the assumed life.

Key input parameters assumed for the assessment are noted below.

- Fuel consumption during construction includes diesel used in on-site construction equipment and vehicles, transport of construction materials, aviation fuel for local and international flights, and fuel consumed in operation of construction camps. The estimate for construction of the mine is based on estimates for the whole Simandou Project assuming one third of the total is expended on each component (mine, rail and port) apart from the construction and operation of temporary camps where one sixth of the total is allocated to the mine (the majority of camps will be located along the railway).

- A low level of mining activity is assumed to start during construction with the ore produced used to test and commission the mine plant.

- Fuel consumption during operation includes diesel fuel used in power generation, heavy mobile equipment (HME) and other plant and vehicles, and aviation fuel for local and international flights.

- The emissions from land clearance during construction are estimated on the basis that 3 750 ha of the total area of 6 460 ha occupied by the mine is cleared of vegetation during the construction period and the rate of clearance the construction years is in proportion to the level of plant and vehicle activity. This area comprises the area occupied by the mine pits, waste emplacements, roads, conveyors, mine plant, stockyard, accommodation camp and other ancillary infrastructure plus a construction area extending 100m outside the immediate footprint of these facilities. The mix of land use types in this area comprises 49% grassland, 35% woodland and scrub, 15% forest and 1% bare or built land. In practice some clearance will extend into the operational period but total emissions from this source will remain the same. Greenhouse gas release rates from vegetation clearance are taken from the Rio Tinto Workbook.

- Data are not available at this time on likely energy use during closure and decommissioning and it has therefore been assumed that annual fuel consumption during dismantling and removal of all facilities will require 50% of the average annual fuel used during construction.

- The uptake of carbon during rehabilitation is estimated assuming that 2 118 ha of land will be revegetated and that this will take place after completion of all mining, comprising 49% woodland and scrub, 39% grassland and 12% forest. It is assumed that the extent of revegetation within the pit areas will be minimal. Active carbon uptake is assumed to continue for 2 years for grassland, 10 years for scrub and 22.5 years for forest, as specified in the Rio Tinto Workbook. Uptake rates for each type of vegetation are taken from the Rio Tinto Workbook.

The predicted greenhouse gas emissions over the lifetime of the mine are presented in Figure 10.2 and the breakdowns by phase and source are presented in Table 10.2 and Table 10.3, respectively.
Table 10.2 Greenhouse Gas Emissions from the Simandou Mine – by Project Phase

<table>
<thead>
<tr>
<th>Project Years</th>
<th>Project Phase</th>
<th>GHG emissions by phase (ktCO₂e)</th>
<th>Average annual emissions (ktCO₂e pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years 1 to 3</td>
<td>Construction and Early Operation</td>
<td>909</td>
<td>6.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>303</td>
</tr>
<tr>
<td>Years 4 to 43</td>
<td>Late Construction and Full Operation</td>
<td>13 844</td>
<td>92.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>346</td>
</tr>
<tr>
<td>Years 44 to 46</td>
<td>Decommissioning</td>
<td>252</td>
<td>1.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>84</td>
</tr>
<tr>
<td>Years 47 to 68</td>
<td>Rehabilitation</td>
<td>-34</td>
<td>-0.2%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>14 971</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 10.3 Greenhouse Gas emissions from the Simandou Mine – by Emissions Source

<table>
<thead>
<tr>
<th>Emissions Source</th>
<th>GHG Emissions per Emissions Source (ktCO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction &amp; Early Operation: Power generation</td>
<td>9</td>
</tr>
<tr>
<td>Construction &amp; Early Operation: Plant &amp; vehicles</td>
<td>389</td>
</tr>
<tr>
<td>Construction &amp; Early Operation: Land clearance</td>
<td>656</td>
</tr>
<tr>
<td>Full Operation: Power generation</td>
<td>5 782</td>
</tr>
<tr>
<td>Full Operation: Plant &amp; vehicles</td>
<td>8 036</td>
</tr>
<tr>
<td>Decommissioning: Plant &amp; vehicles</td>
<td>135</td>
</tr>
<tr>
<td>Rehabilitation: Land clearance</td>
<td>-37</td>
</tr>
<tr>
<td>Total</td>
<td>14 971</td>
</tr>
</tbody>
</table>

The total lifetime direct emissions contribution from the Simandou Mine is estimated to be 14 971 ktCO₂e. The mine will produce a total of approximately 2.9 million tonnes of iron ore product over its lifetime giving an estimated 0.005 tCO₂e per tonne of ore mined (note this excludes railway and port operations).

The rate of emissions will be highest during the years of full operation when the mine will contribute approximately 0.5% of Guinea’s total emissions over the 40 year operating period. Annual emissions will vary from 640 kt per year at maximum production reducing down to about 150 kt at the end of operations. This will constitute about 1 to 2% of Guinea’s project emissions during the early years, reducing to less than 0.5% towards the end of mining when production is declining and Guinea’s national emissions have increased.

Emissions during construction will be lower ranging from 89 to 550 kt, but still constitute up to about 2% of national emissions in the busiest year. During the years of decommissioning emissions will run at about 60 to 120 kt per year constituting less than 0.1% of national emissions. There will be a small but continuing flow of carbon uptake during site rehabilitation running at about 1 kt per year for about 20 years.

