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Department of Climate Change and Energy Efficiency

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Review of the NGER (Measurement) Determination

Response Paper

May 2011

Australian Government

Department of Climate Change and Energy Efficiency

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Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACARP	Australian Coal Association Research Program
ACA	Australian Coal Association
AFM	Ash Free Moist
AGEIS	Australia Greenhouse Emissions Information System
ANZSIC	Australia New Zealand Standard Industrial Classification
APPEA	Australian Petroleum Production and Exploration Association
ASTM	American Society for Testing and Materials
COD	Chemical Oxygen Demand
CPRS	Carbon Pollution Reduction Scheme
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAF	Dry Ash Free
DCCEE	Department of Climate Change and Energy Efficiency
DOC	Degradable organic carbon
EF	Emission factor
EC	Energy content
ETS	Emissions Trading Scheme
EITE	Emissions Intensive Trade Exposed Industries
GCV	Gross calorific value
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
MDL	Minimum detectable limit
MTB	Maximum tolerable bias
MRL	Minimum reportable limit
NGERS	National Greenhouse and Energy Reporting System
NGF	National Generators Forum
PBOGs	Petroleum based oils and greases
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	United States Environmental Protection Agency

Gases

CF_4	perfluoromethane (a perfluorocarbon)
C_2F_6	perfluoroethane (a perfluorocarbon)
CH_4	Methane
CO_2	carbon dioxide
HFCs	hydrofluorocarbons
N_2O	nitrous oxide
PFCs	perfluorocarbons
SF_6	sulphur hexafluoride

Contents

1 Executive summary

The *National Greenhouse and Energy Reporting (NGER) (Measurement) Determination 2008* (the Determination) outlines the measurement and estimation methodologies for greenhouse gas emissions within the *National Greenhouse and Energy Reporting (NGER) Act*. The *NGER Act, NGER Regulations* and *NGER (Measurement) Determination 2008* were the result of comprehensive consultation with business and other stakeholders between May 2005 and June 2008. Since its implementation the Department of Climate Change and Energy Efficiency (DCCEE) continues to work with industry on improvement of NGER estimation methods.

In August 2010 the DCCEE released a discussion paper for comment as part of a review of the *NGER (Measurement) Determination 2008*. The review, completing a commitment to review methods and factors within 5 years, is an enhancement of the annual review process and aims to update the Determination in light of technical and methodological developments–domestically and internationally. As with the regular annual review process, feedback from stakeholders was sought through a submission process between August and October 2010.

The Department released the discussion paper to gather feedback from stakeholders on the Determination. It did not necessarily reflect the views of the Government or the Department, or indicate a commitment to a particular course of action. The paper reviewed the emission factors and energy content factors adopted for method 1 and canvassed a range of issues relating to methodological improvements, technical developments and consultation on feedback received from specific stakeholders.

The Department received constructive feedback from 38 submissions covering the majority of issues raised in the discussion paper. Submissions ranged in sources from large industrial, mining, and energy companies; environmental consultancies, small manufacturing companies and government departments.

Issues that received the most submissions were:

- disaggregation of the fuel type ‘black coal’ into sub-bituminous coal, bituminous coal and anthracite fuel types
- simplification of reporting requirements for consumers of bitumen
- reporting of Petroleum Based Oils and Greases (PBOGs)
- classification, definition and emission factors of fuels provided in *the National Greenhouse and Energy Reporting Regulations 2008* (NGER Regulations) and *NGERS Measurement Determination*.

Not all issues in the discussion paper were addressed by the submissions received and several issues were addressed by only one or two submissions.

Based on the circumstances of each issue; some issues will be addressed in the current year; some deferred to later years; or in a few cases, no changes are anticipated for the time being. For issues that require further research, consultation and consideration this response paper will, as far as practicable, outline the process and timeline for implementing changes to the Determination. The paper summarizes the submissions and describes the Department’s current position on issues raised in the discussion paper after consideration of the industry feedback and additional consultation and research undertaken since the release of the discussion paper.

In an effort to make the response paper targeted and succinct much of the background information from the discussion paper has been removed. As a result this response paper should be read in conjunction with the original discussion paper. For those not familiar with the NGER system, a summary of background information and supporting principles can be found in the appendices at the end of this document.

A summary list of issues covered in the paper and broad timing on when Determination updates are anticipated is provided in the section 1.1.1 for reference. The list will direct you to the appropriate section of the document for additional details.

The discussion paper and this response paper do not consider amendments directly consequential to the introduction of a carbon price. Any such necessary amendments will be addressed in a separate process. This review forms part of the continuous improvement process aimed at creating a robust data set that can underpin a carbon pricing mechanism at the time that one is introduced and supports Australia's emissions reporting internationally.

Where to next

The response paper is the next stage in a year-long consultation process on the Determination. In parallel to this response paper the Department will release a consultation draft of the *NGER (Measurement) Amendment Determination 2011* that will apply to the 2011-2012 reporting year. These amendments will commence on 1 July 2011 pending consultation and approval by the Minister and only impact on NGER reports submitted from October 2012.

Some amendments to estimation methods are dependent on changes to the NGER Regulations. Implementation will occur at the next available opportunity to amend the NGER Regulations which require Federal Executive Council approval.

Following the release of the *NGER (Measurement) Amendment Determination 2011* consultation draft, the public and industry have four weeks to respond and submit comments. The Department will then propose a final set of amendments for the Minister's consideration.

The Department will continue to work with industry on clarifying outstanding concerns, undertaking supporting research and continuing work on defining a clear and robust framework for the estimation of Australia's emissions.

1.1 Outcomes

The submissions highlighted a diversity of views on issues covered in the discussion paper. Some issues have uniform support with industry while on other issues, industry retains divergent views on the appropriate way forward.

For some issues, such as clay brick manufacturing and methane emission factors for liquid fuels there are ongoing research programs that will contribute to improving the estimation methods. In these cases, amendments will be deferred until the research outcomes are available and can fully inform future amendments. For an outline of the Amendment to be implemented for the 2011-2012 reporting year see section 1.2.1.

1.1.1 Proposals for amendments in 2011

- Amend the completeness principle to provide for an explicit, positive list of emission sources (Determination Section 1.13) (see section 2.1.1 of this document)
- The introduction of a threshold for electricity generators to be required to use method 2 or higher to estimate emissions from their primary solid or gaseous fuels (see section 2.1.4 of this document)
- Amendments to the process of testing for carbon in ash including the appropriate testing method and the frequency of testing (see section 2.2.4 of this document)
- Clarify the term for waste oil for reporting of petroleum based oils and greases by changing the term to 'oil transferred offsite' (Determination Division 2.4.5A) (see section 2.2.8 of this document)
- Clarify the treatment of fugitive emissions from the flaring of waste gases in the oil and gas and coal mining sectors. (Determination Chapter 3) (see section 2.3.2 of this document)
- Incorporate lime kiln dust and magnesian/dolomitic lime production in the methods for lime production (Determination Division 4.2.2) (see section 2.4.2 of this document)
- Extend the carbon balance method for the estimation of emissions to chemical and metal products (Determination Parts 4.3 and 4.4) (see section 2.4.1 of this document)
- Clarify the treatment of carbonates consumed during the production of phosphoric acid (Determination Division 4.2.3) (see section 2.4.2 of this document)
- Clarify the treatment of carbon anode emissions (Determination Divisions 4.3.5, 4.4.2 and 4.4.5) (see section 2.4.2 of this document) and clarification that fused magnesia and zirconia production should be reported under the Other Chemical or Mineral Products source (Determination Division 4.3.5) (see section 2.4.2 of this document)
- Include ASTM standards for the analysis of cement and lime products (Determination Divisions 4.2.1, 4.2.2 and 4.2.3) (see section 2.4.3)
- Introduce for wastewater treatment emission factors for nitrous oxide from discharge of effluent differentiated by aquatic environment (see section 2.6.2 of this document)
- Ensure consistency and comparability between the methods for domestic and commercial wastewater emissions estimation and industrial wastewater emissions estimation through the allowance of a deduction for COD (chemical oxygen demand) leaving the site in effluent (see section 2.6.3 of this document)
- Update to estimation method 1 and method 2 for solid waste disposal (see section 2.5 of this document)
- Update to estimation of plant specific COD:VS (chemical oxygen demand: volatile solids) ratios and nitrogen removed in sludge for wastewater treatment plants (see section 2.6.2 of this document)
- Extend the methods for waste incineration to higher order methods such as direct monitoring of emissions (see section 2.7.1 of this document)

1.1.2 Proposals for amendments in 2012

The issues listed below have been discussed in the response paper and are planned for implementation in next year's update to the Determination to facilitate additional research and an appropriate phase-in period for industry.

- Broaden the options available for the treatment of missing data (Determination Section 1.19) (see section 2.1.2 of this document)
- Introduce an explicit minimum reporting rule for emission estimates below the minimum detection limits of measurement instruments and methods for certain sources (see section 2.1.3 of this document)
- Disaggregate the fuel type 'black coal' into sub-bituminous coal, bituminous coal and anthracite fuel types (this amendment also requires updates to the NGER Regulations) (see section 2.2.1 of this document).

1.1.3 Issues requiring amendment of the NGER Regulations

- Clarify the scope of the source for manufacture of solid fuels to ensure inclusion of char, brown coal briquettes and other solid fossil fuels (Determination Division 2.5.2) (see section 2.2.5 of this document)
- Simplify reporting requirements for consumers of bitumen (see 2.2.9 of this document) (update to the NGER Regulations required).

1.1.4 Other issues to be considered for future amendments

The issues listed below have been discussed throughout the response paper. Some issues require further research and data to become available. Other issues will be addressed through improved guidance and examples in the *NGER Measurement Technical Guidelines* (the Technical Guidelines) while other issues will remain on the Department's watch-list to monitor industry, technological and international developments.

- Requirement to use method 2 or higher for large users of solid and gaseous fuels (see section 2.1.4 of this document)
- Options for improving consistency of the treatment of bias tolerances and repeatability and reproducibility limits (see section 2.2.2 of this document)
- Extend identified product types for petroleum refining to include ethylene oxide and methanol (Determination Schedule 3, Part 4) (see section 2.2.6 of this document)
- Review options for reporting of explosives (see 2.2.7 of this document)
- Review methane factors for liquid fuels (see section 2.2.10 of this document)
- Clarify the treatment of fugitive leaks of natural gas and vent emissions from the processing of natural gas by industrial facilities (Determination Chapter 3) (see section 2.3.2 of this document)
- Consider the accounting treatment of the conversion of carbon dioxide to stable carbon containing products (see section 2.3.3 of this document)

- Further consider the accounting treatment of the geological storage of trace gases such as methane in carbon dioxide captured for permanent storage (see section 2.3.3 of this document)
- Clarify the treatment of hydrogen production by facilities other than petroleum refining and ammonia production (Determination Division 4.3.1) (see section 2.4.2 of this document)
- Include an additional method for the estimation of emissions from the calcination of carbonates during ceramic production based on the alkali earth oxide contents of the ceramic products (Determination Division 4.2.3) (see section 2.4.2 of this document)
- Clarify treatment of emissions from the use of carbon dioxide and from the use of nitrous oxide (see section 2.4.4 of this document)
- Development of a method for the estimation of emissions from solid waste disposal using method 4 (see section 2.5.5 of this document)
- Review of estimation methods for emissions from biological treatment of wastes (see section 2.5.6 of this document)
- Development of method for estimation of emissions from wastewater treatment using method 4 (see section 2.6.2 of this document)
- Extend the scope of the source of methane emissions from industrial wastewater treatment plants to wastewater treatment in other industrial sectors such as petroleum refineries (Determination Part 5.4) (see section 2.6.3 of this document)
- Inclusion of estimation methods for new waste disposal techniques such as plasma arc gasification (see section 4.7.2).

