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DEPARTMENT OF STATE DEVELOPMENT

Abbot Point Growth Gateway Project

Greenhouse Gas Assessment

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PROJECT 301001-01956 - ABBOT POINT GROWTH GATEWAY PROJECT

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ABBREVIATIONS AND ACRONYMS

Abbreviation/ Acronym	Description
CH_4	Methane
CIA	(Abbot Point) Cumulative Impact Assessment
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_{2-e}	CO2-equivalent
CoP	Conference of Parties
CSD	Cutter Suction Dredger
DMCPs	Dredge Material Containment Ponds (includes Primary and Secondary DMCPs)
EIS	Environmental Impact Statement
GHG	Greenhouse Gas
ha	Hectare
HFC	Hydrofluorocarbons
INDC	Intended Nationally Determined Contributions
Km	Kilometre
LLDPE	Linear low density polyethylene
Mm^3	Million cubic meters
Mt	Million tonnes
Mtpa	Million tonnes per annum
NGA	National Greenhouse Accounts
NGBR Project	North Galilee Basin Rail Project
NGER	National Greenhouse and Energy Reporting
NO_x	Oxides of nitrogen
PM_{10}	Particulate matter 10 micrometres or less in diameter
$PM_{2.5}$	Particulate matter 2.5 micrometres or less in diameter

Abbreviation/ Acronym	Description
SEVT	Semi-Evergreen Vine Thicket
SF_6	Sulphur hexafluoride
SO_2	Sulphur Dioxide
T0	Terminal 0 – coal terminal developed by Adani at Abbot Point
T2	Terminal 2 – coal terminal to be developed at Abbot Point
SDA	State Development Area
SEIS	Supplementary Environmental Impact Statement
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile Organic Compound

1 INTRODUCTION

The proposed Abbot Point Growth Gateway Project (the APGG Project or the Project) will be developed to support development of Terminal 0 (T0). Dredging of berth pockets and arrival/departure apron is required to provide safe shipping access to the T0 offshore facility.

The APGG Project involves:

- Construction of onshore dredged material containment ponds (DMCPs) within the area previously allocated for the development of Terminal 2 (T2) and adjoining industrial land
- Capital dredging of approximately 1.1 million m^3 (Mm^3) *in situ* volume of previously undisturbed seabed for new berth pockets and ship apron areas required to support the development of T0
- Relocation of the dredged material to the DMCPs and offshore discharge of return water
- Ongoing management of the dredged material including its removal, treatment, and beneficial reuse within the port area and the State Development Area (SDA), where appropriate.

1.1 Scope of the assessment

Section 3.10 of the APGG Project EIS Guidelines details the level of assessment required for the greenhouse gas (GHG) assessment of the Project:

"The EIS is to outline the cumulative direct and indirect greenhouse gas emissions of the proposed action. An inventory of the projected greenhouse gas emissions associated with the proposed action is to be provided. This inventory should include, for context, an outline of total global greenhouse gas emissions."

This technical report is prepared in accordance with this requirement. Table 1-1 outlines the structure of the report.

Table 1-1 Section summary

Section	Description
Section 1	Section 1 provides the scope and the legislative framework for the greenhouse gas assessment.
Section 2	Section 2 defines the greenhouse gas accounting methodology for the Project including the boundary, the definition of 'direct' and 'indirect' emissions and emissions scopes.
Section 3	Section 3 details the assumptions and calculations of the greenhouse gas emissions from key APGG project activities.
Section 4	Section 4 provides the summary of the projected APGG Project greenhouse gas emissions.
Section 5	Section 5 provides the summary of the greenhouse gas emissions from related Australian Adani projects.
Section 6	Section 6 provides the comparison of the APGG Project and related projects' emissions in the context of total global greenhouse gas emissions.
Section 7	Section 7 provides a summary of the recommended mitigation measures for the APGG Project.
Section 8	References used to support the preparation of this report.

The scope of this assessment is focused on key project activities including the construction of the DMCP, the dredging and placement activities and ongoing storage and decommissioning. GHG emissions associated with reuse of the dredged material for beneficial purposes are considered as part of future coal terminal development and are not included within the scope of this assessment.

This assessment did not attempt to develop a lifecycle GHG footprint associated with the coal produced onshore and exported through the Abbot Point T0 project, which would involve a calculation of cradle-to-grave (coal mining to combustion) emissions. However, it is recognised that this Project is a part of the supply chain for the final use of coal exported through the terminal. In order to gain a general understanding of the relatedAustralian jurisdiction GHG emissions associated with coal mining, transport to Abbot Point, and loading onto the ships at the Abbot Point), the report endeavored to collate the GHG emissions from the Environmental Impact Statements (EIS) and Supplementary Environmental Impact Statements (SEIS) for the following projects:

- NGBR project
- Adani Abbot Point T0 project
- Carmichael Coal Mine and Rail Infrastructure project (emissions associated with the rail component only includes from the Carmichael mine to where the rail connects to NGBR, which is approximately half of the total distance of the original Carmichael rail proposal).

Additionally, GHG emissions associated with the combustion of coal that will be exported through T0 are estimated and put into the global context for comparison.

