ACIL ALLEN CONSULTING

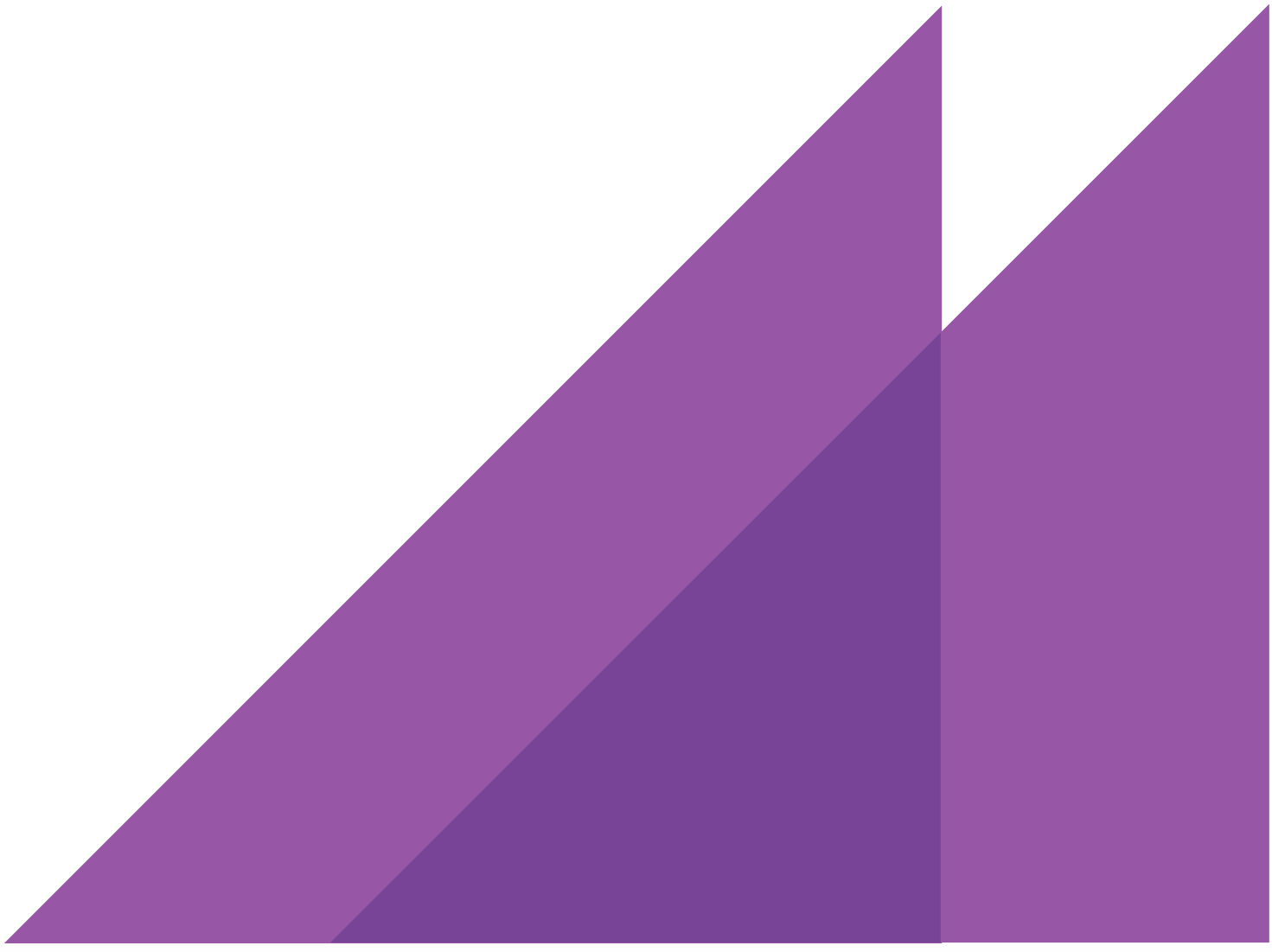
REPORT TO
AUSTRALIAN ENERGY MARKET OPERATOR

10 MAY 2016

EMISSION FACTORS

ASSUMPTIONS UPDATE

FINAL REPORT



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1 INTRODUCTION

ACIL Allen Consulting (ACIL Allen) has been engaged by the Australian Energy Market Operator (AEMO) to provide updated generator greenhouse gas emission factors. These emission factors are for use within AEMO's planning functions.

ACIL Allen's scope of work under this engagement involves providing the following data elements:

- Table of Scope 1 and Scope 3 emission factors for each existing generator in the National Electricity Market (NEM) and the South West Interconnected System (SWIS) of Western Australia
- Table of Scope 1 and Scope 3 emission factors for potential new entrants, as per the technologies assessed by ACIL Allen in 2014
- Aggregate actual Scope 1 and Scope 3 emissions for the 2005 calendar year for both the NEM and SWIS
- Table of actual Scope 1 and Scope 3 emissions at the individual unit level for all NEM generators in 2015.

The datasets are provided in spreadsheet format, and this document represents a high level description of the calculation methodologies and results.

To assist with this exercise, ACIL Allen has sourced data for actual emissions from the Department of Environment Emissions Inventory for 2004-05 and 2005-06.

2 METHODOLOGY

This section outlines the proposed approach in estimating the emission factors for each scheduled, semi-scheduled in the NEM and the SWIS.

2.1 Measurement of emissions

Greenhouse gas emissions are measured in carbon dioxide equivalence (CO_2-e). These are comprised of the following emissions to the atmosphere:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O), or
- synthetic gases (HFCs, SF_6, CF_4, C_2F_6).

The equivalence measure allows the global warming potential of each greenhouse gas to be standardised relative to carbon dioxide.

2.2 Emission factors and intensities

In the context of an electricity generator, an ***Emission factor*** relates the amount of greenhouse gas emitted per unit of fuel consumed (expressed in units of CO_2-e per unit of fuel consumed). Typically these are expressed as quantity of a given GHG emitted per unit of energy (kg CO2-e /GJ).

When combined with the power stations' thermal efficiency, one can calculate the ***Emissions intensity*** of the station, expressed in unit of CO_2-e per unit of electricity produced (either sent-out or as generated).

For the purpose of this work, we have been tasked with providing updated estimates of power stations emission factors and these values, when combined with the existing thermal efficiency and auxiliary values, can be used to calculate emissions intensities.

2.3 Emissions scope

In the language of carbon accounting, for example as set out in the Australian Government's National Greenhouse Accounts (NGA) Factors publications, there are a number of different emission 'scopes'. These are defined in Box 2.1.

BOX 2.1 – **TYPES OF EMISSION FACTORS**

Firstly, it is important to note that an emission factor is activity-specific. The activity determines the emission factor used. The scope that emissions are reported under is determined by whether the activity is within the organisation's boundary (direct—scope 1) or outside it (indirect—scope 2 and scope 3).

