Barangaroo
Concrete Batching Plant

Greenhouse Gas & Energy Report

Lend Lease

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1.0 INTRODUCTION

This report provides a quantitative assessment of the potential greenhouse gas emissions resulting from the operation of the temporary concrete batching plant and outlines details of the energy efficiency measures to be implemented as part of the plants design and operation.

This document has been prepared in response to the Director General's requirements for a Greenhouse and Energy Report related to the operation of the temporary concrete batching plant. It is intended that this report form part of the Barangaroo MOD6 concept plan application.

2.0 BACKGROUND

The Barangaroo project will require a reliable and frequent supply of concrete. Traditionally, concrete would be supplied from nearby concrete batching plant(s) and then delivered to the construction site via concrete agitator vehicles before being pumped and placed. Concrete delivered in this way can only be stored for a limited amount of time and deliveries need to be carefully coordinated and timed to minimise impacts on the construction schedule.

Given the scale of the Barangaroo project and the daily demand for concrete, during peak times up to 2,000m3 of concrete will be required to service the construction site. This would represent approximately 300 agitator truck movements per day causing significant transport emissions and associated traffic impacts. In order to mitigate these impacts Lend Lease has proposed the use of a temporary onsite concrete batching operation that will effectively avoid the need for pre-mixed concrete delivery to site.

The basic function of the onsite batching plant is to mix water, cement, fine and course aggregates and admixtures to form wet mix concrete which can be pumped directly to the adjacent construction site.

The concrete batching plant will comprise of a number of specific elements including:

- Cement silos with a filter bag system - to store cement powder for inclusion within the batched concrete;
- Split drum mixer - to mix raw materials to create concrete, replaces need for agitator trucks;
- Aggregate weigh bins - to accurately measure quantities of sand and aggregates reducing wastage;
- Dust extraction system - to extract airborne cement powder around the inlet to the split drum mixer;
- Settlement and storage pits - to manage the cementitous water runoff around the cement loading point and mixer areas;
- Water holding tanks - to provide a buffer of required water and to manage recycled water for use within the batching of concrete;
- Silo ladders and platform - for access to service cement filters and operate the plant;
- Batch conveyor with cover - to reduce windblown dust from conveyor;
- Batch office - to operate the plant and ensure appropriate supervision of plant and stockpile areas;
- Electrical switchboard container - to house electrical components as per legislative requirements; and
- Admixture tanks and bunds (steel) - to ensure any leaks are contained.

Raw materials which are required to be batched into concrete will be delivered to the site by the plant operator. Materials will then be stored in silos, holding bins, open stockpiles or tanks and released into the batching process via a largely automated process.

A front end loader will be used to move aggregates from the storage locations to the weigh bins. Subsequent to weighing, aggregates will then be transported along the covered conveyor to the split drum mixer. Other raw materials will then be released into the mixer to produce the wet mix concrete.

Following quality control checks, the concrete batch will be released to a holding hopper & pumped from the Central Pumping Station via fixed line to the individual project pours.

3.0 GREENHOUSE GAS EMISSION SOURCES

The greenhouse gas (GHG) emissions related to the on-site concrete batching activities will be from two main sources. These include:

- Scope 1 emissions associated with the use of diesel in the dedicated front end loader, which will be used for raw material stockpile handling; and
- Scope 2 emissions associated with purchased electricity which is used in all other parts of the operation such as the dust extraction and filtration system, split drum mixer, water and admixture pumping, conveyor systems, site lighting and site office.

Indirect and offsite Scope 3 emissions associated with delivery of raw materials are addressed in Section 5.0 of this report. Emissions associated with the pumping and placement of concrete are considered outside of the scope of this report and would occur regardless of whether an onsite concrete batching facility existed or not.

4.0 Quantification of GHG Emission Sources

The following describes the various methodologies and assumptions used to quantify the GHG emission sources identified in Section 3.0 above. All GHG calculations are based on the Department of Climate Change and Energy Efficiency National Greenhouse Accounts Factors - July 2012.

4.1 Scope 1 Diesel Emissions

The front end loader is expected to use approximately 0.2L of diesel for every 1m3 of concrete produced. Over the 3 year life of the batch plant it is anticipated that the facility will produce around 387,582m3 of concrete. GHG emissions associated with diesel use in the front end loader are therefore estimated to represent 208 tCO2-e over the life of the onsite batch plant or around 10% of the batch plants total GHG emissions.