1.2 Legislative framework

GHG emissions are covered by a number of legislative and policy requirements at the Federal level, as well as international protocols to which Australia is signatory. These include:

- *United Nations Framework Convention on Climate Change* (UNFCCC) – Ninety nine countries, including all major economies, have made pledges to the UNFCCC to reduce or limit greenhouse gas emissions by 2020.
- *Kyoto Protocol* – Kyoto Protocol is an international agreement linked to the UNFCCC, which commits its parties by setting internationally binding emission reduction targets. The Australian Government is a signatory to the Kyoto Protocol and as such, has greenhouse gas stabilisation and reporting commitments. The Australian Government has committed to the Kyoto Protocol second commitment period of 2013 to 2020 and the 2020 target of five percent below 2000 levels. The greenhouse gases reportable under the *Kyoto Protocol* are:
  - Carbon dioxide, CO_2
  - Methane, CH_4
  - Nitrous oxide, N_2O
  - Hydrofluorocarbons (HFCs)
  - Perfluorocarbons
  - Sulphur hexafluoride, SF_6.
- *National Greenhouse and Energy Reporting Act 2007* (NGER Act) – NGER scheme applies to facilities that emit over 25,000t CO_2-e per year, consume more than 100TJ of energy for corporations that emit over 50,000t CO_2-e per year or consume more than 200TJ of energy from their combined facilities. These thresholds relate to Scope 1 and Scope 2 emissions.

2 GREENHOUSE GAS ACCOUNTING METHODOLOGY

2.1 Principles for accounting and reporting

The GHG inventory assessment was performed based on the principles outlined in the *Greenhouse Gas Protocol* (WRI, 2004) and the methodologies provided by the Australian Government's *National Greenhouse and Energy Reporting (Measurement) Determination 2008*, 1 July 2014 version.

The guiding principles for compiling a GHG inventory are:

- Relevance
- Completeness
- Consistency
- Transparency
- Accuracy.

2.2 Emissions Assessment

The APGG Project emissions are considered to include emissions from:

- Construction of onshore DMCPs
- Dredging of previously undisturbed seabed for new berth pockets and ship apron areas required to support the development of T0
- Relocation of the dredged material to the DMCPs and offshore discharge of return water
- Ongoing management and removal of the dredged material.

GHG emissions from related projects as discussed in Section 1.1 are included and collated from the EIS and SEIS for those projects.

2.3 GHG considered

Of the six *Kyoto Protocol* greenhouse gases described in Section1.2, only CO_2, CH_4 and N_2O are considered relevant to the APGG Project, with CO_2 being the most relevant gas. All results are reported in units of tonnes CO_2-equivalent (t CO_2-e).

2.4 Emissions scope

Within the reporting boundary, there are two types of emissions:

- Direct GHG emissions – emissions from sources that are owned or controlled by the Project
- Indirect GHG emissions – emissions that are a consequence of the activities of the Project, but occur at sources owned or controlled by other parties.

To help delineate direct and indirect emission sources, three scopes are defined for GHG accounting and reporting purposes:

- **Scope 1: Direct GHG emissions**, which occur from sources that are owned or controlled by the Project; for example, emissions from combustion of purchased fuel, fugitive emissions of GHGs for site equipment or vegetation clearance.
- **Scope 2: Electricity indirect GHG emissions**, which arise from the generation of purchased electricity consumed by the Project. Scope 2 emissions physically occur at the facility where electricity is generated. For the APGG Project, the majority of emissions are considered to arise from fuel combustion and vegetation removal. Electricity consumption is estimated to arise from the use of the site office(s).
- **Scope 3: Other indirect emissions**. Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the Project, but occur from sources not owned or controlled by the Project. Examples of Scope 3 activities are extraction and production of purchased materials, transportation of purchased fuels and use of sold products and services. For the APGG Project, the following Scope 3 indirect emissions are voluntarily included:
  - Extraction, production and transport of fossil fuels consumed
  - Extraction, production and transportation of fuels consumed in the generation of electricity
  - Embodied emissions in key construction material
  - Road transport of construction and equipment material, and construction crew between the camp and the APGG Project sites.

This assessment outlines the cumulative direct and indirect greenhouse gas emissions in relation to the key project activities as defined above and summarised in Table 2-1. In reference to the EIS guidelines, the term 'cumulative' as used in this report is defined as the summation of direct and indirect emissions as defined above.

Table 2-1 Key APGG Project activities and sources of GHG

Key APGG Project Activities	Emissions Scope	Sources
Vegetation clearance	Scope 1 (direct)	Vegetation clearance for DMCP
Construction of DMCPs	Scope 1 (direct)	Diesel fuel consumption in construction machinery and equipment.
	Scope 3 (indirect)	Extraction, production and transport of fossil fuels.
Dredging and placement	Scope 1 (direct)	Diesel and heavy fuel oil consumption in dredging and ancillary equipment
	Scope 3 (indirect)	Extraction, production and transport of fossil fuels.
Lighting	Scope 1 (direct)	Diesel fuel consumption in lighting towers
	Scope 3 (indirect)	Extraction, production and transport of fossil fuels.
Storage and decommissioning	Scope 1 (direct)	Diesel fuel consumption in construction machinery and equipment.
	Scope 3 (indirect)	Extraction, production and transport of fossil fuels.
Electricity consumption at the site office(s)	Scope 2 (indirect)	Electricity consumption in site office(s).
	Scope 3 (indirect)	Extraction, production and transportation of fuels consumed in the generation of electricity.
Construction material	Scope 3 (indirect)	Material embodied energy
Road transport	Scope 3 (indirect)	Transport of construction and equipment material. Transport of construction crew from the camp to project sites.