Direct (or point-source) emission factors give the kilograms of carbon dioxide equivalent (CO2-e) emitted per unit of activity at the point of emission release (i.e. fuel use, energy use, manufacturing process activity, mining activity, on-site waste disposal, etc.). These factors are used to calculate scope 1 emissions.

Indirect emission factors are used to calculate scope 2 emissions from the generation of the electricity purchased and consumed by an organisation as kilograms of CO2-e per unit of electricity consumed. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station.

Various emission factors can be used to calculate scope 3 emissions. For ease of use, this workbook reports specific 'scope 3' emission factors for organisations that: (a) burn fossil fuels: to estimate their indirect emissions attributable to the extraction, production and transport of those fuels; or (b) consume purchased electricity: to estimate their indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the transmission and distribution network.

SOURCE: DEPARTMENT OF THE ENVIRONMENT: NATIONAL GREENHOUSE ACCOUNTS FACTORS, AUGUST 2015, P6

In simple terms for electricity generators:

- Scope 1 emissions relate to emissions associated with combustion of fuels on-site or other emissions associated with the power station facility
- Scope 2 emissions relate to indirect emissions from any electricity purchased from the grid
- Scope 3 relate to indirect emissions associated with the extraction, production and transport of fuel to the power station.

It should be recognised that this definition does cause an issue for renewable generators which do not consume fossil fuel in generating electricity, despite some of these entities reporting scope 1 emissions under the NGER scheme. For renewable plant an Emission factor of zero will be set, despite them possibly having a non-zero Emission intensity value.[1]

The following formula is used to convert the Emissions Factor for an individual generator into an Emissions Intensity value (i.e. converting from tonnes CO_2-e/GJ to tonnes CO_2-e/MWh sent-out):

$$EI_i = \left(\frac{3.6}{TE_i}\right) \times \frac{ef_i}{(1 - A_i)}$$

Where:

EI = Emission Intensity for individual generator (t CO_2-e /MWh)

i = Generator with available energy data & Emission Factor

TE = Thermal Efficiency (MWh(Gen)/MWh(Fuel))

ef = Emission Factor for individual generator (t CO_2-e /GJ)

A = Auxiliaries (% value)

3.6 = Conversion factor (1 MWh = 3.6 GJ).

2.4 NGER reporting

In 2007 Australia introduced a single, national framework for corporations to report on greenhouse gas emissions, energy use and energy production. That framework, known as the National Greenhouse and Energy Reporting (NGER) Scheme, operates under the National Greenhouse and Energy

[1] In most cases, the actual Emission intensity values for renewable generators are very close to zero in any case.

Reporting Act 2007. The Clean Energy Regulator (CER) administers the NGER Scheme and the Department of the Environment is responsible for NGER-related policy development and review.

Under the NGER Scheme, companies which meet the threshold criteria[2] are required to report annually 'Scope 1' emissions, 'Scope 2' emissions, energy production and energy consumption.

The *National Greenhouse and Energy Reporting Regulations 2008* define 'Scope 1' and 'Scope 2' emissions as follows:

'Scope 1' emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility.

'Scope 2' emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility.

For electricity generators, 'Scope 1' emissions generally relate to greenhouse gas emissions associated with combustion of fuel in the electricity generation process. 'Scope 2' emissions would also accrue due to any purchased electricity sourced from the grid or from heat/steam acquired from an external source which is then used to generate electricity by the facility.

For the purpose of this exercise, only Scope 1 emissions values have been considered from the NGER reporting as generators are not expected to be directly liable for Scope 2 emissions.

Since 2012-13, the Clean Energy Regulator has made public reported energy production (GJ or MWh) and Scope 1 & 2 emission values at facility level.[3] Information reported by designated generation facilities is published for facilities where the principal activity is electricity generation and where the facility is not part of a vertically-integrated production process. Facilities generating electricity for their own use or as a secondary activity do not have their emissions and electricity production data published. With the recent publication of the 2014-15 dataset, there is now three years of data available for most generating facilities. This data is used as a basis for comparisons of emission intensity values on an 'as-generated' basis.

2.5 Approach in estimating emission factors

The update of emission factors for this exercise has been undertaken as follows:

1. Review NGER data for NEM market generators (scheduled, semi-scheduled generators) and SWIS generators
2. From this data, calculate Emission intensity values for each generator based on Scope 1 emissions only on a tonnes CO_2-e/MWh as generated basis
3. Calculate Emission Intensity values on an 'as generated' basis from existing AEMO input assumptions (using the Scope 1 emission factors). This will require provision of thermal efficiency and auxiliary use assumptions for SWIS based generators as AEMO does not currently have an input dataset for these generators.
4. Calculate Emission Intensity values from current ACIL Allen internal database values
5. Undertake a comparison of the actual NGER values obtained against existing NTNDP and ACIL Allen estimates and between similar plant technologies
6. Consider the plants running regime and other operational parameters (such as coal quality) through 2012-13 to 2014-15 and decide whether this represents its typical running state
7. Consider other public sources of reported emissions for power stations
8. Settle on any appropriate adjustments to existing values.

This will result in a recommended Emissions Intensity value (Scope 1 only) for each generator (in tonnes CO_2-e/MWh as-generated).

[2] The threshold criteria at facility level are currently set at 25 kt CO_2-e or more of greenhouse gases; production of 100 TJ or more of energy, or consumption of 100 TJ or more of energy. Corporate facility thresholds also apply for aggregate volumes of 50 kt CO_2-e or more of greenhouse gases; production of 200 TJ or more of energy or consumption of 200 TJ or more of energy.
[3] See http://www.cleanenergyregulator.gov.au/NGER/Published-information

As we are constrained by the thermal efficiency and auxiliary assumptions already contained within the dataset (we have not been asked to update these), the emission intensity will be converted to an appropriate fuel emission factor (in kg CO_2-e/GJ of fuel) using the current values. This approach essentially involves estimating the final Emission Intensity figure, rather than its component parts which make up the calculation.

Analysing emission intensity on an 'as generated' basis is preferred as this is the basis for the NGER reporting of electricity production. This essentially removes the potential error introduced through relying on an auxiliary factor in converting these values to a sent-out basis.

The results of this analysis can result in a different fuel emission factor for power stations which utilise the same fuel source.

Scope 3 values are not directly attributable to power stations and are therefore sourced from the NGA factors workbook (August 2015)[4].

[4] Department of Environment, Australian National Greenhouse Accounts: National Greenhouse Accounts Factors, August 2015

3 RESULTS OF ANALYSIS

3.1 Existing stations

This chapter summarises the results of the emission factor review and update. Tables are provided for emission factors and resulting emission intensities for each existing power station in the NEM and the SWIS. The tables compare values implied by NGER reports against the previous input assumption and any proposed revision.