2 Measurement and reporting issues

2.1 General issues

2.1.1 Completeness

The principle of completeness specified in the Determination is intended to ensure that all sources of emissions in the identified sector that are reported by the Australian Government internationally are also reported by NGER reporters.

The completeness principle, as currently stated in the Determination refers to '*all identifiable emission sources within the energy, industrial process and waste sectors as identified by the National Inventory Report must be accounted for.'* Feedback from stakeholders suggested some ambiguity as to the scope of completeness. The discussion paper proposed to clarify the completeness principle by referring to the explicit, positive list of emission sources in section 1.10 of the Determination.

Stakeholders generally supported the clarification to the completeness principal noting that it improved certainty around the emissions sources that need to be reported. For example BHP Billiton stated:

> *'This amendment would provide clarity and reduce confusion on how to interpret the completeness principle.'*

Other stakeholders, while supporting the approach, noted the need to ensure adequate coverage to cover certain industrial processes which may not fit into existing emission source definitions; for example, emissions from the manufacture of steel from electric arc furnaces. Industrial processes will continue to be reviewed to evolve full coverage of emissions that are required to be incorporated into Australia's National Greenhouse Accounts. For example the coverage of electric arc furnace use is addressed in the current round of Determination amendments.

The completeness principle has been updated in the proposed Determination updates to refer to the positive list of sources.

2.1.2 Missing data

Section 1.19 of the Determination provides methods for the estimation of data during the temporary unavailability of a method due to a mechanical or technical failure. Stakeholder advice is that the accuracy of missing data estimates can be improved by utilizing more detailed methods than the average daily emissions estimated approach currently mandated in the Determination. Alternative methods, often outlined in industry guidelines would need to be shown to be more accurate than the existing method and include detailed information on inputs, splicing techniques or proxy indicators to ensure time series consistency.

Submissions were sought on the availability of industry guidelines for resolving data gaps during down time for use under NGERS.

A number of submissions supported the proposal to expand the options for estimating missing data in order to improve accuracy in reporting.

Some industries flagged the current development of industry guidelines that would address missing data provisions. For example the National Generators Forum noted that:

'The NGF has used consultants to deal specifically with the issues related to data gaps and NGF members collectively are in the process of developing generation industry-specific guidelines on the treatment of missing data as well as a number of other issues.

As such, it would greatly assist generators, and other industry, if more thorough or more effective methods for dealing with missing data would be permitted.'

Industry guidelines may be referenced to reduce uncertainty in future amendments to the Determination if they are shown to be more accurate than the current method and provide unbiased results.

Some submission cautioned that industry guidelines may not be sufficient to allow for all eventualities of missing data and reporters may need to adopt additional facility specific approaches to data gaps. For example the National Generators Forum submitted that:

'…reporters should have the discretion of offering alternative facility specific techniques for resolution of data gaps and submit sustaining details with their reports.'

Fully documented industry guidelines relating to missing data provisions are currently unavailable. This issue will be kept under review with the intention of expanding the missing data provisions in the 2012 update to the Determination subject to the availability of industry guidelines.

2.1.3 Application of minimum reportable limits to emissions detection

The minimum detection limit (MDL) thresholds for measurement instruments and/or methods have implications for the precision of emission estimates when emission concentrations are very low. In such situations, the emission estimate is not only associated with an increased level of relative uncertainty but also questions as to whether the emission may actually be present or not.

The discussion paper proposed a range options for reporting data through the introduction of a minimum reportable limit. A number of submissions were received, with a common view that the issue required further consideration before implementation.

The MDL issue is currently of most relevance to the application of method 2 for fugitive emissions from open cut mines where the measurement of low gas contents may occur around levels of the current MDL of the measurement method. Guidelines for the application of method two for open cut mine emission estimation are still being developed with industry and research institutions. Consideration of an MRL has been deferred while exploration of the open cut mine method continues.

2.1.4 Higher order methods for large users of solid and gaseous fuels

Currently in the Determination methods 2, 3 and 4 must be used for estimating emissions if the principal activity of the facility is electricity generation (ANZSIC industry classification code 2611). For large users of solid and gaseous fuels in other sectors any method may be used.

Extending the requirement for use of higher order methods to large users of solid and gaseous fuels in other industries would promote comparability and quality of data across industry sectors.

Consideration was given to introducing a threshold for consumers of solid and gaseous fuels that would only

affect very large consumers of solid and gaseous fuels. The following thresholds were suggested.

- 400,000 tonnes for solid fossil
- 20,000,000 GJ or 500,000,000 m^3 for natural gas distributed in a pipeline.

Thresholds could be introduced over time to assist corporations in preparing for higher order reporting methods, particularly if there were substantial costs involved.

Submissions were sought on extending the requirement to use higher order methods to large users of solid and gaseous fuels from sectors in addition to electricity generators and the measurement cost implications for users of solid and gaseous fuels that exceed certain thresholds.

Industry are concerned that the cost associated with facilities moving to higher order, more accurate methods would not be appropriate at this stage. However there was acknowledgement that the use of higher order methods would be more appropriate with the introduction of a carbon price. The Australian Petroleum Production and Exploration Association (APPEA) submitted that:

> *''In addition to the extra costs, APPEA members do not see any advantages in moving to a higher order method of measurement. Members acknowledge that the Method 1 may not be as accurate as 2 or 3, but understands the default factors to be relatively conservative, i.e. over reporting is more probable than under reporting. Therefore, there is little justification for increasing measurement burdens in order to avoid under-reporting on an international scale.*
>
> *In a CPRS environment, when companies may face a cost on each tonne of CO_2, APPEA members understand that the movement to higher order methods will be necessary and believes this to be a sensible approach.'*

A number of stakeholders outlined special circumstances in their industries that would make the sampling and analysis requirements of method 2 infeasible. To address these concerns the gaseous fuels threshold could be restricted to natural gas distributed in a pipeline and coal seam methane that is captured for combustion.

Recognising the additional reporting cost associated with introducing higher order methods the Department does not propose to proceed with amendments to the Determination at this stage.

Currently, if the primary activity of a facility is electricity generation, a higher order method must be used for estimating emissions of carbon dioxide for the main fuel combusted from the operation of the facility. Some small electricity generators (i.e. small natural gas generators) have noted that this imposes an additional cost on their facility that is not faced by facilities of a similar size in other industries. For example Worley Parsons noted that:

> *'The NGER legislation does not take into account the size of the electricity generation facility but makes a broad statement that all electricity generation facilities must use at least Method 2. This is not the experience gained from the Generator Efficiency Standards as these original standards only applied to facilities of 30MW or above and 50GWh per annum output level (Generator Efficiency Standards - Section 4.0 Application of Greenhouse Efficiency Standards), for some reason these thresholds were not transferred over to NGERS. As a result the enforcement to use Method 2 goes against the NGER statement that the legislation is to 'Minimise the reporting burden on corporations'. It is not normal practice for small power stations to monitor or sample gas composition*

and this creates an additional cost for monthly sampling in order to comply with Method 2.'

While EDL notes that:

> *'The Determination currently provides that where a facility's principal activity is electricity generation, method 1 measurement must not be used to estimate emissions of carbon dioxide for the combustion of the primary solid or gaseous fuel. Consequently, EDL's operations that utilise coal mine waste gas (CMWG) or pipeline natural gas (NG) as fuels for electricity generation require regular emissions testing in accordance with method 2 measurement (or higher).*
>
> *The Discussion Paper notes that the higher order testing reflects generators' experience in emissions testing prior to the introduction of NGERs. The generality of that statement causes some issues for small generators such as EDL. EDL has never entered into an agreement under the Generator Efficiency Standards program nor the Energy Efficiency Opportunity program and as such, is not required to estimate emissions using higher order testing.*
>
> *The Determination in its current form has significant imposts for EDL, a small company seeking to implement key government policies associated with climate change, energy efficiency, waste product utilisation, and better remote community solutions.'*

Therefore, in the interests of reducing the cost of reporting for small electricity generators and improving the consistency in measurement requirements between sectors a threshold has been proposed. Small electricity generators that do not meet the threshold would not be required to use higher order methods when estimating their emissions.

The threshold proposed in the *NGER (Measurement) Amendment Determination 2011* consultation draft is 30MW of electrical capacity and 50 GWh per annum electrical output, consistent with the Generator Efficiency Standards upon which the method 2 measurement requirements were based.

Higher order methods remain available to all facilities that wish to improve the accuracy of their reported data.

2.2 Fuel combustion

2.2.1 Method 1: Review of fuel classifications

Under the NGER Regulations consumption of fuels must be classified by the reporter into nominated fuel classifications. A list of fuel classifications is provided in Schedule 1 of the *NGER Regulations.* The fuel classifications for petroleum products have been harmonized, where possible, with those used for the Australian taxation system. For other fuels, the classifications draw heavily on those used by the International Energy Agency. If a fuel type cannot be identified against the existing fuel list, then it must be reported against an 'other' category.

Fuel classifications and their definitions have the potential to affect the estimation of emissions. This is the case particularly when emissions from the consumption of individual fuels are estimated using method 1 which provides for the use of different default emission factors for individual fuel types. When methods 2 or 3 are used for the estimation of emissions from fuel combustion this issue is less important as the default factors are not used in the estimation process. Instead, the carbon content of fuels is estimated directly from the sampling of fuels consumed.

The definitions of fuel types are provided in the NGER Regulations and draw heavily on the definitions provided by the International Energy Agency and, in some cases, the Intergovernmental Panel on Climate Change.

The case for additional fuel categories would need to be supported by the ability to identify and define the fuel, the use of the fuel at a number of reporting facilities and the ability to derive or source an emission factor that is appropriate for the fuel.

A number of fuel classification queries have been raised previously by stakeholders. These include:

- coal seam methane applied to the natural gas pipeline
- pure ethanol and denatured ethanol
- clarifying the term 'acquired' relevant to steam, compressed air or waste gases.

Submissions were sought on the classifications and definitions of fuels provided in the NGER Regulations and the Determination. In particular, feedback was sought on whether the list of fuels in Schedule 1 of the NGER Regulations is comprehensive and consistent with terminology commonly used by Australian industry.