2.5 Calculation method

Sources (Table 2-1) are quantified in terms of quantities of fuels, and area of vegetation cleared. These quantities are multiplied by the appropriate emission factors to generate GHG emission quantities. Emission factors were sourced from National Greenhouse Accounts (NGA) factors and previous reports.

There are a range of uncertainties associated with the assessment. Uncertainty is usually caused by the application of non-representative factors or methods, and incomplete data available on emission sources. The calculation included in this assessment was based on the best project information available at the time.

3 EMISSIONS SUMMARY OF THE APGG PROJECT

3.1 Vegetation clearance

Vegetation clearance results in GHG emissions due to the release of stored carbon from the cleared vegetation, which depends on the type and density of the vegetation. It is estimated that approximately 75ha will be cleared for the DMCP. This area comprises of approximately 51ha of grass/weeds and 24ha of woodland (ELA, 2015). Vegetation clearing for pipeline alignment is estimated to be minor (<1ha) and is therefore excluded from the assessment.

It was assumed that the average amount of carbon released per hectare was identical to the vegetation clearance for the Abbot Point Multi Cargo Facility (GHD, 2009a), which was 227t CO_2-e/ha. It is assumed that all carbon from the above-ground vegetation, roots and soil carbon pools would be removed by the Project and would not regrow following construction.

GHG emissions associated with vegetation clearance are listed in Table 3-1.

Table 3-1 Vegetation clearance project emissions

Scope	Source	Activity	Project Emissions	Unit
Scope 1	Vegetation clearance	DMCP	16,927	t CO2-e

3.2 Construction of DMCPs

During construction of the DMCPs, GHG emissions will arise from fuel consumption for earthmoving and other equipment, both mobile and stationary. Calculations for emissions during this phase of project activities were based on the following assumptions:

- The construction of the embankments will be carried out by sourcing materials predominantly from the internal borrow.
- The maximum unsuitable material that will need to be cut to internal stockpile is approximately 510,000m^3. Unsuitable material may be required to be cut from stockpile either to allow access to additional suitable material or to form a suitable pond floor within limited steps and low areas. The estimated double-handled amount of unsuitable is estimated to be approximately 400,000m^3.
- The total volume to be cut, placed and compacted to form the embankments is approximately 690,000m^3.
- The construction methodology includes site preparation, internal and external embankment construction, containment liner installation and access roads, spillway,

stormwater diversion drains and fence installation. The preliminary list of equipment considered is:

- 15 x Cat 637 scrapers or equivalent
- 8 x 40kL water trucks or equivalent
- 4 Cat 825 compactors or equivalent
- 2 x 18t pad foot drum rollers
- 2 x Cat 14H grader or equivalent
- 1 x tractor with laser bucket
- 2 x 45t dump trucks
- 1 x Cat 965 front end loader or equivalent
- 2 x 32t excavators
- 1 x 45t excavator
- 4 x D9 dozer or equivalent (a D10 or bigger dozer might be required in case hard clay requires ripping)
- 2 x 12t smooth drum rollers
- Specialised liner equipment such as wedge welding machines (up to eight), extrusion welding guns (up to six), leister guns, wheel mounted generators, etc.
- 2 x 4 t tele-handlers

- As specific details regarding equipment models and hours operated were not available, the amount of fuel used to construct the embankments is assumed to be 6L of diesel per m^3 of material moved (GHD, 2010)
- Emissions factors used are shown in Appendix 1.

GHG emissions associated with construction of DMCPs are listed in Table 3-2.

Table 3-2 Construction of DMCPs - project emissions

Scope	Source	Activity	Project Emissions	Unit
Scope 1	Diesel	Earthmoving equipment	25,902	t CO2-e
Scope 3	Diesel	Earthmoving equipment	1,964	t CO2-e
Scope 1, 3 Total			**27,866**	**t CO2-e**

3.3 Dredging and placement

GHG emissions are associated with dredging of the seabed and placement of the dredged material within the DMCP. Dredging will be required for the berth pockets and departure apron for T0. The current estimate is that 1.1Mm^3 of material will be relocated to the DMCP (Royal HaskoningDHV, 2015). Diesel fuel and heavy fuel oil will be used to power the dredge, booster pump and ancillary equipment. It has been assumed that the type of dredge to be used is a medium size Cutter Suction Dredge (CSD). At this stage the exact type and size is unknown.

Assumptions:

- The CSD has an average dredge rate of 815m^3/h. This is averaged from 650m^3/h for the apron and 925m^3/h for the berth working 16 hours per day, 13 days per fortnight for 13 weeks (Royal HaskoningDHV, 2015). Installed power is assumed to be 6,000kW and fuel consumption is 208 grams of heavy fuel oil per kWh (GHD, 2009b). If another type of dredger is used, it is considered that the dredging duration will change according to the installed power. The associated GHG emissions are assumed to be similar.
- The booster pump needs to be running when the CSD operates. Installed power is assumed to be 6,000kW and fuel consumption is the same as the CSD (208 grams of heavy fuel oil per kWh).
- One workboat will operate 20% of the hours of the CSD. Fuel consumption is 50L/h (GHD, 2009).
- One bulldozer will be operating for 16 hours per day that the CSD operates. Fuel consumption is 65L/h (GHD, 2009).
- Emissions factors used are shown in Appendix 1.