3.1.1 Scope 1 emission factors

The following charts provide comparisons of emission factors and resulting emission intensity values (presented on a tonnes CO2-e/MWh as generated basis) from:

- the average reported NGER value across the three years 2012-13 to 2014-15
- the current AEMO planning assumption
- a proposed update value.

Comparisons are undertaken on an 'as generated' basis as this is the basis of reporting "Electricity production" from the CER data.

Each chart has common fuel type/generation types grouped together so comparisons can be made across generators of the same fuel/type. Emission intensity values are not provided for wind and hydro as these values are all assumed to be zero.

The results of the review of Scope 1 emission factors are presented graphically in **Figure 3.1** and **Figure 3.2**. In most cases there was a reasonably good alignment between the existing factors assumed in the dataset and those implied from the NGER datasets.

Notable proposed changes for power stations which are responsible for significant annual emissions include:

- Callide B: increase from 94 to 101 kg CO_2-e/GJ
- Gladstone: increase from 90 to 102 kg CO_2-e/GJ
- Kogan Creek: increase from 87 to 93 kg CO_2-e/GJ
- Vales Point: increase from 87 to 89 kg CO_2-e/GJ
- Loy Yang A and Yallourn: decrease from 96 to 95 kg CO_2-e/GJ.

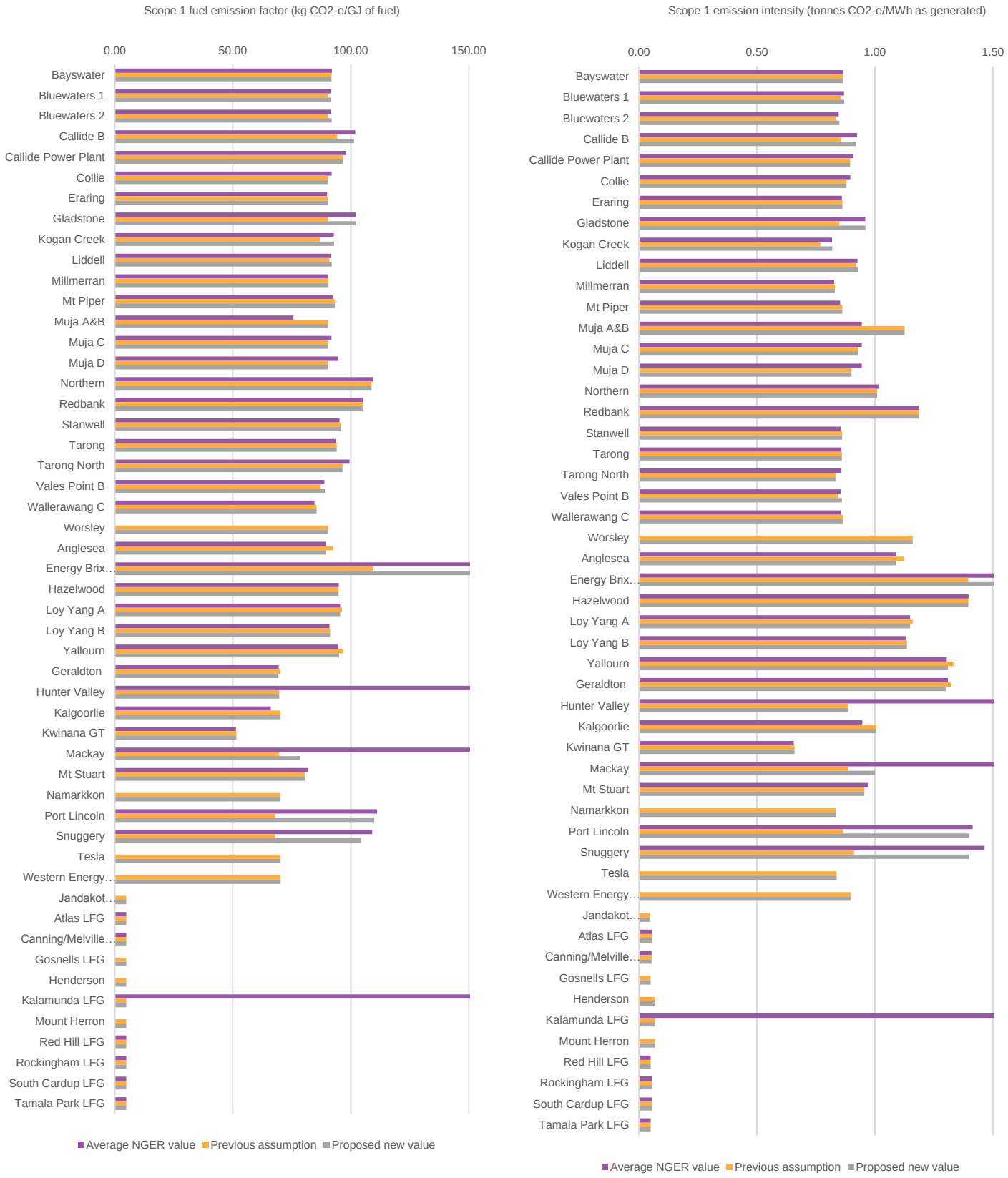
There were a number of changes to low capacity factor peaking plant to better align with NGER reported values, however their impact on emissions is negligible and their intensity value is critically dependent on the number of starts and their running regime.

Also, where the CER data only provided a value for a combined station (e.g. Tarong/Tarong North) we have split out estimated emission intensities for each based on their relative thermal efficiencies and typical generation shares.

For a few selected stations, no CER data was reported and in these cases the previous NTNDP value was adopted.