A number of submissions were received on the fuel classifications.

Expansion of coal types

Submissions were sought on the proposal to disaggregate black coal into sub-bituminous, bituminous coal and anthracite. The submissions were generally supportive of the proposal, seeing it as providing greater flexibility for reporting which will allow a more accurate reflection of coal types.

For example BlueScope Steel stated that:

> *'BlueScope supports the proposal to disaggregate black coal (other than that used to produce coke) fuel category into sub-bituminous, bituminous and anthracitic categories. By inserting these sub-classifications, BlueScope*

believes that the accuracy of the scheme will be materially improved.'

While Wesfarmers noted that:

'Wesfarmers and its Resources Division encourages the disaggregation of the "black coal" fuel category. The category titled "open cut sub-bituminous coal in Western Australia" will more accurately reflect the energy content of coal produced by Premier Coal in the Collie Basin.'

Consultations were also held with ABARES as they are a key user of NGER coal type consumption and production data. ABARES use coal data for the compilation of the Australian Energy Statistics, the national energy balance and reporting of national energy data to the International Energy Agency (IEA).

In response to the submissions, the Department proposes to:

- Change the coal names by replacing Black coal (other than used to produce coke) with Sub-bituminous coal, and Bituminous coal, and Anthracite
- Include in the NGER Regulations, for introduction in 2012, the disaggregated coal types using the Australian standard for classification and coding systems for Australian Coals (AS 2096-1987).
- Establish appropriate default energy content and carbon content factors using 'as received basis'. The Department proposes to utilise the 3 years of NGER data which will be available following November 2011 to assist in the development of these factors
- Consult on the introduction of energy content and emission factors for the new coal types prior to introduction in the June 2012 Determination.

In considering the proposed changes, the Department examined the following issues:

Selection of coal type names

Coal type names should be simple, straightforward and have a common understanding by reporters, as well as a sound scientific basis.

There are numerous systems available for the classification of coals. The traditional coal names as listed in the Australian Standard for Classification and Coding Systems for Australian Coals (AS 2096-1987) provides the most straightforward, readily recognizable coal names for use by reporters using method 1 while improving the range of available coal types and respective energy contents.

The Department proposes to replace the existing fuel type – Black coal (other than used to produce coke) with Sub-bituminous coal, and Bituminous coal, while also adding the coal type – Anthracite. The proposed coal types are presented in Table 1. Brown coal and coking coal are retained. Several submissions supported the retention of coking coal and its respective energy contents.

Establishing definitions for the coal categories

The IEA and Australia Standards both provide a coal classification structure and associated coal definitions. The IEA are currently in the process of amending their classification to a form that is similar to the Australian Standard.

Given that the IEA definitions are currently under development the Department proposes to utilize the

Australian Standard for Classification and Coding Systems for Australian Coals (AS 2096-1987). It provides classification and definitions for coal types in a format that refers to traditional names. This provides an authoritative and relevant source which the Department considers can be used to provide definitions for the proposed coal categories. For the purposes of the Determination fuel list, coking coal is an exception that is defined by its use, rather than its physical properties, i.e. coal that is used to produce coke. The proposed definitions are shown in Table 1.

Establishing the default energy content reporting 'basis' of the coal categories

The energy content of coal can be quoted on a wide range of bases. For instance, two commonly used bases are; 'dry ash free' (DAF) and 'ash free moist' (AFM), referring to the hypothetical conditions for which a sample is assumed to be free of ash and moisture (DAF), or with moisture determined by its moisture-holding capacity (AFM). Both bases give very different energy content figures for the same sample of coal.

The Department intends to retain the use of default energy contents for coal based on an 'as received/as sampled' basis. This approach assigns an energy content on the direct coal tonnage consumed or produced and is therefore based on coal 'as is' and does not rely on further measurement of moisture, ash etc. It is consistent with the simple approach of method 1 used throughout the Determination. It is also consistent with the measure of salable coal as used by ABARES and with advice from the Australian Coal Association (ACA).

Other submissions suggested that the Determination should not provide explicit default energy content for the coal types, but instead provide a DAF energy content. The DAF energy content will then need to be varied by a formula; with the reporter deriving an actual energy content relevant to their ash and moisture contents. While this approach would potentially improve the quality of data obtained through method 1, the Department considers there is a risk that it may impose a burden on the reporter to obtain additional information on its coal composition using sampling and analysis that is not consistent with the principle of the method 1 approach used throughout the Determination. Higher order methods are available for reporters who wish to derive facility-specific energy contents for their coal.

Establishing the default energy contents (GJ/t) and CO_2 emissions factors for the coal categories

The Department intends to consider the NGER reporting data obtained through reporting using higher order methods. Following November 2011 there will be 3 years accumulated data available from NGER reports to assist the Department in developing appropriate default factors. The Department will consult on the introduction of the energy content and emission factors prior to introduction in the June 2012 Determination.

Table 1. Proposed new coal types and definitions

Coal type	Definition (c) (d)
Brown coal [(a)]	Coal having a gross specific energy of less than 19.00 MJ/kg (AFM).
Sub-bituminous coal [(a)]	Coal having a gross specific energy in the range 19.00 MJ/kg to 23.98 MJ/kg (AFM) inclusive, or to 26.48 MJ/kg (AFM) inclusive provided that the crucible swelling number is only 0 or 1/2.
Bituminous coal [(a)]	Coal having a volatile matter ≥ 14.0 percent (DAF) *and* gross specific energy ≥ 26.50 MJ/kg (AFM) (≥ 24.00 MJ/kg (AFM) provided that the crucible swelling number is ≥ 1).
Anthracite coal [(a)]	Coal having volatile matter less than 8.0 percent (DAF).
Coking coal [(b)]	Coal that is used to produce coke

Notes:

a) Source is the Australian standard for classification and coding systems for Australian Coals (AS 2096-1987).

b) Coals used to produce coke to be classified as 'Coking coal'

c) DAF is 'dry ash free'

d) AFM is 'ash free moist'

Acetylene

Submissions were received outlining both support and concern for the potential explicit listing of acetylene as a separate fuel type. BlueScope Steel stated in their submission;

> *'BlueScope Steel reported acetylene in the 2010 NGER submission. The significant time and resources required to produce accurate estimations of the consumption of this fuel was disproportionate to the immaterial nature of the actual emissions from this source.'*

The Department proposes to not separately identify acetylene as a NGERS fuel type at this stage. The Department will continue to monitor existing and alternative fuel types and would appreciate further feedback from industry as it becomes available.

2.2.2 Methods 2 and 3: Bias and precision testing

Methods 2 and 3 provide for the use of measurements made at the facility to determine a facility-specific emissions factor. The precision of these estimates may be estimated in accordance with specific procedures set out in certain Australian and international standards. The principal elements relate to bias and repeatability/reproducibility.

Bias testing

In the case of method 2 for fuel combustion, the Determination outlines the general requirements:

- Samples must be free of bias such that any estimates are neither over nor under estimates of the true value.
- Bias must be tested in accordance with an appropriate standard (if any).

The Determination notes that an appropriate standard for most solid fuels is *AS 4264.4 – 1996 Coal and Coke – Sampling – Determination of precision and bias*.

Bias can be defined as the tendency to obtain a value that is either consistently higher or consistently lower than the reference value. In practice this is the difference between the reference value and the average result obtained from a large number of determinations.

The Australian standard establishes processes for the testing of bias in the analysis of coal characteristics. The standards establish the concept of maximum tolerances – i.e. the tests allow the analyst to conclude that the results of this bias testing are within an acceptable range under what is termed a Maximum Tolerable Bias (MTB). However, a standard MTB is not defined in quantitative terms under the standard referenced for solid fuels (AS 4264.4) nor under the Determination. Given this, the Determination could be amended to set a MTB to enable the consistent application of bias tolerances across each fuel type.

Submissions were sought on the options for improving the consistency of the treatment of bias tolerances. Stakeholders did not identify any standards that could be referenced for the testing of bias for gaseous and liquid fuels.

The most substantial submission on the use of bias was provided by the National Generators Forum who stated:

> *'NGF members welcome the discussion on bias, repeatability and reproducibility but note that it may do little to remove the vagueness in the (Measurement) Determination with respect to bias testing. Bias testing is often expensive, at times not particularly practical and in some cases it could be dangerous.*
>
> *The suggested direction for establishing a maximum tolerable bias (MTB) is welcomed as it assists in determining a measured parameter assumed to be 'free of bias'. The use of AS4264.4 in determining bias is sensible, but, as noted, the standard does not set quantitative limits, nor does it deal with the correction of results, as this is outside the scope of the standard.*
>
> *Also there continues to be a lack of clarity around the frequency of testing for bias.'*

Alternatively, one submission supported the results of bias testing being reported under NGERS in conjunction with facility specific emission factors.

The Determination does not specify requirements on the frequency of bias testing. However, the Technical Guidelines recommend the frequency of bias testing based on approaches established during the operation of

the Generator Efficiency Standards [1] program.

The Technical Guidelines state that bias testing should always be carried out on a new sampling system. For an existing system, the following verification procedure may be followed if there is some doubt about the conformance of the sampling system:

- conduct a detailed technical audit of the sampling system
- correct any non-conformances that have been observed
- conduct a limited bias test on the system, usually with the coal that exhibits the widest stochastic variability in total moisture or ash, to provide a more quantitative verification that the sampling system is performing correctly.

Stakeholders have also noted that the Determination and Technical Guidelines do not set out any methods to correct for bias. However, the Australian standards that address bias detection issues do not recommend correction of data. Rather they recommend that, if bias is detected, the cause of bias should be removed.

The NGF noted in their submission that industry follows the Technical Guidelines and apply significant rigour to bias testing for new plant items.

The Department is not proposing any changes to the current bias treatments in the Determination at this stage.

The Department will investigate arrangements for the testing of bias applied in other reporting systems including the EU ETS and US Mandatory Reporting Rule including the testing of bias for gaseous and liquid fuels. The Department will continue to seek feedback from industry with the aim of introducing an appropriate MTB in future updates to the Determination.

2.2.3 Reproducibility, repeatability and equivalence of standards

Australian and international standards set out procedures for the analysis of the precision of estimates of specified coal characteristics. Different standards set out slightly different procedures but all standards aim to permit the analyst to produce accurate, unbiased estimates that may be consistently prepared over time and from laboratory to laboratory. Two parameters found in the analysis standards that are open to comparison relate to repeatability and reproducibility.

Repeatability refers to the ability of an analyst to determine the same value for a common sample over time while reproducibility refers to the ability of one laboratory to obtain the same value for a common sample as obtained by another laboratory.

Stakeholders have identified that there are sometimes varying reproducibility and repeatability requirements between standards for the estimation of carbon in coal. In order to address this potential ambiguity the Determination could refer to minimum reproducibility and repeatability limits to be applied consistently to the analysis of characteristics of specified fuels.

Submissions were sought in relation to the option of establishing common minimum standards for repeatability and reproducibility limits for the analysis of characteristics for specified fuel types.