Based on these assumptions, Project-related emissions for dredging and placement are shown in Table 3-3.

Table 3-3 Dredging and onshore placement - project emissions

Scope	Source	Activity	Project Emissions	Unit
Scope 1	Heavy fuel oil	Dredge, booster pump	12,018	t CO2-e
Scope 1	Diesel	Workboat, dozer	274	t CO2-e
Scope 1 Sub Total			**12,292**	**t CO2-e**
Scope 3	Heavy fuel oil	Dredge, booster pump	866	t CO2-e
Scope 3	Diesel	Workboat, dozer	21	t CO2-e
Scope 3 Sub Total			**887**	**t CO2-e**
Scope 1, 3 Total			**13,178**	**t CO2-e**

3.4 Lighting

GHG emissions for the Project will include those which arise from lighting for dredging activities and DMCP construction. Actual lighting requirements will be dependent on the type and extent of works that would occur at night time, and this will be largely dependent on program constraints or determined by the construction contractor.

The estimates are based on the following assumptions:

- Light towers equivalent to AL™6-6000 (Genie, a Terex brand) will be used. Each light tower contains 4 x 1500W metal halide lamps. Diesel consumption is approximately 2.3 L/h (Genie Light Towers specifications).
- For DMCP construction:
  - Construction period is assumed to be four months
  - Night work is assumed to be 12 hours per day
  - Primary night works, including embankment construction and liner installation, require approximately 10 lighting towers
  - Another 10 lighting towers will be required for lighting the perimeter of the embankments at key points (corners etc.) and work fronts (e.g. fencing, spillway construction).
- For dredging and placement:
  - Dredging duration is assumed to be three months
  - Night work is assumed to be 12 hours per day during the DMCP construction period

- Pipe fabrication and installation requires approximately 13 lighting towers for pipe stacking yard, pipe welding station and onshore locations where they are connecting the onshore dredge and return water pipes together
- Dredging activities will require approximately 17 lighting towers for the dredged material discharge point, pump-out station and perimeter of the embankments at key points.

- The emission factor for diesel is shown in Appendix 1.

Exclusion:

- Lighting at the site office(s) is assumed to be supplied by grid electricity and estimated in Section 3.6.

Based on these assumptions, Project-related emissions for dredging and placement are shown in Table 3-4.

Table 3-4 Lighting emissions

Scope	Source	Activity	Project Emissions	Unit
Scope 1	Diesel	Lighting	364	t CO2-e
Scope 3	Diesel	Lighting	28	t CO2-e
Scope 1, 3 Total			**392**	**t CO2-e**

3.5 Storage and decommissioning

GHG emissions arising from the post dredging phase include diesel used for embankment decommissioning and dredged material movement (i.e. loading for beneficial reuse). It should be noted that the transport away from the DMCP and beneficial reuse of material is outside of the Project scope. The GHG emissions were calculated based on the following assumptions:

- The volumes of material required to be loaded and transported off-site for beneficial reuse were estimated to be 1.1Mm^3. It is considered that the dredged material will lose moisture during storage. To be conservative, no reduction in volume is assumed.
- The embankment will be completely decommissioned. The embankment volume is estimated to be 690,000m^3.
- The amount of fuel used to load the material for off-site beneficial reuse is 6L of diesel per m^3 of material moved (GHD, 2010).
- The emission factor for diesel is shown in Appendix 1.

Based on these assumptions, Project-related emissions for storage and decommissioning are shown in Table 3-5.

Table 3-5 Storage and decommissioning emissions

Scope	Source	Activity	Project Emissions	Unit
Scope 1	Diesel	Earthmoving equipment	28,978	t CO2-e
Scope 3	Diesel	Earthmoving equipment	2,197	t CO2-e
Scope 1, 3 Total			31,175	**t CO2-e**

3.6 Electricity Consumption at the Site Office(s)

GHG emissions will include those arising from electricity consumption at the site office(s). This will include the electricity consumption required by air conditioning, office equipment (e.g. computers, printers, copiers), kitchen equipment (e.g. fridge, kettle), and lighting.

The GHG emissions were calculated based on the following assumptions:

- Site office(s) will be sized to cater for an average of 20 people
- Total site office area required including crib room is assumed to be 280 m^2
- Site office(s) are assumed to be operational for one year
- Energy content for grid electricity is assumed to be 3.6MJ/kWh
- Electricity required for the site office(s) is assumed to be equivalent to Australian average energy intensity for office tenancies at 377 MJ/m^2 per year. (COAG, 2012)
- Emission factors for grid electricity are shown in Appendix 1.
- Grid electricity will be available.

Based on these assumptions, the emissions associated with consumption of the grid electricity are shown in Table 3-7.

Table 3-6 Storage and decommissioning emissions

Scope	Source	Activity	Project Emissions	Unit
Scope 2	Electricity	Site office(s)	24	t CO2-e
Scope 3	Electricity	Site office(s)	4	t CO2-e
Scope 2, 3 Total			28	**t CO2-e**

3.7 Construction material

GHG emissions arise from embodied emissions associated with construction materials for the steel pipeline to transport material from the dredge to the storage area, as well as from the cement to build the embankment for the DMCPs. Embodied emissions include all emissions associated with the fabrication of a product from the acquisition of natural resources to delivery, including mining, manufacturing of materials and transport. It does not include direct emissions from the use of the material. The steel pipeline and cement are considered the key construction materials for the Project.