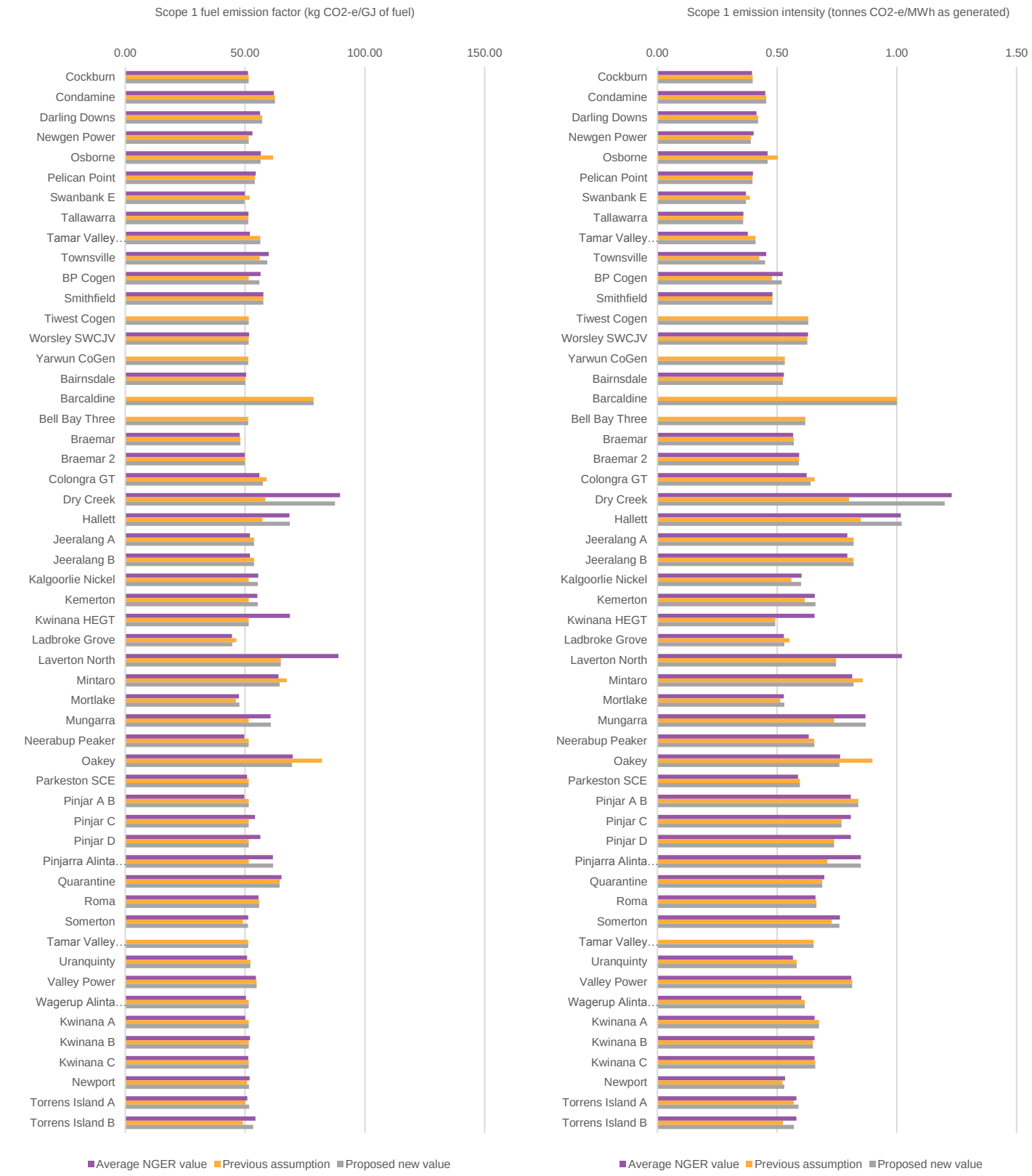
AEMO have not provided any thermal efficiency and auxiliary usage assumptions for SWIS-based power stations. ACIL Allen has utilised its own internal assumptions for these.

FIGURE 3.1 SCOPE 1 RESULTS: COAL; DIESEL AND LANDFILL GAS PLANT



SOURCE: ACIL ALLEN; CLEAN ENERGY REGULATOR VARIOUS NGER REPORTS

FIGURE 3.2 SCOPE 1 RESULTS: NATURAL GAS PLANT



SOURCE: ACIL ALLEN; CLEAN ENERGY REGULATOR VARIOUS NGER REPORTS

3.1.2 Scope 3 emission factors

There are no corresponding Scope 3 values published to compare the input values against. Scope 3 emission values were updated based on the latest NGA factors workbook published by the Department of Environment in August 2015.

The report contains generic Scope 3 emission factors by fuel type which are summarised in **Table 3.1**. While these are these are official figures, it should be noted that these values are averages for the entire industry and impossible to attribute accurately to specific generators.

The estimate for sub-bituminous coal has been used for black coal stations and as there is only a single value for all regions, we have differentiated between Queensland and NSW by halving the value for Queensland, and doubling the value for NSW. The justification for this differential is that fugitive emissions from coal mining in NSW are much larger than for QLD[5] and it is more common for coal to be railed to power stations in NSW than in QLD. This maintains the approach used in previous updates to these values.

TABLE 3.1 SCOPE 3 EMISSION FACTORS FOR FUELS BY REGION (KG CO_2-E/GJ)

	Metro	Non-metro	Value adopted
Solid fuels			
Bituminous coal			3.0
Sub-bituminous coal			2.5
Brown coal			0.4
Natural gas			
NSW & ACT	12.8	13.6	12.8
Victoria	3.9	3.9	3.9
Queensland	8.7	7.8	7.8
South Australia	10.4	10.3	10.4
Western Australia	4.0	3.9	4.0
Tasmania			3.9
Liquid fuels (Diesel)			3.6

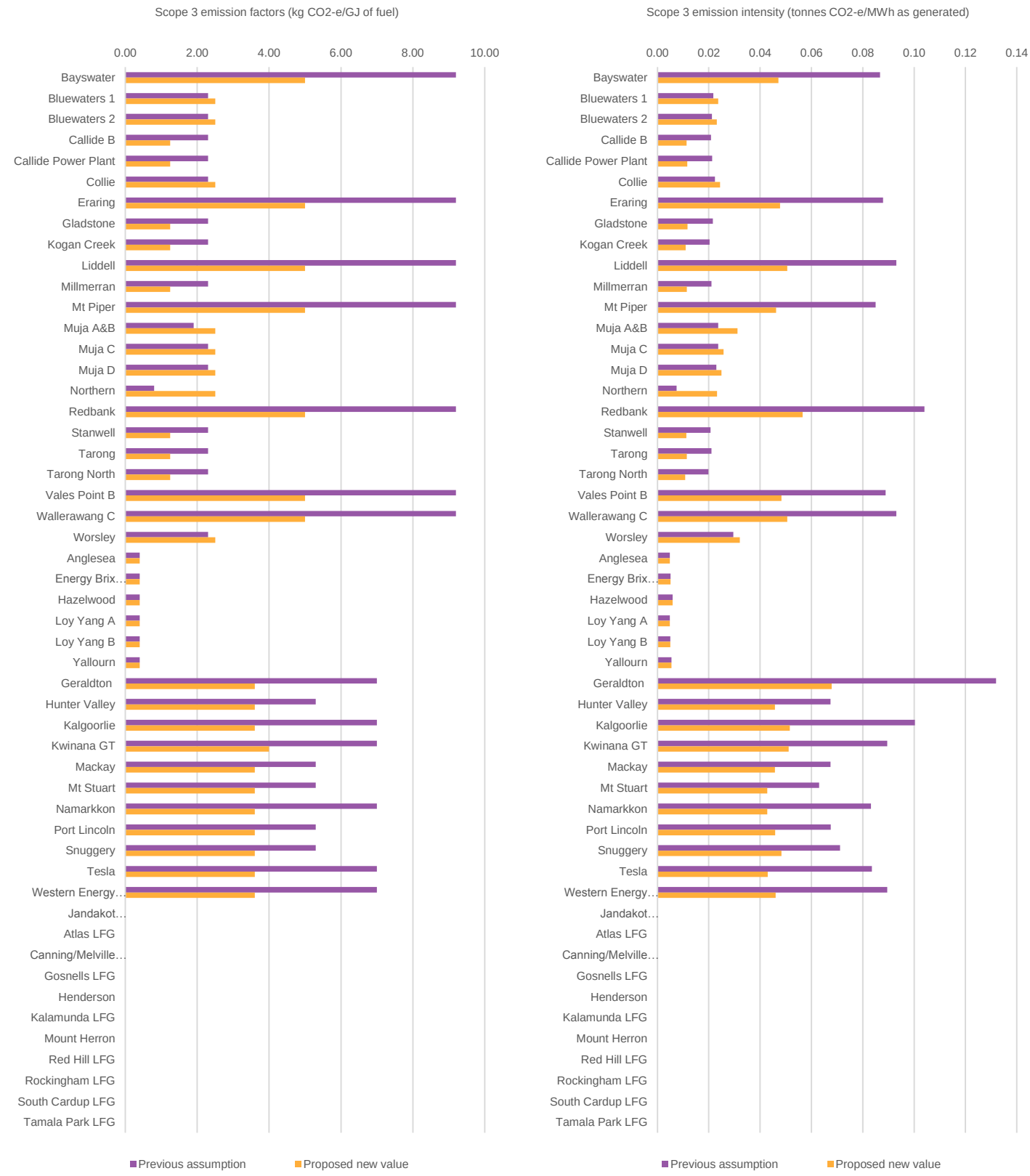
Note: Metro is defined as located on or east of the dividing range in NSW, including Canberra and Queanbeyan, Melbourne, Brisbane, Adelaide or Perth. Otherwise, the non-metro factor should be used.