[1] The Generator Efficiency Standards program was introduced on 1 July 2000 to achieve movement towards best practice in the efficiency of fossil-fuelled electricity generation, and to deliver reductions in the greenhouse gas intensity of energy supply.

The NGF submitted:

> *'Repeatability and reproducibility issues will also be addressed in the NGF guidelines under development. An issue of particular significance is the issue of reproducibility for carbon in coal and ash and again NGF will incorporates its consultant's advice on this Issue in the NGF guidelines. However, it should be noted that different standards detail different reproducibility tolerances, adding to the overall concerns about poor inter-laboratory reproducibility for carbon determinations…*
>
> *At present, all parties concerned are awaiting the outcome of Proficiency Testing Australia's round-robin 26 with respect to coal analysis before advancing this issue further.'*

The Department will await the findings of the PTA (Proficiency Testing Australia) study and NGF guidelines with respect to coal analysis before looking to improve equivalence between standards by setting minimum repeatability and reproducibility standards for the estimation of carbon in coal.

2.2.4 Carbon in ash determination

In order to estimate a facility-specific oxidation factor, sections 2.9 through 2.11 of the Determination outlines the requirements for sampling and analysis of furnace ash and fly ash for key characteristics including carbon content. The Department sought feedback from stakeholders on the following issues.

- Requirement to sample carbon in fly ash as a function of load – Stakeholders have noted that sampling fly ash with load is a significant cost imposition. Evidence showed that the variation in carbon was found to be relatively narrow for large base load electricity generators. It was proposed to remove the requirement to sample as a function of load in the Determination.

The proposal to remove the requirement for facilities to sample ash as a function of load was supported by current method 2 and 3 reporters. The National Generators Forum noted that:

> *'NGF members welcome the Discussion Paper's treatment of carbon in ash, and in particular with respect to ash sampling as a function of load. As responsible entities, NGF members do conduct sampling depending on plant operational requirements and sampling as a function of load would still be used as necessary if a dependency is suspected.'*

This requirement has been removed in the proposed amendments to the Determination and will be included as a recommendation in the Technical Guidelines for facilities where load profiles vary significantly throughout the operation of the facility.

- Frequency of sampling for carbon in fly ash – the requirement in the Determination to sample carbon in fly ash at least every one or two years is less regular than is required to get accurate results and is potentially less frequent than current industry practice.

The National Generators are concerned by the discussion on ash sampling frequency, noting that:

> *'NGF members are concerned about the suggestion that ash sampling frequency is less than desired. All NGF members augment annual or biennial ash sampling with further sampling if operating conditions change*

significantly. Without changes in operating conditions, there is no evidence to suggest that more frequent sampling is needed, particularly when initial more thorough sampling programs indicate consistency.'

The Determination has retained the existing frequency of sampling for carbon in fly ash. The proposed amendments acknowledges that more regular testing may be undertaken as is the case at some facilities.

- Other carbon losses – stakeholders point out that other carbon losses such as economiser ash and mill rejects may also contain unused carbon and should be accounted for in the oxidation calculation.
- The Determination currently uses the loss on ignition analysis (AS 3583.3 -1991) for testing of carbon in ash. Stakeholder feedback has indicated that this method can overestimate the amount of carbon in ash.

The Determination states that samples of furnace ash may be collected:

- if contained in a wet extraction system – by using sampling ladles to collect if from sluiceways
- if contained in a dry extraction system – directly from the conveyor.

It is recognised that the ash handling system at each facility is different and in some cases the collection points above may not be feasible.

Submissions were sought in relation to additional points from which the furnace ash may be collected and in relation to the possible amendments to the process of testing for carbon in ash.

The National Generators Forum suggested a general requirement that representative ash sampling is done and it be left to facilities to demonstrate how this has been completed. The Department proposes to retain the current approach until more information is available on sampling practices. The Department welcomes feedback from industry to ensure the Determination requirements are appropriate for all facilities, particularly in relation to the location of sampling of fly ash and furnace ash.

2.2.5 Manufacture of solid fuels

Reporters have identified char production facilities as a source that required clarification of an appropriate method in the Determination. Division 2.5.2 in the Determination currently provides for emissions from the manufacture of solid fuels but has been limited to fuel transformation in coke ovens. It was proposed to clarify the application of this division to also include the production of char, brown coal briquettes and other solid fuels of fossil origin.

Submissions were sought on the inclusion of other solid fossil fuel production such as char and brown coal briquettes in Division 2.5.2.

Industry expressed support for modifying Division 2.5.2 to enable the carbon balance method to be applied to estimating emissions from the manufacture of solid fuels such as coal char, brown coal briquettes and other forms of coke.

Premier Coal noted difficulty in reporting emissions from its char manufacturing plant using the existing Determination and endorsed the inclusion of methodologies for calculating emissions from char manufacturing in the Determination.

The Department proposes to clarify Division 2.5.2 Manufacture of Solid Fuels in order for a carbon balance to be used for a broad range of solid fuel manufacturing, including cokes (coke oven coke, coke breeze, foundry coke, and retort coke), coal char and coal briquettes.

2.2.6 Petrochemical and methanol production

Carbon dioxide emissions from petrochemical production are estimated under Division 2.5.3 of the Determination. Division 2.5.3 provides a carbon balance for which method 1 refers to Schedule 3 for appropriate carbon content factors for each fuel input (see Schedule 3 Part 4). Schedule 3 also provides carbon content factors for petrochemical products which is not exhaustive. It was proposed to add ethylene oxide and methanol to the list of petrochemical products listed in Part 4 of Schedule 3 in the Determination.

Submissions were sought on the inclusion of ethylene oxide and methanol to the list of petrochemical products listed in Part 4 of Schedule 3 however limited feedback was received. In light of the response, the Department intends to address this issue after further consideration.

2.2.7 Combustion of fuels in explosives

Estimation of emissions from combustion of pre-prepared explosives is complex as it is difficult to establish a default fuel mix to be applied to the consumption of explosives. When prepared in the field, the quantity of fuel used in the preparation of the explosive is known. However, in the case where explosives are pre-prepared, then the fuel that enters the facility within the explosive may not be known and consequently not accurately reported as combusted.

To be consistent with the treatment of fuel consumed during the combustion of pre-prepared explosives and explosives prepared in the field, it is proposed that combustors of explosives estimate fuel consumed in the explosion process from information available from the manufacturers of the explosives. Concurrently, it was proposed that manufacturers of explosives also report estimates of fuel consumed without combustion in the manufacture of explosives in order to improve transparency and completeness of information for fuel consumed in explosives.

Submissions were sought in relation to a) users of explosives to estimate and report emissions from fuel combusted during the explosion process and b) manufacturers of explosives to report fuel consumed without combustion when used for the manufacture of explosives.

The Department has received a number of submissions regarding the reporting of explosives and would like to develop a consistent approach to estimating emissions and fuel consumption in all explosives regardless of origin.

It was noted that suppliers and consumers of ready-mixed explosive materials exchange Material Safety Data Sheets which may provide a consistent basis to estimating the liquid fuel content of the explosives. The National Code of Practice for the Preparation of Material Safety Data Sheets indicates that a MSDS must be provided upon request from consumers.

The Department investigated the option of providing a default factor for ANFO however a consistent liquid fuel proportion was not agreed with sourced options including 6% and 10%.

The Department has been advised there is ongoing industry study into the generation of an ANFO specific

emissions factor. As a result this discussion item will be kept under review by the Department until the study is completed. Feedback from industry would be welcomed which may inform a default liquid fuel content for explosives, for cases where exact quantities cannot be verified with the supplier.

In the meantime, the Technical Guidelines will be elaborated to provide more examples of how to report explosives.

2.2.8 Treatment of lubricants and greases

Under the Determination facilities have the option of estimating emissions from PBOGs either using a default oxidation factor of 40%, consistent with the default factor applied in the National Inventory, or by deriving their own oxidation factor using information on the amount of waste oil transferred offsite. However, there are instances where PBOGs may be used without combustion which remains reportable under section 2.68 of the Determination.

The Department engaged HRL Technology to investigate the estimation of emissions from PBOGs under NGERS. The HRL Technology report found that the emission estimation method outlined in the Determination (Division 2.4.5A) is not appropriate for all uses of PBOGs. A range of scenarios exist where PBOGs are consumed but not combusted for which section 2.68 of the Determination is available.

The discussion paper proposed the concept of flash point as a way of assisting facilities to identify whether PBOGs are partially oxidised or consumed without combustion. Additionally, the Department proposed to draft into the Technical Guidelines a framework using the flash point of PBOG to inform this classification. Submissions were sought on the concept of flashpoint to identify whether or not PBOGs are likely to be combusted.

The reporting of PBOGs continues to be an issue for a number of NGER reporters. For example the Civil Contractors Federation stated that:

> *'However, Contractors may also have to report use of petroleum based oils and greases. These are the products commonly used for lubrication purposes. This is a very complex area and our members usage of these products is so small and the contribution to greenhouse emissions so infinitesimal that we seriously question the value of collecting this information.'*

Section 2.68 of the Determination is available to reporters for the reporting of fuels consumed without combustion including certain uses of lubricants and greases. Uses of PBOGs that may fall into this category include coating of metal products with petroleum-based oils for corrosion protection and use of petroleum-based oils as hydraulic fluids (including brake fluids). No emissions occur from fuels reported under this section of the Determination.

In some situations it may be unclear whether the PBOG is likely to be partially oxidized. In these cases the option of utilising the flashpoint of the PBOG was discussed. Industry submissions raised concerns about the complexity of the introduction of a flashpoint and the fact that the flash point can be an unreliable measure. Use of the flash point framework would not be required under the Determination but rather would be available to facilities who wish to use it as a means for supporting the facilities' allocation of fuels to section 2.68 (fuel consumed without combustion).

The Department proposes to list guidance around the use of flash point as an option available to facilities to assist in justifying their allocation of fuels to non-combustion purposes when there is ambiguity. This guidance could be published in Technical Guidelines.

For incidental emissions and energy consumption facilities have the option of utilizing another method that is consistent with the principles in section 1.13 of the Determination. The incidental provisions may be an appropriate way for many facilities to reduce the burden associated with measuring and estimating data on PBOGs.

The alternative method for the estimation of the oxidation factor allows facilities to derive their own oxidation factor based on the amount of waste oil transferred outside the facility. The HRL Technology report noted that the term 'waste oil' could be problematic as some facilities transfer fuel offsite without considering it as a waste product. It is proposed that the term 'oil transferred offsite' could replace 'waste oil' to more accurately reflect the transfer of PBOGs, without impacting on the calculation.

A number of submissions supported the proposal to clarify the term 'oil transferred offsite'. The Department proposes to include the clarification in the proposed updates to the Determination.

A number of facilities have reported consuming multiple types of PBOGs creating a significant measurement and reporting burden. It is expected that the information collected by facilities in their first two years of reporting and advice on the application of incidental estimates will help reduce the reporting burden on PBOGs for NGER reporters.