The GHG emissions were calculated based on the following assumptions:

- Dredge pipe:
  - 1 x 1,000mm O.D with 25mm wall thickness steep pipe
  - Total offshore and onshore pipeline length is estimated to be 4.4km
- Return water pipe:
  - 1 x 1,000mm O.D. x 16mm wall thickness steel pipe
  - Total offshore and onshore pipeline length is estimated to be 4.0km
- Density of the steel pipe is estimated to be 7.85t/m^3
- Approximately 1,500m^3 of cement is required
- Density of the cement is estimated to be 1.1t/m^3
- Embodied emission factors for steel pipe and cement are shown in Appendix 1.

Exclusions:

- Embodied emissions from other construction material are excluded due to lack of data. The impact of this exclusion is estimated to be insignificant.

Based on these assumptions, the embodied emissions associated with the construction material are shown in Table 3-7.

Table 3-7 Storage and decommissioning emissions

Scope	Source	Activity	Project Emissions	Unit
Scope 3	Embodied	Steel pipe	11,286	t CO2-e
Scope 3	Embodied	Cement	1,370	t CO2-e
Scope 3 Total			11,286	**t CO2-e**

3.8 Road transport

GHG emissions arise from diesel fuel used for:

- Mobilisation/demobilisation of plant items required for embankment construction
- Importation of crushed rock and riprap from the Abbot Point Deco Quarry located on Abbot Point Road approximately 5km from the DMCP site
- Delivery of dredging pipelines
- Delivery of construction materials (fencing, liner, cement, gypsum)
- Movement of the construction workforce
- Servicing of the site.

This information has been sourced from the APGG Project Road Transport Impact Assessment (WorleyParsons, 2015). The following assumptions are made:

- Construction water is imported from the Abbot Point Deco Quarry with 100ML of water required for construction of the DMCPs. The water would be transported in 40,000kL water trucks.
- No bulk earthworks will be imported or spoiled from the pond site.
- 1,485,000m^3 of linear low-density polyethylene (LLDPE) liner will be transported to the site.
- 4,500m of permanent security fencing will be transported to site.
- 500m^3 of riprap and 1,500m^3 of crushed rock will be transported to the site from the Deco Quarry.
- 500t of gypsum will be transported to the site.
- 1,500m^3 of cement will be transported to the site.
- 8,400m of dredging pipeline will be delivered to site in 12m lengths.
- The construction workforce will consist of 25 persons in project and quality management, 35 persons to operate/maintain machinery, and 30 persons to form the liner crews. It has been assumed light vehicles will be used for the transportation of these workers.
- Dredges will be launched and serviced from Bowen.
- Workforce transfers to/from dredges will be via Bowen.
- All material and equipment transport will be via semi-trailer. Total travel of 343,326km is estimated.
- It is estimated that a total of 440,400km will be travelled by light vehicles (diesel).

- An emission factor of 11.4L of diesel per 100km for light vehicles and 28.0L per 100km for semi-trailers has been assumed (ABS, 2010).

Exclusion:

- Rail and air transport is considered minor and has thus been excluded from the assessment.

Based on these assumptions, Project-related emissions for road transport are shown in Table 3-8.

Table 3-8 Road transport emissions

Scope	Source	Activity	Project Emissions	Unit
Scope 3	Diesel	Road transport	425	t CO2-e

4 GHG INVENTORY AND EMISSIONS SUMMARY

The results of the GHG inventory for Project-related emissions are shown in Table 4-1.

Table 4-1 Project-related emissions

Scope	Source	Emissions	Unit
Scope 1	Vegetation clearance	16,927	t CO2-e
Scope 1	DMCP construction	25,902	t CO2-e
Scope 1	Dredging and placement	12,292	t CO2-e
Scope 1	Lighting	364	t CO2-e
Scope 1	Storage and decommissioning	28,978	t CO2-e
Scope 1 Total		**84,464**	**t CO2-e**
Scope 2	Electricity at site office(s)	24	t CO2-e
Scope 2 Total		**24**	**t CO2-e**
Scope 3	Embodied emissions	12,656	t CO2-e
Scope 3	Road transport	425	t CO2-e
Scope 3	DMCP construction	1,964	t CO2-e
Scope 3	Dredging and placement	887	t CO2-e
Scope 3	Lighting	28	t CO2-e
Scope 3	Storage and decommissioning	2,197	t CO2-e
Scope 3	Electricity at site office(s)	4	t CO2-e
Scope 3 Total		**18,160**	**t CO2-e**
Scope 1, 3 Total		**102,647**	**t CO2-e**

Scope 1 emissions account for approximately 82% of the total Project emissions. The key sources are from earthworks associated with DMCP construction and decommissioning. Scope 2 emissions are minimal and Scope 3 emissions represent approximately 18% of the total Project emissions. The emissions breakdown is shown in Figure 4-1.