SOURCE: ACIL ALLEN BASED ON DEPARTMENT OF ENVIRONMENT: NATIONAL GREENHOUSE ACCOUNT FACTORS, AUGUST 2015

The updated Scope 3 factors have resulted in a decrease for coal plant, with most gas plant largely unchanged. Scope 3 emissions remain a small proportion of overall emissions.

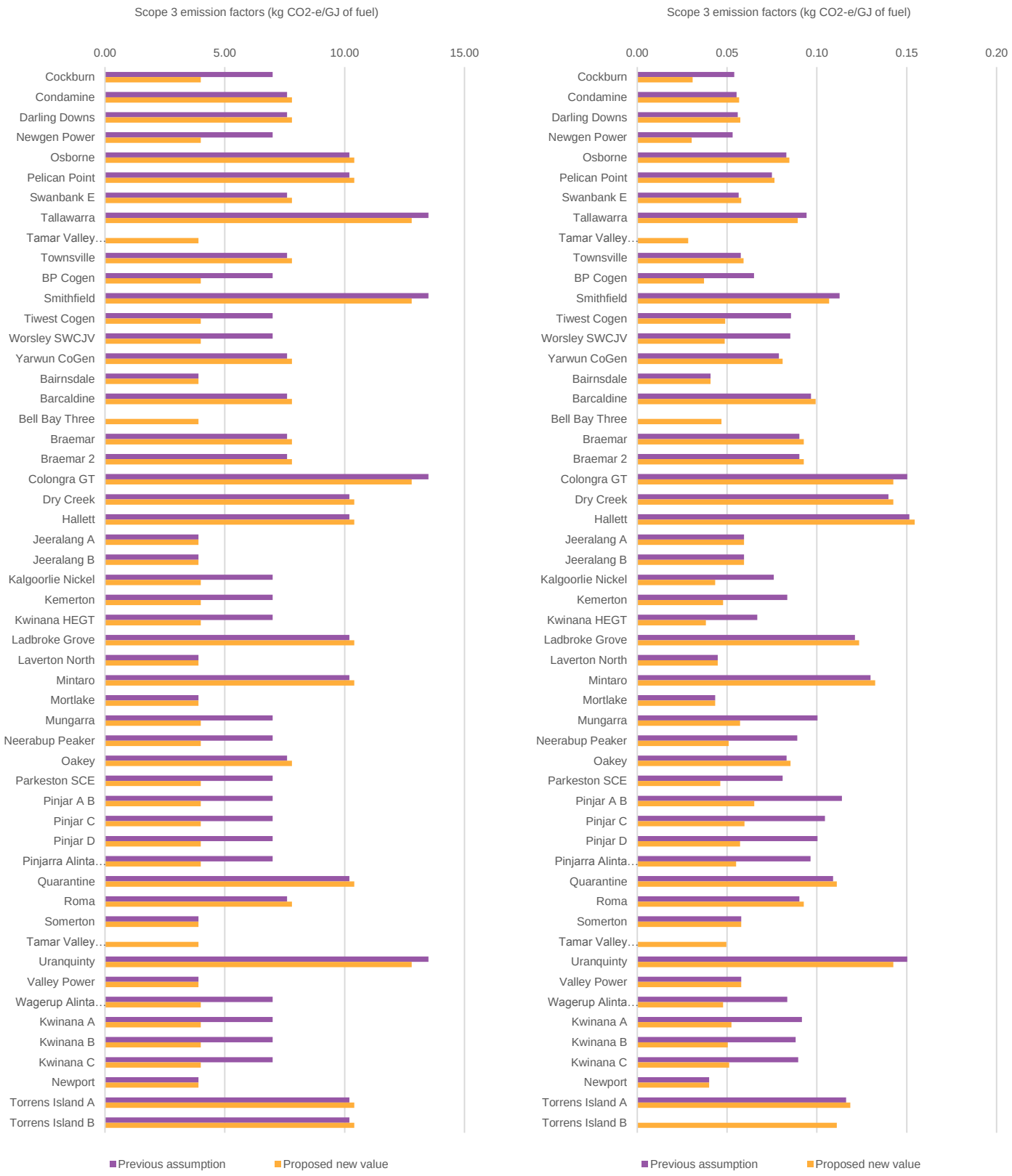
[5] For example, current fugitive emission factors for open cut coal mining in NSW are 0.045 tonnes CO_2-e/ tonne raw coal, compared with QLD at 0.017 tonnes CO_2-e/ tonne raw coal.

FIGURE 3.3 SCOPE 3 RESULTS: COAL; DIESEL AND LANDFILL GAS PLANT



SOURCE: ACIL ALLEN; CLEAN ENERGY REGULATOR VARIOUS NGER REPORTS

FIGURE 3.4 SCOPE 3 RESULTS: NATURAL GAS PLANT



SOURCE: ACIL ALLEN; CLEAN ENERGY REGULATOR VARIOUS NGER REPORTS

3.1.3 Materiality of changes

The impact of the proposed changes to Scope 1 and Scope 3 emission factors was assessed by applying them to actual calendar year 2015 dispatch outcomes and calculating aggregate emissions using both the old and the new inputs.