Operation of the mine dominates the overall emissions making up 93% of total emissions, with construction making up 6% and decommissioning only 1%. Combustion of fuel for mobile plant and power generation makes up 96% of these emissions with 4% arising from the balance of land clearance and re-vegetation.
Figure 10.2 Predicted Annual Contribution of Greenhouse Gas Emissions from the Mine (kt CO₂e)

- Electricity Generation
- Diesel Plant and Vehicles
- Land Clearance
- Land Rehabilitation
10.5 Mitigation of Greenhouse Gas Emissions

Greenhouse gas emissions over the lifetime of the mine are predominantly from the combustion of diesel fuel in heavy mobile equipment and vehicles (57%) and power generation (39%). Reduction in diesel consumption and resulting GHG emissions will therefore be the key focus for mitigation measures at the mine. Minimising fuel consumption is an economic and well as an environmental driver for the Project and a number of good practice measures to achieve this are already accounted for in the base case from which the emissions calculations are derived. These measures include the following.

The Project will seek to maximise fuel use efficiency in heavy mobile equipment and vehicles at the mine by implementing a number of good practice measures including the following:

- in-pit primary crushers and conveyor loading points will be located to minimise haulage distances and maximise the benefits of gravity in movement of material;
- uphill movements will be avoided as far as possible;
- mineral waste management will be managed to minimise haulage quantities and distances including use of in-pit disposal as soon as possible during mining life;
- optimising ore and waste handling processes to minimise the need for multiple handling;
- vehicle and equipment movements will be scheduled to minimise idle time and distances travelled;
- vehicles and equipment will be selected to be as fuel-efficient as possible taking into account potential challenges in maintenance and replacement given the remoteness of the site; and
- a central control system for dispatch of equipment will be operated in order to eliminate unnecessary use and fuel consumption.

The Project will seek to reduce power consumption and resulting greenhouse gas emissions at the mine by implementing a number of good practice measures including:

- the number of transfer points on conveyors and idler spacing will be optimised and low loss idlers will be used on longer conveyor runs;
- variable voltage, variable frequency drives and regenerative motors will be used on downhill conveyors to generate power for use at the mine;
- the design and operation of dewatering and pumping systems will be optimised to minimise energy use for water management, including covering bunded areas to minimise water ingress, correct sizing of pumps, avoiding sharp bends in pipework, installation of variable frequency drives and power factor correction;
- the main mine header tank will be located uphill to reduce pumping requirements; and
- dust suppression systems will be designed so that they can be turned off when not needed to minimise the need for pumping water.

The Project will minimise greenhouse gas emissions from changes in land cover and land use by:

- keeping land clearance during construction to the minimum necessary for the works;
- rehabilitating cleared areas as soon as possible after completion of construction;
undertaking progressive rehabilitation of land during operations so that land is revegetated as soon as possible after mining and waste disposal operations are completed; and

working in partnership with other stakeholders to undertake forest restoration in the Pic de Fon Classified Forest and elsewhere.

In addition to these measures, Rio Tinto’s Greenhouse Gas Emissions Standard E4 will require the Project to achieve continuous improvement in greenhouse gas emissions. This will be accomplished by identifying sources, evaluating and prioritising them according to significance, and then designing and implementing a Greenhouse Gas and Energy Efficiency Action Plan containing the appropriate control, reduction and mitigation measures. This plan will be kept up to date as business needs and external requirements change and as there is technological advancement and progress in emission and energy efficiency management over the lifetime of the operation. As part of this process the Project will:

- set progressive improvement targets for greenhouse gas emissions;
- include a plan for measuring and reporting of greenhouse gas emissions against these targets;
- define clear responsibilities and accountabilities for GHG emission and energy efficiency management;
- include a plan for reducing emissions by energy efficient design, use of alternate sources of energy and development of step change technologies; and
- ensure a secure and cost-efficient electricity supply by undertaking analysis of technology and supply options.

The Project will continually seek opportunities to reduce further greenhouse gas emissions during on-going design in order to meet improvement targets.

10.6 Summary of Findings

An analysis of the greenhouse gas implications of the Simandou Mine has been undertaken for the Project lifetime in line with internationally accepted greenhouse gas accounting protocols and Rio Tinto policies and standards. The results are compared with Guinea’s own national greenhouse gas emissions, as reported to the UNFCCC.

The Simandou Mine is estimated to generate of the order of 15 million tonnes of CO₂ equivalent over the 68 years of construction, operation and closure, or approximately 0.5% of Guinea’s emissions over the same period. At its peak it is predicted to contribute about 5% of Guinea’s annual emissions

92% of emissions will arise from use of fuel for mining, ore handling and power generation during operations, about 4% from fuel use during construction and decommissioning, and the balance from the net effect of land clearance during construction and revegetation during site rehabilitation.

The Project will adopt a range of good practices in energy management to minimise its use of fuel and resulting greenhouse gas emissions. In addition it will develop a Greenhouse Gas Emissions Reduction and Energy Efficiency Action Plan which will establish targets for reducing emissions over time, and set out the actions the Project proposes to take to meet these targets and a plan for monitoring and reporting against them. This plan will be updated as business needs and external requirements change and as there is technological advancement and progress in emission and energy efficiency management over the lifetime of the operation.