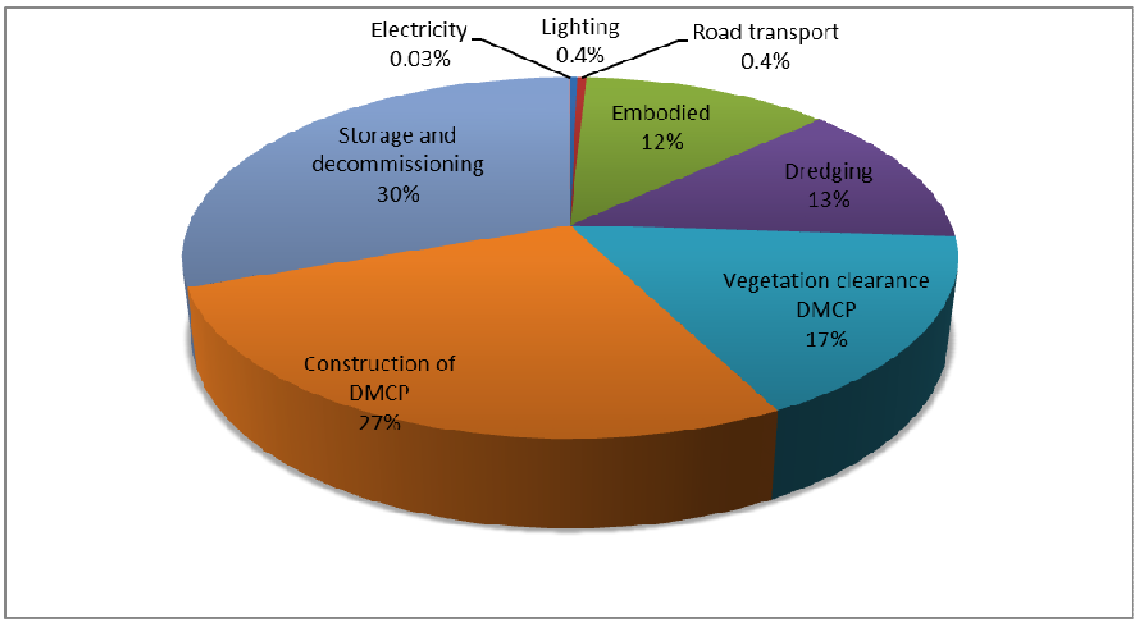

Figure 4-1 Emissions breakdown by key activity

5 ASSOCIATED GREENHOUSE GAS EMISSIONS

This assessment did not attempt to develop a lifecycle GHG footprint associated with the coal produced onshore and exported through the Abbot Point T0 project, which would involve a calculation of cradle-to-grave (coal mining to combustion) emissions. However, it is recognised that this Project is a part of the supply chain for the final use of coal exported through the terminal. In order to gain a general understanding of the related Australian jurisdiction GHG emissions associated with coal mining, transport to Abbot Point, and loading onto the ships at the Abbot Point), the report endeavored to collate the GHG emissions from the Environmental Impact Statements (EIS) and Supplementary Environmental Impact Statements (SEIS) for the following projects:

- NGBR project
- Adani Abbot Point T0 project
- Carmichael Coal Mine and Rail Infrastructure project (emissions associated with the rail component only include from the Carmichael Coal Mine to where the rail connects to NGBR, which is approximately half of the total distance of the Carmichael rail).

These projects are briefly described and the Scope 1 and Scope 2 emissions associated with the construction and operation of the projects are summarised in this section. No review of the completeness or accuracy of these has been undertaken.

5.1 Carmichael Coal Mine and Rail project

The Carmichael Coal Mine and Rail Infrastructure project, proposed by Adani (Adani Mining Pty Ltd) will develop an open-cut and underground coal mine, 189km rail link and associated infrastructure approximately 160km north-west of Clermont in central Queensland. Adani developed an EIS for the project (GHD, 2012) and supplementary information to the EIS (GHD, 2013a), which was approved under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC 2010/5736) on 24 July 2014.

Emission sources include:

- Electricity consumed by mining operations and infrastructure at the mine site
- Diesel fuel consumed by mining operations and other vehicles
- Fugitive emissions from the coal mine
- Use of explosives
- Wastewater handling

- Vegetation clearing for the mine and half of the rail corridor – NGBR is assumed to be connected in the half way point of the Carmichael original rail project
- Diesel fuel consumed by locomotives to haul the coal to approximately the point where NGBR starts – west of the Gregory Development Road (assumed to be half of the total distance of the Carmichael rail).

The summary of Scope 1 and Scope 2 operational emissions is shown in Table 5-1.

Table 5-1 - Carmichael project emissions*

Scope	Type	Emissions	Unit	Reference
Mine				
Scope 1	Direct	621,313	t CO2-e / year	(GHD, 2013a)
Scope 2	Indirect	818,885	t CO2-e / year	(GHD, 2013a)
Annual sub-total		1,440,198	t CO2-e / year	(GHD, 2013a)
Sub-total - 60 year life span		**86,411,880**	**t CO2-e / year**	
Rail (includes the rail component from the mine to where the rail connects to NGBR, which is approximately half of the total distance of the Carmichael rail.)				
Scope 1	Direct	320,260	t CO2-e / year	(GHD, 2012)
Scope 2	Indirect	-	t CO2-e / year	(GHD, 2012)
Annual sub-total		320,260	t CO2-e / year	(GHD, 2012)
Sub-total - 60 year life span		**19,215,606**	**t CO2-e / year**	(GHD, 2012)
Mine and Rail				
Scope 1	Direct	**941,573**	t CO2-e / year	
Scope 2	Indirect	**818,885**	t CO2-e / year	
Annual sub-total		**1,760,458**	t CO2-e / year	
Sub-total - 60 year life span		**105,627,486**	**t CO2-e / year**	

* The EIS (GHD, 2012) and SEIS (GHG, 2013a) combined the construction emissions into the annual operational emissions quoted in the table.