For Scope 1 emissions, the changes resulted in a net increase in emissions of around 0.8 Mt CO_2-e (159.1 Mt to 159.9 Mt), whereas the changes to Scope 3 emissions resulted in a net decrease of around 2.6 Mt CO_2-e (7.7 Mt to 5.1 Mt).

3.2 New entrants

Values for new entrants are based on the default emission factors for natural gas and coal from the NGA factors workbook. These are pro-rated down for technologies that employ carbon capture and storage based on the assumed CO_2 capture rate.

TABLE 3.2 SCOPE 1 EMISSION FACTORS AND EMISSION INTENSITY INPUTS

Technology	Auxiliary factor (%)	Thermal Efficiency (%, HHV sent-out)	Scope 1 emission factor (kg CO2-e/GJ of fuel)	Scope 1 intensity (tonnes CO2-e/MWh generated)
Biomass	8.0%	28%	4.83	0.06
CCGT - With CCS	11.6%	42%	7.73	0.06
CCGT - Without CCS	2.1%	50%	51.53	0.36
OCGT - Without CCS	1.0%	34%	51.53	0.54
Solar PV SAT 50 MW	1.0%	100%	0.00	0.00
Solar PV DAT 50 MW	1.0%	100%	0.00	0.00
Solar PV FFP 50 MW	0.0%	100%	0.00	0.00
Solar Thermal Central Receiver with 6 hrs storage	10.0%	100%	0.00	0.00
Solar Thermal Compact Linear Fresnel no storage	8.0%	100%	0.00	0.00
Solar Thermal Parabolic Trough with 6 hours storage	10.0%	100%	0.00	0.00
Supercritical PC - Black coal with CCS	21.2%	29%	9.02	0.09
Supercritical PC - Black coal without CCS	6.5%	40%	90.23	0.76
Supercritical PC - Brown coal with CCS	26.5%	25%	9.39	0.10
Supercritical PC - Brown coal without CCS	11.5%	36%	93.92	0.83
Wind - 200 MW	1.0%	100%	0.00	0.00

Note: CCS capture rate assumed is 90% for coal and 85% for natural gas

SOURCE: ACIL ALLEN BASED ON NGA FACTORS

Scope 3 emission factors are location dependent, but again are based on the default NGA factors as shown in **Table 3.1**. The resulting values are shown in **Table 3.3** and **Table 3.4**.

TABLE 3.3 NEW ENTRANT SCOPE 3 EMISSION FACTORS (KG CO2-E/GJ)

Technology	NSW	QLD	SA	VIC	TAS	SWIS
Biomass	0	0	0	0	0	0
CCGT - With CCS	12.8	7.8	10.4	3.9	3.9	4
CCGT - Without CCS	12.8	7.8	10.4	3.9	3.9	4
OCGT - Without CCS	12.8	7.8	10.4	3.9	3.9	4
Solar PV SAT 50 MW	0	0	0	0	0	0
Solar PV DAT 50 MW	0	0	0	0	0	0

Technology	NSW	QLD	SA	VIC	TAS	SWIS
Solar PV FFP 50 MW	0	0	0	0	0	0
Solar Thermal Central Receiver with 6 hrs storage	0	0	0	0	0	0
Solar Thermal Compact Linear Fresnel no storage	0	0	0	0	0	0
Solar Thermal Parabolic Trough with 6 hours storage	0	0	0	0	0	0
Supercritical PC - Black coal with CCS	5	1.25	2.5			2.5
Supercritical PC - Black coal without CCS	5	1.25	2.5			2.5
Supercritical PC - Brown coal with CCS				0.4		
Supercritical PC - Brown coal without CCS				0.4		
Wind - 200 MW	0	0	0	0	0	0

Note: Scope 3 emissions are not affected by CCS at the power station as these emissions occur elsewhere

SOURCE: ACIL ALLEN BASED ON NGA FACTORS

TABLE 3.4 NEW ENTRANT SCOPE 3 EMISSION INTENSITY (TONNES CO2-E/MWH AS GENERATED)

Technology	NSW	QLD	SA	VIC	TAS	SWIS
Biomass	0.00	0.00	0.00	0.00	0.00	0.00
CCGT - With CCS	0.10	0.06	0.08	0.03	0.03	0.03
CCGT - Without CCS	0.09	0.05	0.07	0.03	0.03	0.03
OCGT - Without CCS	0.13	0.08	0.11	0.04	0.04	0.04
Solar PV SAT 50 MW	0.00	0.00	0.00	0.00	0.00	0.00
Solar PV DAT 50 MW	0.00	0.00	0.00	0.00	0.00	0.00
Solar PV FFP 50 MW	0.00	0.00	0.00	0.00	0.00	0.00
Solar Thermal Central Receiver with 6 hrs storage	0.00	0.00	0.00	0.00	0.00	0.00
Solar Thermal Compact Linear Fresnel no storage	0.00	0.00	0.00	0.00	0.00	0.00
Solar Thermal Parabolic Trough with 6 hours storage	0.00	0.00	0.00	0.00	0.00	0.00
Supercritical PC - Black coal with CCS	0.05	0.01	0.02			0.02
Supercritical PC - Black coal without CCS	0.04	0.01	0.02			0.02
Supercritical PC - Brown coal with CCS				0.00		
Supercritical PC - Brown coal without CCS				0.00		
Wind - 200 MW	0.00	0.00	0.00	0.00	0.00	0.00

Note: Scope 3 emissions are not affected by CCS at the power station as these emissions occur elsewhere

SOURCE: ACIL ALLEN BASED ON NGA FACTORS

3.3 Actual emissions for calendar years 2005 and 2015

Part of the scope of work required provision of actual emissions for 2005 and 2015. Unfortunately, there is no 'actual' measure of emissions which are done on a calendar year basis and estimates are required. We have sourced Inventory data from the Department of Environment for 2004-05 and 2005-06 which covers the calendar 2005 year. Inventory data for 2014-15 is currently being prepared but has not yet been completed, so no actual data is available to estimate a calendar year 2015 value.

Through the use of the inventory data, ACIL Allen has calculated actual emission intensity values for each reported power station for 2004-05 and 2005-06 and has applied this to actual reported dispatch outcomes from AEMO's dispatch data.

The first and second quarter of 2005 have used the emission intensities from the 2004-05 inventory dataset and the third and fourth quarter of 2005 has used the 2005-06 inventory intensities. For plant which are not individually reported within the inventory, we have adopted our current emission intensity estimate.