(refer to Appendix A for detailed calculations and assumptions).

4.2 Scope 2 Electricity Emissions

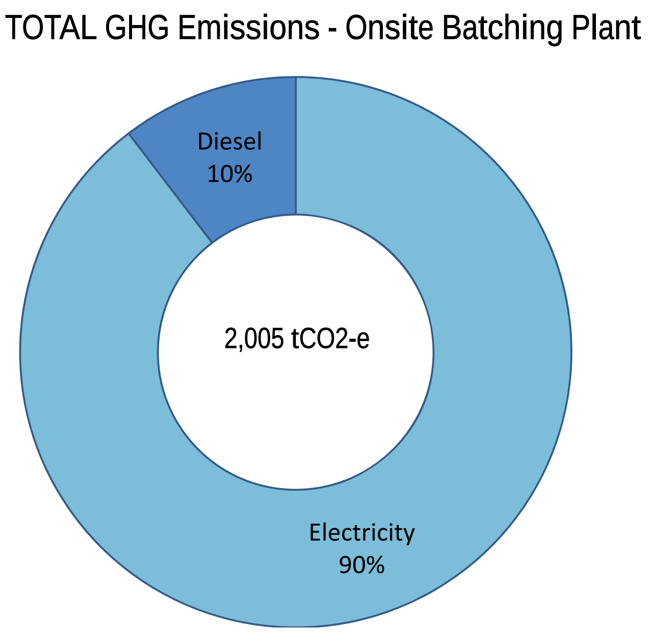
The expected electricity demand of the concrete batching plant is predicted to be around 700kW. This is based on data provided by Boral for the proposed batch plant with a rated concrete production of 160m3 per hour. This electricity demand equates to approximately 4.375kWh of electricity use per m3 of concrete batched.

Based on production of around 387,582m3 of concrete over the life of the batching plant electricity emissions are estimated to represent 1,797 tCO2-e or around 40% of the batching plants total GHG emissions.

(refer to Appendix A for detailed calculations and assumptions).

4.3 Batch Plant GHG Emissions

Overall emissions associated with the direct operation of the temporary concrete batching plant are estimated to be 2,005 tCO2-e or approximately 668 tCO2-e per annum. The graph below shows the indicative breakdown of emission sources for the onsite batching plant.



5.0 Emission Savings

Traditionally, concrete for a project such as Barangaroo would be supplied from nearby concrete batching plants such as those operated by Boral at Alexandria and Artarmon. This concrete would be delivered to the construction site via concrete agitator vehicles before being pumped and placed onsite. The installation of an onsite concrete batching plant will effectively avoid the need for delivery of premixed concrete to site and will therefore significantly reduce transport requirements and associated GHG emissions.

Although there will be a requirement to deliver raw materials such as cement sand and aggregates to the onsite batching plant, the GHG emissions generated with this activity would still occur under a traditional supply scenario. This is because raw materials would still require transport to both the Artarmon and Alexandria plants. In some cases aggregates sourced from areas South of Sydney would pass the construction site on route to the Artarmon batching plant before being transported back to the construction site as premixed concrete.

Approximately 380,000m3 of concrete is required for the Barangaroo South site over the life of the proposed batch plant. The batch plant will therefore result in a net reduction of more than 58,000 agitator truck movements over the life of the project.

GHG Emission savings shown in the table below are based on a traditional supply of premixed concrete with 30% coming from Alexandria and with the remaining 70% being supplied from the Artarmon facility. This represents the most likely offsite supply arrangement and is based on advice from Boral Concrete.

Premixed Concrete (Offsite) Transport Emissions

Location	m3 of concrete	tCO2-e	Annual cars off the road
Alexandria	114,000	2,689	719
Artarmon	266,000	6,822	1,825
	TOTAL	9,511	2,545

Avoided transport emissions due to the utilisation of onsite batching are estimated to be 9,511 tCO2-e over the life of the project. This represents more than double the onsite batching plants operational emissions and is equivalent to removing 2,545 cars from the road annually.

The graph below displays the overall onsite emissions related directly to the batching operations as well as the predicted emission savings due to avoided transport.