5.2 North Galilee Basin Rail project

The NGBR project proposed by Adani (Adani Mining Pty Ltd) includes the construction and operation of a rail corridor of approximately 310km in length, including standard gauge rail and associated infrastructure, from approximately 70km east of Adani's proposed

Carmichael Mine, to the Port of Abbot Point. Adani developed an EIS for the project and additional information to the EIS, which was approved with conditions under the EPBC Act (EPBC 2013/6885) on 23 September 2014.

The GHG emissions for the NGBR project (GHD, 2013b) were calculated based on the following key sources:

- Diesel consumption for general construction equipment and rail haulage
- Electricity consumption for maintenance yard and signaling/communications equipment
- Vegetation clearing for the rail corridor.

The estimated emissions for this project are summarised in Table 5-2.

Table 5-2 NGBR project emissions

Scope	Type	Emissions	Unit	Reference
Construction				
Scope 1	Direct	1,070,284	t CO2-e	(GHD, 2013b)
Scope 2	Indirect	-	t CO2-e	(GHD, 2013b)
Operation				
Scope 1	Direct	639,160	t CO2-e / year	(GHD, 2013b)
Scope 2	Indirect	143,664	t CO2-e / year	(GHD, 2013b)
Annual sub-total		782,824	t CO2-e / year	(GHD, 2013b)
Sub-total - 60 year life span		**46,969,428**	**t CO2-e / year**	
Total (adjusted to combine construction and operation)*				
Scope 1	Direct	**656,998**	t CO2-e / year	
Scope 2	Indirect	**143,664**	t CO2-e / year	
Annual sub-total		**800,662**	t CO2-e / year	
Sub-total - 60 year life span		**48,039,712**	**t CO2-e / year**	

* Construction emissions are allocated over 60 years to be incorporated with the operational emissions to show average annual emissions for the NGBR project.

5.3 Abbot Point T0 project

The Abbot Point Coal Terminal 0 project, proposed by Adani (Adani Abbot Point Terminal Pty Ltd) will provide a new stand-alone coal export facility at the Port of Abbot Point for

export of up to 70Mtpa of coal.. Adani developed an EIS for the project (CDM Smith, 2013) which was approved with conditions under the EPBC Act (2011/6194) on 10 December 2013.

Key emissions sources include:

- Vegetation clearing for the terminal
- Electricity consumed by coal handling, support equipment, and general management activities
- Diesel fuel consumed by construction and operational equipment.

The summary of the emissions is shown in Table 5-3.

Table 5-3 Abbot Point T0 emissions

Scope	Type	Emissions	Unit	Reference
Construction				
Scope 1	Direct	67,000	t CO2-e	(CDM Smith, 2013)
Scope 2	Indirect	-	t CO2-e	(CDM Smith, 2013)
Operation				
Scope 1	Direct	900	t CO2-e / year	(CDM Smith, 2013)
Scope 2	Indirect	22,600	t CO2-e / year	(CDM Smith, 2013)
Annual sub-total		23,500	t CO2-e / year	(CDM Smith, 2013)
Sub-total - 60 year life span		**1,477,000**	**t CO2-e / year**	
Total (adjusted to combine construction and operation)*				
Scope 1	Direct	**2,017**	t CO2-e / year	
Scope 2	Indirect	**22,600**	t CO2-e / year	
Annual sub-total		**24,617**	t CO2-e / year	
Sub-total - 60 year life span		**1,477,000**	**t CO2-e / year**	

* Construction emissions are allocated over 60 years to be incorporated with the operational emissions to show average annual emissions for the T0 project.

5.4 Emissions summary of associated projects

GHG emissions from the construction and operation of the Carmichael Mine and Rail, NGBR and Abbot Point T0 facilities are included in this assessment as Adani related projects. A summary is shown in Table 5-4.

For the purposes of this assessment, a 60 year timeframe has been chosen,. reflective of the project life of the Carmichael mine.

Table 5-4 Emissions of related projects

Scope	Project	Emissions	Unit
Scope 1	Carmichael Mine and Rail	941,573	t CO2-e/year
Scope 1	North Galilee Basin Rail	656,998	t CO2-e/year
Scope 1	Abbot Point T0	2,017	t CO2-e/year
Scope 1 Total		**1,600,588**	**t CO2-e/year**
Scope 2	Carmichael Mine and Rail	818,885	t CO2-e/year
Scope 2	North Galilee Basin Rail	143,664	t CO2-e/year
Scope 2	Abbot Point T0	22,600	t CO2-e/year
Scope 2 Total		**985,149**	**t CO2-e/year**
Scope 1, 2 Total		**2,585,737**	**t CO2-e/year**
Scope 1, 2 over 60 year life		**232,716,297**	**t CO2-e**

6 EMISSIONS COMPARISONS

The high level Australian Jurisdiction GHG assessment considers two aspects:

- **Project-related emissions** – Emissions calculated were Scope 1 and Scope 3 for fuel consumption, Scope 1 for vegetation clearance, Scope 2 and Scope 3 for grid electricity consumption, and Scope 3 for road transport, third party fuel and embodied emissions. A total of 102,647t CO2-e was estimated
- **Related emissions** from the construction and operation of the associated mine, rail and port projects, which will ultimately use the proposed T0 facilities. Emissions for these projects have been extracted from the relevant EIS and SEIS documents. A total of 2,585,737t CO2-e/year was estimated. Assuming a 60 year project life, the total emissions from these related projects are 232,716,297t CO2-e. The breakdown of annual operational emissions by the projects is as follows:
  - Carmichael Coal Mine and Rail project – 1,760,458t CO_2-e/year
  - NGBR project – 800,662t CO_2-e/year
  - Abbot Point T0 project – 24,617t CO_2-e/year.