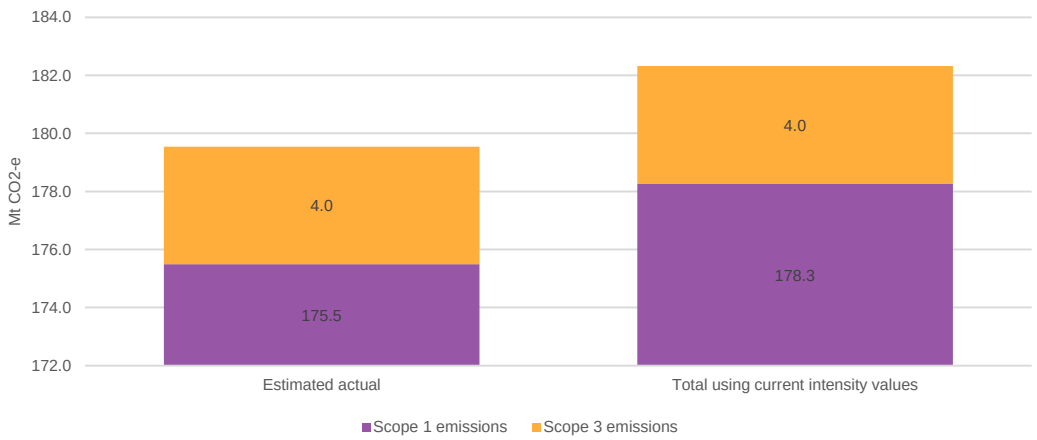
These intensities (calculated on a tonnes CO_2-e/MWh as generated basis) have then been applied to reported dispatch in each calendar quarter for 2005 and totalled to provide an estimate of Scope 1 emissions. The dispatch measure used is the sum of 'InitialMW' from AEMO's MMS datasets for each scheduled and semi-scheduled generator. Non-scheduled or embedded generators are excluded from the total emission figure.

There is no reporting of Scope 3 emissions attributable to individual facilities and therefore actuals are not available. We have therefore used the current Scope 3 emission intensities to calculate a total for 2005 based on generation volumes for each power station.

3.3.1 NEM emissions

Figure 3.5 shows a summary of the analysis for calendar year 2005 for the NEM. Total estimated Scope 1 emissions from NEM scheduled and semi-scheduled generators is 175.5 Mt CO_2-e, with associated Scope 3 emissions of 4 Mt CO_2-e. Based on the current intensity values assigned to individual generators, the calculated value would be around 178.3 Mt CO_2-e (1.6% higher).

FIGURE 3.5 SUMMARY OF ESTIMATED ACTUAL EMISSIONS FOR THE NEM IN CALENDAR YEAR 2005



Note: Includes scheduled and semi scheduled generators only

SOURCE: ACIL ALLEN ANALYSIS

TABLE 3.5 SUMMARY OF ESTIMATED ACTUALS FOR THE NEM IN CALENDAR YEAR 2005 (MT CO_2-E)

	Estimated actual	Total using current intensity input values
Scope 1 emissions	175.5	178.3
Scope 3 emissions	4.0	4.0
	179.5	182.3

Note: Includes scheduled and semi scheduled generators only

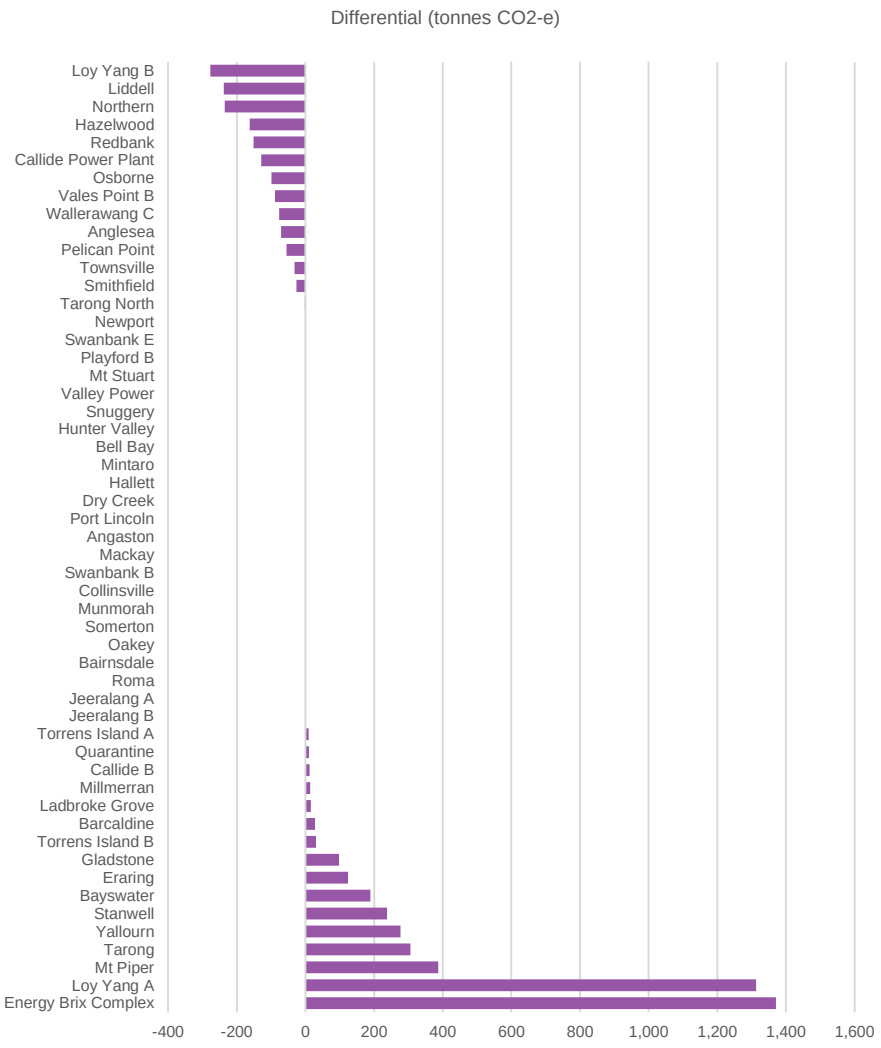
SOURCE: ACIL ALLEN ANALYSIS

Most of this difference is attributable to Energy Brix and Loy Yang A power stations which combined are 2.6 Mt CO_2-e over the estimated actual when using the current intensity values. While Energy Brix is somewhat academic given the station has now ceased operating, the NGER reports suggest its

emission intensity rose considerably toward the end of the plants life. Similarly, the emission intensity of Loy Yang A has risen which could be attributable to either the coal source or a declining thermal efficiency as the plant ages.

Figure 3.6 shows a breakdown of the differentials between the actual 2005 emission intensity values and the current estimated emission intensity values when applied to calendar year 2005 dispatch.