It is proposed to include examples in the Technical Guidelines of potential reporting of PBOGS using the incidental reporting provisions and section 2.68 (fuels consumed without combustion) as means of limiting the reporting burden for facilities where PBOGs can be a minor source of energy consumption and emissions.

2.2.9 Fuels consumed without combustion – bitumen

Bitumen is a heavy petroleum derivative used in asphalt production and is used in the majority of road surfaces around Australia. All bitumen is consumed in Australia without combustion.

The NGERS facility reporting threshold is 25 kilotonnes of emissions or 100 terajoules of energy consumption. The facility threshold equates to around 2,300 tonnes of bitumen a year, a level of consumption reached by almost every asphalt plant and spray sealing operator in Australia. Most of these asphalt plants have levels of emissions and consumption of other fuels well below the facility thresholds. The widespread occurrence of these conditions is unique to bitumen consumption and imposes a potentially significant reporting burden on small asphalt plants and spray sealing operators that would otherwise not be required to report under NGERS.

The Department identified two possible solutions and sought submissions on the options to simplify the reporting of bitumen consumption. The two possible solutions were:

Option 1: A specific threshold could be introduced for the reporting of bitumen consumed without combustion. A threshold of around 25 kilotonnes of bitumen would exclude small and medium sized asphalt plants. This threshold is, however, much larger than other thresholds used for non-combustion of fuels and is even larger than existing facility thresholds. Under this proposal bitumen production (a limited number of large refineries) would remain subject

to existing reporting thresholds. This approach would treat bitumen differently to other fuels; however, bitumen is a unique case due to the large amount of energy consumed without combustion by facilities that would not otherwise meet the facility reporting thresholds.

Option 2: Redefine bitumen to not include consumption for non-combustion purposes (e.g. as a sealant or road surfacing agent). Bitumen production (a limited number of large refineries) would remain subject to existing reporting thresholds.

The Department received many submissions on the reporting of bitumen. The majority of submissions supported option 2. For example the Australian Asphalt Pavement Association stated that:

> *'In summary, reporting bitumen consumption therefore:*
>
> 1. *Provides no useful information relative to energy consumed and greenhouse emissions;*
> 2. *Gives a misleading value for energy consumed, a value that is many times greater than the actual quantity of fuel consumed by the road surfacing industry;*
> 3. *Requires companies to devote considerable resources to collect data and report on each facility despite most consuming very little actual energy;*
> 4. *May provide competitively sensitive information, particularly in the case of small and specialist companies;*
> 5. *Is inconsistent with other combustible materials and the purpose of NGERs.*
>
> *For the above reasons AAPA strongly supports Option 2 in the Consultation Paper - that bitumen be redefined to not include consumption for non-combustion purposes (e.g. as a sealant or road surfacing agent). '*

The Department proposes to proceed with option 2 and update the definition of bitumen in the NGER Regulations at the next available juncture. If this approach is adopted, the consumption of bitumen for non-combustion purposes would not be reported under NGERS.

2.2.10 Liquid fuels methane emission factors

The discussion paper noted that Australia's internationally implied methane emission factor for liquid fuels was significantly higher than factors reported by other Annex 1 countries. The majority of these methane emissions occur in the road transport sector. The Department has utilised external consultants to interrogate the data from the National In-Service Emissions Study (NISE2) to improve the parameters used for petrol passenger vehicles and light commercial vehicles in the road transport model of the national inventory. The parameter updates have resulted in a reduction in the implied emission factor for the road transport sector in the national accounts.

Further work on the parameters of the road transport model is planned over the next 12 months. It is anticipated that these parameter updates will further improve the implied methane emission factor for liquid fuels. These updates will be published in the 2012 National Inventory Report which will be subjected to international review before updates to the factors are made in the Determination.

2.3 Fugitive emissions from fuels

2.3.1 Fugitive emissions from open cut coal mines

Under method 1 for open cut coal mine fugitive emissions, National Inventory default factors are applied at the State level to all mines in the State and provide the basis for a simple, low cost method of emission estimation. However, there is evidence to suggest that Australia's coal mines exhibit a wide variability in coal gas content reflecting varying geological histories of each field. Consequently, the use of facility specific information on emissions rather than the default emission factor approach is likely to lead to improved emission estimates. The further development of the method 2 approach has been a high priority in order to provide the opportunity for facilities to estimate a facility-specific emission estimate using their own gas measurements.

A comprehensive program of research and measurement technique development is continuing in order to inform future refinements to the existing method 2. The research program is a collaboration of the Australian Coal Association Research Program (ACARP), CSIRO researchers, commercial laboratories and government and has several streams looking at underground and open cut emission sources and laboratory measurement procedures. Outcomes from the program are anticipated to significantly increase the quality of Australia's coal mining fugitive emissions estimation through the development of more rigorous methods for the measurement of gas. The Department is jointly managing the program through membership of the Australian Coal Association Research Program Fugitive Emission Steering Committee, which provides guidance and oversight of the methodology development and research projects.

Submissions were received from the two coal mining companies operating in the Western Australian Collie Basin. Premier Coal noted that it is working with ACARP and the CSIRO in order to develop an accurate understanding of the fugitive emissions from open cut mining in the Collie Basin as, in their view, the existing Method 1 default factor for open cut coal mining in Western Australia is causing an over estimation of emissions.

The Griffin Group which operates the Griffin coal mine in the Collie Basin submitted that methane in its coal mine is below detectable limits and that the current default factor does not give Griffin the choice of adopting a direct measuring system or opting to use an appropriate default factor.

The Department acknowledged in the discussion paper that coal mining operational practices and anecdotal evidence suggests that open cut coal mining within the Western Australian Collie coal basin is associated with low fugitive gas emissions. Recent progress in the ACARP open cut methodology project indicates that it is at an advanced stage. Given this progress, the Department considers that it is preferable to not change methodology default factors at this stage. The Department notes that both coal mining companies (Premier and Griffin) are currently active participants in the ACARP methodology development.

2.3.2 Oil and gas

Flaring of gas (Division 3.3.2, 3.3.3, 3.3.9)

Methods are made available in the Determination for the flaring of gas that occurs within the oil and gas sector. Method 1 is available where default emission factors for carbon dioxide, methane and nitrous oxide are provided in terms of tonnes of CO2-e per tonne of gas flared. Feedback from reporters has indicated that the

carbon dioxide content of the gas prior to flaring can vary widely. In the case of sour gas flaring, the carbon dioxide may account for a significant percentage of the pre-flare gas stream. Consequently, in the case of sour gas, use of the method 1 default flaring emission factor for the total gas stream could result in an overestimation of the carbon dioxide emissions.

The Determination also makes available a method 2 and method 3 for reporters to use. For method 2, the carbon dioxide emission factor must be determined in accordance with method 2 for the combustion of gaseous fuels in Division 2.3.3 of the Determination. This specifies the requirements for sampling and analysis of the gas and the calculation of the emission factor from the gas composition. Method 3 in the Determination refers to the gaseous fuels section specified in Division 2.3.4.

Submissions were sought on approaches for dealing with the flaring of sour gas.

The Department received strong support in favour of amending the methodology for sour gas flaring. The Australian Petroleum Production & Exploration Association (APPEA) had previously expressed concern that the flaring of sour gas could lead to overestimation and supported the proposal. Support was also provided in submissions by the Australian Coal Association and BHP Billiton in terms of coal gas flaring. The Department proposes to amend the flaring methodology taking the approach demonstrated in the America Petroleum Institute (API) Compendium for sour gas. Emissions resulting from the hydrocarbon component of the flare are added to the carbon dioxide component of the pre-flared gas stream to estimate total flare emissions. The approach of allocating the CO_2 to the flaring emissions rather than reporting the CO_2 separately as venting was preferred because it is simpler for reporting purposes.

In implementing this amendment to the methodology the Department proposes to change only methods 2 and 3, and leave method 1unchanged. The Department believes that some sampling and analysis of pre-gas flare is needed to understand the quantity of CO_2 in the flare. The submission by Australian Petroleum Production & Exploration Association (APPEA) indicated that the members are not in a position to move to a higher order method due to onerous and costly sampling requirements. However, the sampling requirements for unprocessed gas consumed in flares in the Determination reduce the burden of sampling for method 2. Section 2.25 (Frequency of Analysis) has been clarified to indicates that the sampling of gases (other than pipeline quality gases) associated with fugitive emissions need not be undertaken at a monthly frequency if it will cause significant hardship or expense.

To maintain consistency, the changes proposed for flaring oil and gas fugitive emissions are also proposed for flaring coal mining fugitive emissions

Gas production and processing (Divisions 3.3.6 and 3.3.9)

The scope of Divisions 3.3.6 and 3.3.9 relate to emissions from fugitive leaks or venting or flaring of gas during natural gas production or processing activities. Similar emission processes can occur at power generators or other industrial facilities and a number of these facilities reported emissions under Division 3.3.9 Natural gas production or processing (emissions that are vented or flared) in their NGERS reports submitted in 2009. Natural gas, while significant, is also not the only gas of fossil origin produced and processed for use as a fuel or feedstock. Reporters have identified coke oven gas as an example.

Submissions were sought in relation to the application of Division 3.3.6 and 3.3.9 on the clarification of scope to include all facilities that consume natural gas or other gases of fossil origin for either combustion or a

feedstock.

There were mixed views in response to the proposal to broaden the industry sector coverage of fugitive gas leakage. While some supported the idea, others considered it to increase reporting burden for an insignificant emission source that is impractical to report meaningfully.

The Department will keep the issue under review. No amendments are proposed in the current year.

2.3.3 Carbon capture and storage

Following a commitment to undertake further elaboration on Carbon Capture and Storage, the discussion paper addressed the following issues:

- use of estimates of emissions from permanent storage sites reported to the Commonwealth Minister under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and appropriate Ministers under relevant State legislation governing carbon dioxide storage for future reporting under NGERS
- issues relating to temporary storage of carbon dioxide in conjunction with issues of compliance and the use of intermediaries for capture and transport of carbon dioxide
- the issue of compliance particularly in relation to how the NGER system will interact with other Commonwealth and State legislation
- the impacts of new Commonwealth and State legislation and the development of new permanent storage types and new permanent storage technologies
- deductions of carbon dioxide captured for permanent storage in the metals production (with the exception of integrated metalworks).

The ACA supported the view that compliance issues should be dealt with in the future when details covering state and federal legislation covering gas storage becomes clearer. At the same time the ACA notes:

> *'…that off-shore storage is under Commonwealth legislation while on-shore [storage] is addressed under State legislation, there is significant potential for confusion if the issues are dealt with separately. For example, estimation of emissions from permanent storage sites will require different approached for off-shore and on-shore scenarios.'*

Commenting on the suggestion of not recognising carbonation as a means of permanent storage as the carbon may be emitted during calcination of the product in downstream use, the Australian Coal Association noted:

> *'The ACA considers it premature to single out specific technologies for inclusion or exclusion at this stage. We agree with the suggestion that a set of technology neutral principles to criteria should be developed against which future storage technology options should be judged and recommend any technology that meets those criteria should be included.'*

The issue of storage of other gases highlighted differences in estimation methods for methane generated, from fuel combustion and industrial processes, and methane in the captured gas stream, leading to potentially erroneous results when estimating emissions.