To put the inventory in a larger context:

- At 2012, global GHG emissions were 31,700Mt (IEA, 2014)
- At 2012, Australian national GHG emissions were 562.7Mt CO2-e (Kyoto Accounting) (Australian Greenhouse Emission Information System)
- At 2012, Queensland's GHG emissions were at 134.5Mt CO2-e (Queensland Government Statistician's Office).

The APGG Project emissions equate to approximately 0.08% of the Queensland's annual emissions and less than 0.02% of Australian's national annual emissions. Australian national annual emissions are less than 2% of the global total aggregated emissions.

The emissions of the discussed related projects plus the APGG Project emissions equate to approximately 2.7Mt CO_2-e/year. This represents around 2.0% of the Queensland's annual emissions, or 0.5% of Australian's national annual emissions and approximately 0.01% of the global total aggregated emissions.

In addition to the Project's emissions and emissions from related Adani projects, the GHG emissions which result from the combustion of coal which will pass through the proposed Abbot Point Coal Terminal 0, i.e. 70Mtpa have been estimated and provide global context. These combustion emissions are estimated to be around 167Mt CO_2 per annum or 10,002Mt CO_2 over a 60 year timeframe. These annual emissions from the combustion of

coal expected to pass through T0 are approximately 0.5% of the global GHG (based on 2012 figure).

7 MITIGATION MEASURES

GHG emissions will primarily arise from the use of construction and dredging machinery as well as activities related to vegetation clearance. Methods for reducing GHG emissions fall into the following broad categories:

- Avoid: Identify where and how GHG emissions can be avoided
- Reduce: Identify where behavior or processes can be modified to achieve GHG emissions reductions
- Switch: Identify where fuel and energy source switching can be used to reduce GHG emissions.

The following high-level mitigation measures are recommended:

- Assessment of construction techniques to improve fuel efficiency, e.g. reduce double handling of material to build embankment, reduce engine idling time
- Selection of fuel-efficient vehicles and machinery where practical
- Implementation of fuel saving initiatives on site such as efficient driving practices
- Sourcing material locally where practical
- Considering the potential to switch to LED lighting from metal halide lamps in the lighting towers
- Rehabilitation of the land disturbed with compatible vegetation.

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Appendix 1 Emission Factors

Appendix 1

NGER Scope 1 Emission Factors

NGER Emission Factor	Energy Content Factor		Emission Factor				
			TOTAL	CO_2	CH_4	N_2O	Unit
Diesel Oil (Transport)	38.60	GJ/kL	69.90	69.20	0.20	0.50	kg CO_2-e/GJ
Diesel Oil (Stationary)	38.60	GJ/kL	69.50	69.20	0.10	0.20	kg CO_2-e/GJ
Heavy Fuel Oil (transport)	39.70	GJ/kL	73.56	72.90	0.06	0.60	kg CO_2-e/GJ
Petrol (Transport)	34.20	GJ/kL	66.92	66.70	0.02	0.20	kg CO_2-e/GJ

Source: Commonwealth of Australia Department of the Environment. (2014). National Greenhouse Accounts Factors.

NGER Scope 2 Emission Factors

NGER Emission Factor	Energy Content Factor		Emission Factor				
			TOTAL	CO_2	CH_4	N_2O	Unit
Consumption of Qld grid electricity	-	-	0.81				kg CO_2-e/kWh

Source: Commonwealth of Australia Department of the Environment. (2014). National Greenhouse Accounts Factors.

NGER Scope 3 Emission Factors

NGER Emission Factor	Energy Content Factor		Emission Factor				
			TOTAL	CO_2	CH_4	N_2O	Unit
Diesel Oil (Transport)	38.60	GJ/kL	5.30				kg CO_2-e/GJ
Diesel Oil (Stationary)	38.60	GJ/kL	5.30				kg CO_2-e/GJ
Petrol (Transport)	34.20	GJ/kL	5.30				kg CO_2-e/GJ
Heavy Fuel Oil (transport)	39.70	GJ/kL	5.30				kg CO_2-e/GJ
Consumption of purchased electricity (Qld)	-	-	0.13				kg CO_2-e/kWh

Source: Commonwealth of Australia Department of the Environment. (2014). National Greenhouse Accounts Factors.

Material Scope 3 GHG emissions

Emission factor							
			TOTAL				
Steel pipe embodied energy GHG emissions			2.70				t CO_2-e/tonne
Cement - General			0.83				t CO_2-e/tonne

Source: University of Bath. (2008) Inventory of Carbon & Energy (ICE) Version 1.6a