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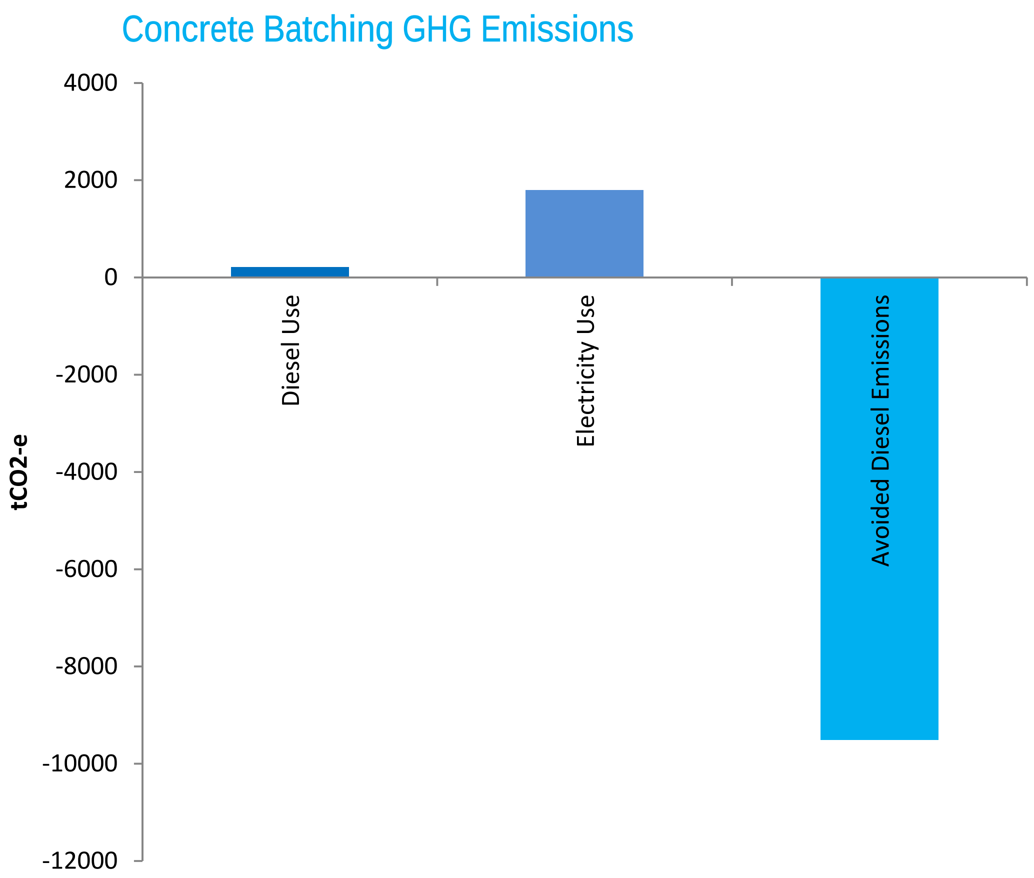

(refer to Appendix A for detailed calculations and assumptions).

6.0 Energy Efficiency Measures

A number of energy efficiency measures are to be implemented at the onsite concrete batching plant. These include inherent design initiatives, technology improvements and operational procedures. Specific initiatives are summarised below.

- The onsite batch plant will utilise a number of electrical devices, specifically motors to drive a number of conveyors, augers and concrete mixers. Each motor has been specifically designed by Boral's plant fabricator, X-Tec, to meet both operational design requirements as well as ensuring energy efficiency. This includes ensuring appropriate motor sizing with variable speed drives for mixers and conveyor systems;
- Aggregate and sand stockpile bins, have been designed and orientated within the site to minimise the number of loader movements and the total distance travelled, to reduce the Diesel usage and improve the overall plant efficiency;
- Use of storage over weigh bin systems for aggregates and sand. This is more efficient than a front end loader fed weigh systems and will significantly reduce the number of loader movements by ensuring a full capacity bucket is always lifted from the stockpile area;
- In between each 'batch' production of concrete the plant will be placed into an 'idle' state which uses significantly less power than at full production, if no concrete production is required for a longer period (approximately 30

minutes but time dependant on weather conditions and strength of last batched concrete) the batch plant will be fully shut down i.e. all conveyors switched off, mixers cleaned and turned off;

- At the end of every production day the plant will be shutdown including lights, compressors and control room utilising after-hours master switching for site office and non-essential power circuits;
- When not in use the front end loader will be parked and switched off to prevent any uneccessary engine idle time.