> *'The ACA agrees that such reconciliation may be difficult as the captured gas may be directly measurable whereas*

the emissions may be estimated by a default method. However as a principle credit should be given for verifiable capture and storage of any greenhouse gas. If inconsistencies in methods used for estimation or measurement lead to spurious outcomes … that should give rise to a priority on improving the default estimation method.'

The considerations raised by the Australian Coal Association will be used in further deliberations on this topic. However, the limited deployment of carbon capture and storage practices in the field reduces the urgency of these issues. The Department will continue to examine these issues and follow the development of State and Territory legislation in relation to gas storage activities. No amendments are proposed in the current year.

2.4 Industrial processes

Issues arising in the industrial processes sector relate to:

- the extension of the carbon balance method for emissions estimation
- clarifications to the scope of certain sources
- additional standards for analysis that may be cited
- the treatment of 'industrial gases'.

2.4.1 Review of the use of the carbon balance method

The discussion paper canvassed using the carbon mass balance approaches to emissions estimation within the Determination, and sought submissions on the expansion of these methods to additional chemical, mineral and metals production sources.

A carbon balance method is provided for sources with multiple carbon inputs and outputs and where the integrated nature of the facility means that the emissions estimate for the system as a whole is more accurate than estimates of specific emission sources. Current sources that use a carbon mass balance approach include Iron and Steel and other integrated metalworks (Division 4.4.1), petrochemical production, soda ash production as well as limited application to cement clinker and lime production.

While the carbon balance method will result in more accurate emissions estimations, the Department recognizes the calculation is more complex. To maximise transparency of the calculation, all carbon inputs and carbon outputs including any carbon in waste products should be reported. This implies amending the NGER Regulations list of variables to be reported. On the other hand, the default method 1 provided in the Determination offers a simpler approach that is desirable to retain as a low cost estimation method for reporters.

Submissions were sought on the option to extend the use of the carbon balance method within the industrial processes sector addressing chemical or mineral production using a carbon reductant, ferroalloy and other metals production, and aluminium production.

In response the Department received submissions from organisations covering a range of industries. All submissions supported, in principle, the expansion of the carbon mass balance methods to additional sources.

Particular implementation issues were raised by respondents concerning the implementation of the coal mass balance estimation approaches. For example BHP Billiton commented that:

> *'…uptake of the estimation method … will depend upon the requirements of the method with respect to monitoring and testing, and how this investment compares to the potential improvement in emissions estimation accuracy. Of particular impact on this decision may be the effort required to characterize waste streams with regard to carbon content.'*

The issue of estimating the carbon content within waste streams has been raised previously with the Department and is of particular interest in relation to method 1 reporting, which is to provide a simple and low cost estimation method. It was also submitted that the reporting burden is balanced against the benefits and

suggestion of a materiality threshold on input/output streams be established to ease the compliance burden.

On a technical note, it was raised that the current uncertainty assessment framework does not provide a prescribed method for uncertainty in carbon mass balance estimation under method 1. However the approach for estimating uncertainty in these situations is covered off in Determination section 8.9(3).

Comments on the application of carbon mass balance approaches to specific sources were not received however specific issues have been raised in previous formal and informal consultations with the Department.

The Department proposes to implement carbon mass balance methods for relevant sources, including other carbonates, ferro-alloys, and other metals production. The proposed amendments would be in effect for the 2011-2012 reporting year. The Department acknowledges issues with regard to estimating the carbon content of industrial waste streams and will undertake consultation to establish an appropriate framework for characterizing carbon within product and by-product waste streams to support method 1 reporting.

2.4.2 Clarifications of certain sources

Lime Production (Division 4.2.2)

As part of the assessment process for Emissions Intensive Trade Exposed Industries (EITE) the Department received submissions relating to emissions from lime production, which highlighted improvements in emissions estimation that could be incorporated into Australia's National Inventory systems. The changes were implemented for the 2011 National Inventory submission covering emissions up to the 2008-09 financial year.

Amendments are proposed to maintain the consistency between the National Inventory and the Determination, and align the method for estimating emissions from lime production with other mineral products, including cement.

The proposal includes the estimation of lime kiln dust for both method 1 and 2 as an additional factor affecting emissions estimates, and refined methods that take account of the concentration of magnesium carbonate which is known to affect the emissions resulting from the calcination process. The higher concentrations of magnesium carbonate result in the production of magnesian and dolomitic lime, which is distinct from other forms of lime.

The variance in magnesian carbonate concentrations (listed below) within the limestone means that emissions can vary. To allow for this variance the proposed amendments take account of magnesian carbonate concentrations for method 2 estimation. For method 1 estimation, default emissions factors for dolomitic lime, sourced from the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, have been added.

Definitions included in the proposed amendments for magnesian and dolomitic lime have been sourced from *ASTM C51-07 Standard Terminology Relating to Lime and Limestone (as used by the Industry)*.

- Magnesian lime is lime formed from limestone containing 5-35% magnesium carbonate
- Dolomitic lime is lime formed from limestone containing 35-46% magnesium carbonate.

The new inclusions allow reporters to account for magnesian carbonate within their emission estimates. In

most cases the use of sampling and analysis under method 2 will result in more accurate emission estimates than the use of method 1.

Ceramics production (Division 4.2.3)

The consumption of carbonates during production of ceramic materials results in the emission of carbon dioxide. The quantity of emissions and emissions estimates is affected by the composition and type of clay used. As a result, analysis of clay content must take into consideration a number of variables making the use of method 3 particularly difficult for some producers.

Alternative methods for the estimation of emissions from ceramics production are included in the European Union's Emissions Trading Scheme's guidelines for the monitoring and reporting of greenhouse gas emissions. The EU 'Method A' is similar to the method in Division 4.2.3 based on consumption of carbonates. 'Method B,' is an alternative based on production quantities and the content of alkali earth oxides such as CaO, MgO and BaO present in the ceramic product.

Submissions were sought on the inclusion of a method 3 for ceramics production based on production and the alkali earth oxide contents of the ceramics products.

The Department received one submission from Think Brick Australia on behalf of the clay brick industry. The submission raised a range of methodological and cost concerns about the approaches outlined in the discussion paper. They also wrote that the application of the EU methodologies would not adequately address the issues currently facing the brick industry.

Think Brick has commissioned a carbon sampling program to determine 'the average organic and inorganic carbon content' of feedstocks with the intention of further understanding the carbon emissions from clay brick production. It is anticipated that results will start to become available in June 2011.

> *'Given the continued difficulty and high costs of measuring organic carbon and carbonates, the industry would like to request additional time to finalise its carbon sampling program and report on the results. At this stage it is anticipated that we will have initial results and a methodology by June 2011.'*

The Department proposes to defer amendments to the Determination until such time as more robust data on Australian conditions are available. Contingent on the release and success of the above research program the Department proposes to finalise relevant amendments to the Determination in 2012.

Phosphoric acid production (Division 4.2.3)

Submissions were sought on the application of methods under Division 4.2.3 to the production of phosphoric acid from phosphate rock using the wet process. The production of phosphate fertiliser from phosphate rock involves the production of phosphoric acid using a process where phosphate rock is reacted with sulphuric acid. Carbon dioxide emissions result from a secondary reaction in which limestone present in the phosphate rock reacts with the acid. It was proposed to amend the Determination to clarify the scope of the method.

The Department received one submission in relation to the reporting of phosphoric acid that supported the inclusion of a methodology for accounting for phosphate rock emissions.

The Department proposes to amend Division 4.2.3 to explicitly include emissions from phosphoric acid in the positive list of applicable activities to commence in 2011.

Hydrogen production (Division 4.3.1)

The Department sought submissions on the inclusion of hydrogen production for sale in Division 4.3.1. Currently emissions from hydrogen production as part of petroleum refining activities are explicitly identified in Division 2.5.1 of the Determination. Hydrogen is produced as an intermediate product of ammonia production. Intermediate production processes are captured within existing estimation methods.

The US EPA Mandatory Reporting of Greenhouse Gases Rule provides for the reporting of emissions from hydrogen production separately and includes all facilities producing hydrogen for sale using reforming, gasification, oxidation, reaction or other methods of transformation of feedstocks.

Consideration was also given to the estimation of emissions from hydrogen production associated with a petroleum refining facility being incorporated under Division 4.3.1 instead of Division 2.5.1.

Submissions were received from petroleum refining and other sectors expressing a range of views. On the whole there was little direct support for the inclusion of hydrogen for sale within Division 4.3.1. Comments from the petroleum industry were against incorporating hydrogen production in refining facilities within Division 4.3.1, and preferred to maintain the existing reporting arrangement. For example, Shell noted that;

> *'The proposal for the estimation of emissions from hydrogen production associated with a petroleum refining facility to be incorporated under Division 4.3.1 of the Determination seems incongruous given this division is specific to ammonia production, and involves a different methodology. Shell's preference is to keep it separate under a petroleum refining source.'*

Electricity generators raised a particular concern relating to hydrogen used for cooling with their generation facilities;

> *'…NGF members see no value or point, in reporting power station hydrogen production or use as it is not combusted as an energy source. Accordingly NGF member seek exclusion for power station hydrogen, used in hydrogen-cooled generations, reporting requirements, as it is a non-NGERS issue.'*

The Department proposes to retain existing reporting arrangements for hydrogen production and ammonia production. Future reporting of hydrogen for sale requires further consultation and will be examined as part of the 2012 amendments.

Consumption of carbon reductants and carbon anodes (Division 4.3.5)

Several companies have indicated that in their production processes they consume a carbon anode in addition to either fuel combustion emissions or other industrial process emissions. For example, the production of electro-fused magnesia involves the calcination of a carbonate as well as the consumption of a carbon anode. Another example is the production of fused zirconia for which assistance was considered under the Emissions Intensive Trade Exposed Industries (EITE) program of the Carbon Pollution Reduction Scheme.

Emissions associated with the consumption of carbonates currently reported under Division 4.2.3 do not incorporate emissions from the consumption of carbon anodes. Consideration was therefore given to the broadening of Division 4.3.5 to include consumption of carbon anodes and include emissions from the production of fused magnesia and fused zirconia.

No submissions were received by the Department on the inclusion of carbon anode emissions and the

inclusion of the production of fused zirconia and magnesia. Submissions related to the inclusion of a carbon mass balance are dealt with in section 2.4.1.

The Department proposes to include emissions from carbon anodes and fused magnesia and zirconia to Division 4.3.5 through addition to the positive list of activities. The changes would be included as part of the proposed 2011 Determination amendments.

2.4.3 Method 2/3 review of applicable standards

The discussion paper considered the introduction of the following standards for the chemical analysis of lime, clinker and limestone inputs and outputs to production.