FIGURE 3.6 DIFFERENTIAL IN SCOPE 1 EMISSIONS BETWEEN ACTUAL 2005 EMISSION INTENSITY VALUES AND CURRENT ESTIMATED VALUES: NEM



SOURCE: ACIL ALLEN ANALYSIS

3.3.2 SWIS emissions

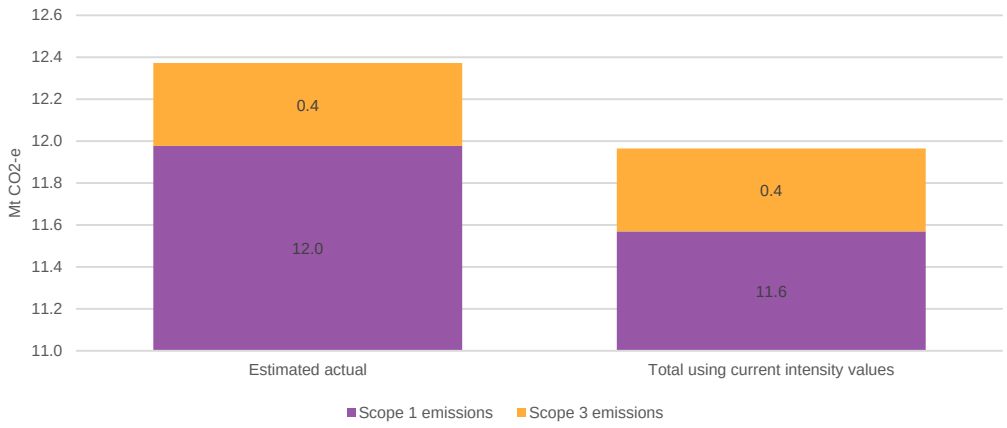
Figure 3.7 and **Table 3.6** provide the corresponding values for estimated actual SWIS emissions for calendar year 2005. Establishing an estimate for the SWIS was much more challenging than the NEM due to the lack of detailed dispatch data at power station level. In addition, the emission data from the Department does not provide a neat split between SWIS and off-grid Western Australian emissions. ACIL Allen has therefore had to make some assumptions regarding generation volumes for plant not explicitly reported in the Inventory dataset and also assume a level of generation across the four calendar quarters.

There also appears to be some erroneous emissions data within the inventory. While overall emissions are calibrated to statistics on fuel consumption, in some cases the allocation to individual generators appeared to be incorrect. It should also be noted that there is some generation which

occurs in the SWIS which is associated with vertically integrated generation facilities which do not export power to the grid (e.g. Alcoa's steam cogeneration units). Unlike the NEM, this energy is excluded from the market totals.

Total estimated Scope 1 emissions from SWIS generators is estimated to be 12.0 Mt CO_2-e, with associated Scope 3 emissions of 0.4 Mt CO_2-e. Based on the current emission intensity values assigned to individual generators, the calculated value would be around 11.6 Mt CO_2-e (3.4% lower) when applied to calendar year 2005 generation levels.

FIGURE 3.7 SUMMARY OF ESTIMATED ACTUAL EMISSIONS FOR THE SWIS FOR CALENDAR YEAR 2005



Note: Includes scheduled and semi scheduled generators only

SOURCE: ACIL ALLEN ANALYSIS

TABLE 3.6 SUMMARY OF ESTIMATED ACTUALS FOR THE SWIS IN CALENDAR YEAR 2005 (MT CO_2-E)

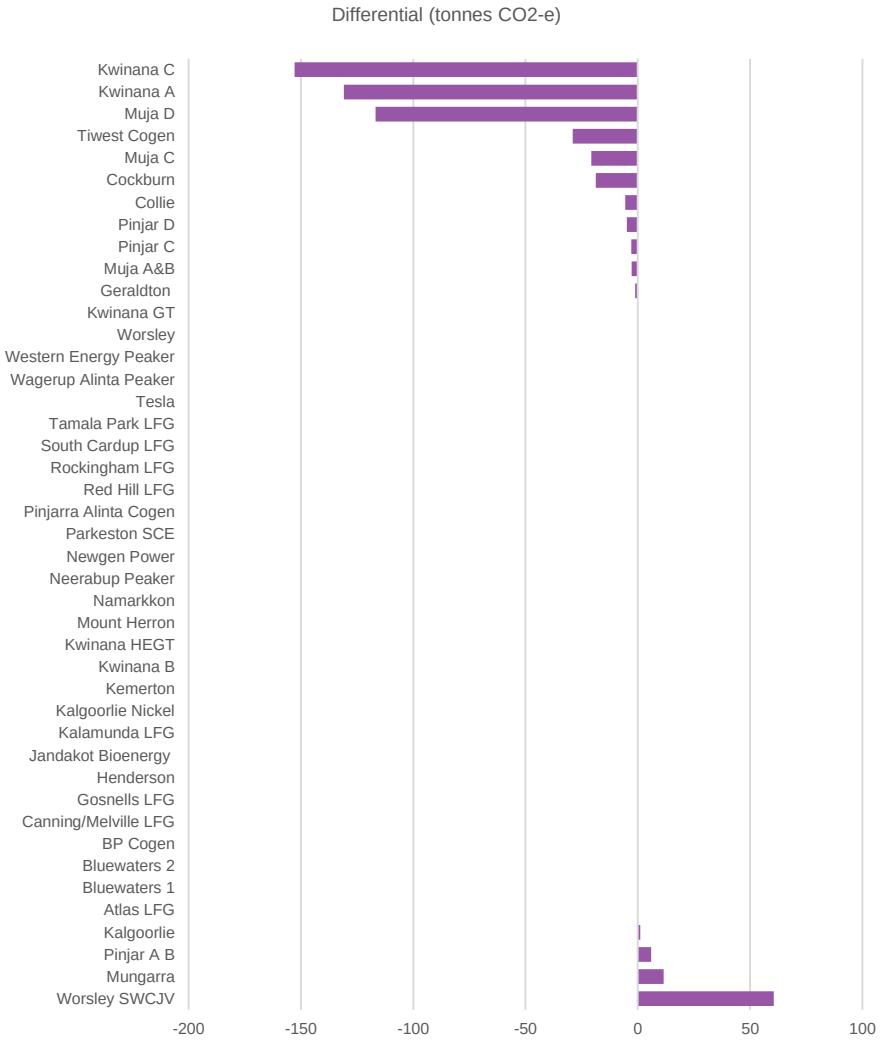
	Estimated actual	Total using current intensity input values
Scope 1 emissions	12.0	11.6
Scope 3 emissions	0.4	0.4
	12.4	12.0

Note: Includes scheduled and semi scheduled generators only

SOURCE: ACIL ALLEN ANALYSIS

Figure 3.8 shows a breakdown of the differentials between the actual 2005 emission intensity values and the current estimated emission intensity values when applied to calendar year 2005 dispatch. Current emission factors would underestimate emissions in the SWIS by around 0.4 Mt CO_2-e, with the majority of this differential attributable to Kwinana A/C (now retired) and Muja D power stations.

FIGURE 3.8 DIFFERENTIAL IN SCOPE 1 EMISSIONS BETWEEN ACTUAL 2005 EMISSION INTENSITY VALUES AND CURRENT ESTIMATED VALUES: SWIS



SOURCE: ACIL ALLEN ANALYSIS

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