Furthermore, a number of design decisions were made as to the type of batching plant to be installed onsite, to enable a reduction in energy usage. This included utilising a wet mix process, where concrete is fed into a barrel and the raw materials mixed with paddles driven by electric motors, rather than a dry mix process which would still require diesel powered concrete agitator trucks to mix the concrete.

7.0 Conclusion

The onsite batching plant is predicted to generate 2,005 tCO2-e of GHG emissions for the duration of the project. These emissions are estimated to be generated primarily through the use of electricity and from the consumption of diesel used in equipment for raw materials loading. The design and layout of the plant is specific to the site and has been carefully optimised to maximise the energy efficiency of the overall concrete delivery process. Shut down procedures between batching cycles and outside of working periods will further contribute to the overall efficiency of the plant.

The Onsite Concrete Batch Plant offers a number of benefits to Barangaroo project including significant savings in GHG emissions due to reduced reliance on the road transport of premixed concrete. These savings equate to around 9,500 tCO2-e over the life of the project and are equivalent to removing around 2,500 cars off the road annually. These emission savings represent a reduction in GHG emissions equivalent to almost five times quantity of GHG emissions generated by onsite batching plant in operation.

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8.0 Appendix A

Diesel Emission Calculations for Front End Loader Operation

	Emissions of carbon dioxide	
=	(0.0002 x 38.6 x 69.2)	
	0.534224	kg CO2-e
	Emissions of methane	
=	(0.0002 x 38.6 x 0.1)	
	0.000772	kg CO2-e
	Emissions of nitrous oxide	
=	(0.0002 x 38.6 x 0.2)	
	0.001544	kg CO2-e
	TOTAL Scope 1 GHG Emissions (kg CO2-e/m3 Concrete)	
=	0.534224 + 0.000772 + 0.001544	
	0.53654	kg CO2-e
	TOTAL Scope 1 GHG Emissions (TOTAL Project Production)	
=	(387,582 x 0.53654) / 1000	
	208	**tCO2-e**

Operation of the front end loader is estimated to use 0.2L of diesel per m3 of concrete batched. Information provided by Richard Fitzgibbon – Project Engineer Boral Concrete.

Electricity Assumptions and Calculations

Operational Parameter	**Project Total**	**Units**
Total Project Production	387,582	m3 conc
Batch Plant Rated Throughput/hr	160	m3/hr
Load at full production kW	700	kW
Hours required for Project Volume	2,422	hrs
Total Power Consumption kWh	16,95,671	kWh
Total Power Consumption MWh	1,696	MWh
GHG Emission Factor*	1.06	kgCO2-e/kWh
GHG Emissions Concrete batch plant project total	1,797	tCO2-e
Energy Usage per m3 concrete production	4.375	kWh/m3
GHG Emissions per m3 concrete production	4.6375	kgCO2-e/m3

*Full scope emission factors - consumption of purchased electricity by end users NSW 2009/10
Electricity consumption rates based on data provided by Richard Fitzgibbon – Project Engineer Boral Concrete.

Offsite Batching Transport

Offsite Supply Assumptions	Qty	UoM	Comments
TOTAL Concrete	380,000	m3	Approximate concrete supply for Barangaroo.
Alexandria (Burrows Road South)	16.0	km	Return distance from batch plant to Barangaroo
Artarmon (88 Reserve Road)	17.4	km	Return distance from batch plant to Barangaroo
Agitator Payload	6.5	m3	Average agitator truck payload – Provided by Boral.
Batching Process	Dry		Dry process employed at both Artarmon and Alexandria batch facilities.
Alexandria	30%		Proportion of supply to site based on advice from Boral.
Artarmon	70%		Proportion of supply to site based on advice from Boral.

Vehicle Type	kgCO2-e/m3km	Source:
Concrete Agitator	7.37E-1	Australasian Unit Process LCI 2012

Private Transport Equivalent - Average Australian Car								
Litres Per km*	Average km travelled*	Annual Fuel Consumption (L)	GJ	kg CO2	CH4 (kgCO20e)	N2O (kgCO2-e)	kg CO2-e per annum	t CO2-e per annum
0.115	14200	1633	55.85	3725	1	11	3737	**3.7**

*ABS Survey of Motor Vehicle Use 2001-2002