- ASTM C25-06, Standard Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime
- ASTM C50-00 (2006), Standard Practice for Sampling, Sample Preparation, Packaging, and Marking of Lime and Limestone Products.

The following were suggested for reporting of iron and steel production:

- ASTM E1019-08 Standard Test Methods for Determination of carbon, sulphur, nitrogen and oxygen in steel, iron, nickel and cobalt alloys by various combustion and fusion techniques
- ASTM E1915-07a Standard Test Methods for Analysis of Metal Bearing Ores and Related Materials by Combustion Infrared- Absorption Spectrometry.

These standards may have application in Cement Clinker Production (Division 4.2.1), Lime Production (Division 4.2.2), Use of Carbonates (Division 4.2.3), and Metal Products (Part 4.4). Submissions were sought on the relevance of the above standards and other possible standards to reference.

No comments were received from industry in regarding to the application of standards for the analysis of carbonate inputs and mineral outputs. The Department proposes to add these standards as part of the proposed updates to the Determination.

The Department received two submissions from the iron and steel industry both raising concerns about the applicability of the standard to Australian conditions.

Steel manufacturer OneSteel stated that:

> *These standards are not commonly used in OneSteel steelmaking operations, and crucially would have no application under method 2 carbon mass balance outlined in Division 4.4.1, While method 2 is used for steelmaking at Whyalla it does not require sampling and analysis of the carbon content factor of steel or ore as these data points do not fall within the requirement in the Determination for a fuel or carbonaceous input material that accounts for more than 5% of total carbon input for the activity.*

The Department does not propose to make these standards mandatory in the sampling and analysis of feedstock materials. This does not prevent the use of the above standards by the iron and steel industry where appropriate.

2.4.4 Reporting and use of industrial gases

Industrial gas use refers to the direct use of a greenhouse gas product for consumer or industrial purposes other than for use in fuel combustion. The main greenhouse gases used in the Australian economy are carbon dioxide and nitrous oxide. Supply of carbon dioxide to the economy comes not only from capture in oil and gas related activities and other production processes, but is also extracted from naturally occurring carbon dioxide wells. Nitrous oxide is produced by heating ammonium nitrate.

Emissions from industrial use of greenhouse gases are reportable under the Intergovernmental Panel on Climate Change (IPCC) guidelines that govern international reporting of emissions. As part of international accounting rules, it is necessary to distinguish between carbon dioxide captured and supplied for a permanent storage and carbon dioxide captured and supplied for temporary storage; that is consumption in uses that lead to deferred emissions of carbon dioxide within the national economy.

Carbon dioxide, and nitrous oxide, has many uses as a consumption item in the economy, including the production of urea, carbonation of drinks, refrigeration and shielding gas for welding applications. Each of these applications result in the emission of carbon dioxide into the atmosphere. A proportion of industrial gas use data is obtained as indirect emissions through reporting of carbon dioxide from ammonia production. For other activities the NGER reporting framework has no explicit source to report these emissions.

Under the current framework small emitters of carbon dioxide that do not meet NGER reporting thresholds will not be required to report. Without a materiality threshold, facilities within corporations that exceed the corporate thresholds would be required to report all emissions sources within the facility, including those from small scale uses.

The discussion paper outlined and sought submissions on three options for the reporting of CO_2 production and use.

- Option 1 Emissions are identified by the amount of carbon dioxide supplied or transferred out of a facility. This is an upstream approach to the identification of emissions.
- Option 2 is modelled on the treatment under NGERS of the estimation of emissions by HFC users. Emissions are estimated where and when they occur.
- Option 3 is a combination of option 1 and 2. Emissions would be estimated by the user of carbon dioxide; however, this could be augmented with information reported on the coverage of carbon dioxide supplied to the economy through the 'matters to be identified' within the NGER Regulations.

Submissions were mostly concerned with the reporting burden that would be imposed by having to estimate the onsite emissions from the use of carbon dioxide from a large quantity of small emission sources. OneSteel's submission pointed out that;

> *'Like most industrial and commercial operations, OneSteel Limited has CO_2 fire extinguishers and may use CO_2 in post mix drink dispensers amongst other common small applications such as portable pneumatic tools and welding. Implementing a system to estimate the use of CO_2 at our 270 plus facilities would create an onerous administrative burden while failing to improve the accuracy of corporate emission estimates given the anticipated small CO_2 amounts.' ... 'The proposed inclusion of emissions from CO_2 use should not be implemented without a materiality threshold (e.g. bulk tanks above a certain volume) or specific exclusions for fire fighting equipment, beverage*

dispensers, welding, pneumatic tools and other small scale applications.'

BlueScope steel articulated similar concerns.

> *'BlueScope steel has no single system to identify and capture the releases from these sources, further it is believed that the emissions from these sources would be insignificant. Attempting to quantify these emissions would require an excessive investment of time, resources and expenditure for an immaterial gain in reporting accuracy.'*

The NGF urged for a simplification of the option 3 proposed in the discussion paper.

> *'The discussion paper introduces unnecessary complexity in the reporting of very minor emissions from the use of industrial gases and NGF members desire a very simple approach to such reporting simply based on the stock inventory utilization with respect to bottled industrial gases. NGF members use small amounts of carbon dioxide for generator purging purposes and small amounts of nitrous oxide in laboratory applications. Differentiating biogenic and non-biogenic forms of carbon dioxide is not possible for bottled gas at the user level and therefore should be undertaken at the supplier level.'*

The Department acknowledges the reporting burden that might eventuate if reporting was required against such a disaggregated set of data and reiterates that this is not the intent of the proposal.

The Department remains committed to establishing a method for estimating and reporting the production and use of industrial gases. Further work is required to look at approaches to a materiality threshold and the reporting boundaries. Discussions with industry are ongoing as part of clarifying a reporting methodology that balances international reporting requirements and administrative complexity for industry.

2.5 Solid waste disposal

Within solid waste disposal methane emissions arise from the decomposition of organic wastes wherever anaerobic conditions occur. Under NGERS, available methods for the estimation of methane emissions from landfills include method 1 and methods 2 and 3.

Method 1 is derived from a first order decay model set out in the IPCC guidelines and used in the Australian national inventory. It requires data on the tonnages of waste delivered to the landfill over the lifetime of the landfill. Conversion of this activity data into methane generated at the site depends on a number of variables.

The Discussion Paper outlined issues in relation to a number of these variables and sought submissions from stakeholders. The Department also held a solid-waste industry workshop in October 2010 to consider the discussion paper issues in detail. The discussion below outlines the Department's intentions in relation to the issues based on the submissions received and stakeholder feedback from the industry workshop.

2.5.1 Methane correction factor

The Methane Correction Factor (MCF) is used to characterize the landfill in the extent to which anaerobic conditions are experienced.

Currently the Determination provides only a default MCF of 1.0, reflecting an assumption that landfills are 'well-managed' and that the conditions for anaerobic decay exist. However, methane conversion factors may vary depending on landfill management practices; the IPCC provides a range from 0.4 for an unmanaged and shallow landfill to 1.0 for a well managed site.

Currently, there is no empirical evidence to suggest that the MCF factor of 1.0 does not apply to Australian landfills. More research is required into the stages of decomposition within a landfill in Australian conditions before this assumption could be relaxed and then clearly identified verifiable criteria would need to be applied to the landfill's characteristics.

Submissions were sought on the assumption that perfect anaerobic conditions exist such that a MCF factor 1.0 should apply to all Australian landfills.

Feedback in submissions and from the industry workshop outlined recent desktop research into the use of MCF values to estimate emissions from landfills. The focus of this research into the application of MCFs was on non-methanogenic decay processes. While the MCF is used in the IPCC First Order Decay model as an index to account for the level of waste management and the associated extent of lifetime anaerobic decay, it could alternatively be used to account for degradable organic carbon (DOC) loss in the early aerobic decay phase.

The Department recognises the need for further field data and intends to actively monitor empirical developments in the area of landfill decay processes in the immediate post disposal, pre-capping time period.

2.5.2 Oxidation of methane generated at landfills

The current NGERS default value for the proportion of methane oxidation occurring in the landfill cap is 0.1; however empirical research has found higher oxidation rates in some circumstances.

Noting the current limitations on measurement and modelling of oxidation rates, submissions were sought on the default oxidation factor of 0.1 and potential field measurement or modeling protocols for the determination of site-specific oxidation rates.

Feedback in submissions and from the industry workshop outlined the current state of knowledge in relation to oxidation and highlighted the need to develop an adequate test procedure to determine oxidation levels at a landfill. The Department intends to continue to investigate the development of a site-specific methane oxidation framework under NGERS and will maintain a watching brief on key developments in areas critical to the determination of site-specific oxidation rates; in consultation with industry stakeholders.

2.5.3 Fraction of degradable organic carbon dissimilated – DOCf

Australia's waste type specific DOC_f values

The DOC_f values for individual waste types selected for the national inventory are based on well documented research contained in Barlaz 1998, Barlaz 2005 and Barlaz 2008. These estimates provide an upper limit of an appropriate DOC_f value.

It was proposed in the discussion paper to adopt, in NGERS, the DOC_f values currently used within the National Inventory. This will maintain the consistency between Australia's international commitments and the methods used for NGERS. The adoption of the National Inventory factors is expected to have a small impact on national emissions overall, reflecting the national average DOC_f value across all waste types of 0.52.

Submissions were sought on the incorporation into the Determination of waste-type specific DOC_f values used in the National Inventory Report 2008. Feedback received through submissions and from the industry workshop was supportive of the proposed changes to DOC_f values.

The Department proposes to amend the DOC_f values, as laid out in the discussion paper, in the Determination based on the values used in the 2008 Inventory with amendments taking effect in the 2011/12 reporting year.

The Department will examine the possibilities of refining DOC_f values used in the inventory as lab-based research results become available as a precursor to inclusion in the Determination. A review of DOC_f values will occur after 3 years following industry consultation.

2.5.4 Method 2: facility specific 'k' values

Method 2 for solid waste disposal permits operators of landfills to make measurements of methane generation at their facility in order to determine a facility-specific estimate of the rate of decay, 'k', at the landfill. The facility-specific value of 'k' changes over time the profile of methane emissions but does not change the total amount of emissions from a site.

Issues

A number of landfill sites have trialed method 2 or are in the process of trialing method 2. Results obtained so far have been encouraging but underline the importance of obtaining good information on both the rate of methane generation and also the quantities of waste deposited in the representative zone under examination.

Submissions were sought on the need to strengthen the monitoring requirements of method 2 to require additional walkover surveys of the surface of the representative zone, to test the extent to which the cap is

maintained throughout the course of the measurement process.

In light of stakeholder experiences with method 2, the Department intends to review the method 2 procedure in consultation with industry to address specific issues of gas inflow/outflow of the representative zone, the influence of food degradation in young sites, the frequency of gas well metering, and flux-box density and layout provisions.

Importance of reliable activity data

Stakeholder trials of method 2 procedures have highlighted the importance of accurately determining the volume of waste in the representative zone when estimating an appropriate 'k' value. It has been suggested that expanding the size of the representative zone to include complete well-fields will enable a more accurate estimate of the quantity of degradable organic carbon in the representative zone (C_a) to be derived and will ensure that gas inflow or outflow from the zone is minimized. The Department will continue to consult with industry on this issue with a view to further refinement of the current method 2 procedure.

Methodological issues

Method 2 rests on the measurement of a flow of methane at a point in time. This flow of methane must reflect the decomposition of carbon in the waste deposited in the representative zone.

However, the data on C_a is subject to uncertainty and minimum requirements must be established in relation to C_a to underpin the estimate of 'k'.

The additional mathematical conditions are:

(1) $C_a \geq C_a{\sim}$

where $C_a{\sim}$ is the minimum amount of decomposition of carbon required to solve for 'k'.

(2) $\delta k/\delta C_a \leq 0$

Condition (1) ensures that the solution for 'k' occurs in the range where, for a given measurement of methane generated in the representative zone, higher estimated values of C_a result in lower values of 'k'.

Submissions were sought on the use of additional conditions to ensure consistent estimation processes are used for the calculation of 'k'.

Feedback received through submissions and from the industry workshop was supportive of these additional provisions. The Department intends to incorporate these additional conditions on the estimation of k into the Technical Guidelines.

How often should 'k' be re-evaluated?

Submissions were sought on whether the estimate of 'k' obtained using method 2 should be able to be re-estimated on a periodic basis and, if so, under what conditions.

Consideration of the frequency of 'k' value estimation under method 2 will be included as part of the broader review of method 2 that the Department will undertake over the coming months.

2.5.5 Method 4: direct monitoring of emissions

There is currently no method 4 option for landfills in the Determination. However, there is a commitment in the Technical Guidelines to work towards the inclusion of a method 4 framework for solid waste.

In order to ensure that the general NGER principles for direct measurement emissions are met, the paper sought input on a range of issues regarding direct measurement. In addition, there is ongoing discussion with stakeholders on the best approach to addressing the current short-comings of direct measurement approaches.

In particular, submissions were sought on the following issues related to the direct measurement of emissions from landfills:

- Stakeholder experiences with the direct measurement of landfill emissions both locally and internationally.
- Responses to the qualitative assessment of current measurement techniques.
- Views on and knowledge of standards and protocols covering the direct measurement of emissions from landfills.
- Views on any of the other issues canvassed in the discussion paper.

Method 4 approaches to the measurement of emissions from landfills remain in the experimental phase and their use is not yet routine or widespread; domestically or internationally. The Department intends to continue to monitor developments in this area and will give further consideration to the development of a method 4 framework in future iterations of the Determination.

2.5.6 Biological treatment of wastes including composting

The default NGER approach for the estimation of emissions from biological treatment is based on the default methodology outlined in IPCC 2006. The Department is exploring a range of options for the refinement of the biological treatment methodology.

Submissions were sought on possible approaches to the estimation of emissions from biological treatment of solid waste noting:

- the importance of a robust empirical basis for the use of country-specific estimation methods
- the general NGERS measurement principles
- the need for consistent treatment across emission sources.

No submissions were received on the topic of estimating emissions from the biological treatment of solid waste.

Further work on the methodology is required before refinements can be made to the estimation of emissions from biological treatment. In particular, further field data will be required to support the adoption of non-default emission factors or estimation approaches.

2.6 Wastewater treatment

2.6.1 General issues

Review of definitions and terminology (MCF)

The Department recognizes the need to review and clarify terminology and definitions within the wastewater sector. Submissions were sought on the proposed changes to definitions and terminology referred to in the discussion paper. The Water Services Association of Australia (WSAA) provided a submission on this issue acknowledging the proposed changes to terminology outlined in the Discussion Paper.

Reporting

Currently, information reported supporting emission estimates is limited. In the interest of completeness and transparency, the Department is considering the requirement of additional information in NGER annual reports. In particular, complete reporting of COD values for wastes leaving the facility would facilitate consistent emissions estimation and reporting. Consideration will be given to the reporting of COD disposed in:

a) sludge disposed to landfill

b) sludge disposed to agricultural lands and compost

c) sludge stockpiled

d) effluent disposed to a waterway

e) effluent disposed to sewage system.

Additional reporting for nitrogen disposal is also being considered for domestic and commercial wastewater, including:

a) nitrogen disposed to landfill

b) nitrogen disposed to agricultural lands and compost

c) nitrogen stockpiled is being considered.

No submissions were received on this particular issue and the Department will continue to consult with industry stakeholders as necessary.

For information on additional reporting requirements for nitrogen disposed via effluent discharge in to different aquatic environments please see the section 2.6.2.

2.6.2 Domestic and commercial wastewater

Plant specific COD:VS ratios

The Determination provides default values for the ratio of COD:VS of a sludge stream. Given the variation in plant operations nationally, actual values may vary considerably from default values provided. The discussion paper addressed the amendment of the Determination to allow reporters to determine a COD:VS ratio for the primary sludge and waste activated sludge streams using regular sampling and analysis.

The Water Services Association of Australia (WSAA) provided a submission expressing support for the addition of sampling and analysis provisions in the Determination for the derivation of plant-specific COD:VS ratios. The Department intends to consult further with the WSAA in developing these additional sampling and analysis provisions with a view to including them in future iterations of the Determination.

Nitrogen removed from the plant in sludge

To estimate the emissions of nitrous oxide from wastewater, the dry mass of sludge transferred out of the plant during the year is factored against the fraction of nitrogen in the sludge transferred out of the plant. Submissions were sought on the inclusion of an equation for deriving the quantity of nitrogen in sludge and appropriate default values for F_n. WSAA provided a submission on the proposed amendments to the Determination and suggested a default value of 0.05 for F_n to use in the equation outlined in the Discussion Paper.

The Department proposes to amend the Determination to include the equation for deriving the quantity of nitrogen in sludge referred to in section 4.6.2 of the discussion paper. The suggested default value for F_n of 0.05 will be included the proposed amendment.

Differentiation of nitrous oxide emission factors for discharge by aquatic environment

Submissions were sought on the introduction of nitrous oxide emission factors by discharge environment. WSAA provided a submission on the proposed amendments to the Determination and providing some additional guidance on the proposed definitions of receiving environments.

The Department proposes to amend the Determination to reflect the methodology outlined in the discussion paper, including the following definitions for receiving environment:

Enclosed waters: All waters other than open coastal waters or estuarine waters.

Estuarine waters: All waters (other than open coastal waters) that:

- are ordinarily subject to tidal influence
- enclosed by a straight line drawn between the low water marks of consecutive headlands.

Open coastal waters: All waters of the Pacific Ocean, Southern Ocean and Indian Ocean except those waters enclosed by a straight line drawn between the low water marks of consecutive headlands.

Method 4 for nitrous oxide plant emissions

Some wastewater treatment plants are completely enclosed and could undertake continuous monitoring and report using a method 4 for nitrous oxide emissions.

Submissions were sought on the need for a method 4 for the estimation of nitrous oxide emissions from wastewater plants, including the applicability of the referenced sampling protocol and other standards that may be appropriate for the implementation of a method 4. WSAA provided a submission on this issue recommending that a method 4 framework be developed in consultation with WSAA.

Further work is required to develop a method 4 framework for the measurement of emissions from wastewater treatment plants. The Department intends to continue the ongoing dialogue with WSAA in the development of a framework.

Emissions from stockpiles of biosolids

Submissions were sought on appropriate default values for degradable organic carbon (DOC) in biosolids, the methane correction factor (MCF) and the oxidation factor (OF), to enable the estimation of emissions from biosolid stockpiles at wastewater treatment plants. WSAA provided a submission on this issue recommending that methods be developed in consultation with WSAA.

The Department recognises that further work is required to develop methodologies for the treatment of emissions from biosolids stockpiles at wastewater treatment plants. The Department intends to continue the dialogue with the WSAA in the development of methodology options with a view to including guidance in future iterations of the Determination.

2.6.3 Industrial wastewater

Scope

The scope of the industrial wastewater source is currently restricted to industries identified in the national inventory.

Submissions were sought on the proposed extension to the scope of the source to petroleum refineries. A number of submissions were received on this issue highlighting the small contribution wastewater treatment makes to the total emissions at petroleum refineries.

The Department intends to defer this proposed amendment. The Department will continue to monitor information on emissions from the on-site treatment of industrial wastewater in a range of industries including petroleum refining and will consider inclusion of additional industries within the scope of this section should emissions be deemed significant.

Wastewater methods

Currently the method provided for industrial wastewater differs from that of domestic and commercial wastewater plants as there is no provision to allow for the deduction of COD leaving the treatment site through effluent.

Submissions were sought on the proposed amendment to the methodology to include an allowance for COD leaving the industrial treatment plant in effluent. No submissions were received on this issue.

The Department proposes to amend the Determination to allow for consideration of COD leaving the plant in effluent.

2.7 Waste incineration and other methods of waste disposal

2.7.1 Waste incineration

The Determination currently only provides a method 1 for waste incineration. The Department has been advised that some facilities have the capabilities to implement direct monitoring of the emissions from this source i.e. a method 4.

Submissions were sought on a proposal to introduce higher order methods for emissions estimation from waste incineration. No submissions were received on this issue.

The Department will propose to amend the Determination to include a method 4 option for the estimation of emissions from waste incineration.

2.7.2 Other methods of waste disposal

The Department is aware that new technologies for waste disposal such as plasma arc gasification and anhydrous pyrolysis are available and that the emissions estimation methods currently in the Determination may not be appropriate for these treatment methods.

Submissions were sought on the methods appropriate for waste disposal techniques that cannot report using existing methods in the Determination. No submissions were received on this issue.

The Department intends to monitor developments in the area of alternative waste treatment methods and will consider inclusion of options for the estimation of emissions from alternative waste treatment when sufficient information becomes available.

3 References

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4 Appendix 1: National Greenhouse and Energy Reporting Framework

The National Greenhouse and Energy Reporting Act 2007 ('the Act') established the legislative framework for a national greenhouse and energy reporting system. The Act provides for an integrated reporting system that will provide the basis for:

- informing government policy formulation and the Australian public;
- meeting Australia's international reporting obligations;
- assisting Commonwealth, State and Territory government programs and activities;
- underpinning the introduction of an emissions trading scheme in the future; and
- avoiding duplication of similar reporting requirements in the States and Territories.

The Act makes reporting mandatory for corporations whose energy production, energy use, or greenhouse gas emissions meet certain specified thresholds.

This Determination is made under subsection 10 (3) of the Act and provides methods, and criteria for methods, for the estimation and measurement of the following items arising from the operation of facilities:

(a) greenhouse gas emissions

(b) the production of energy

(c) the consumption of energy.

The structure of the Determination is designed to facilitate the integration of corporate and facility level data provided under the Act with international data standards on greenhouse emissions.

The scope of the Determination is given by the following categories of emission sources:

The emission sources are:

- **Fuel combustion**: emissions from the combustion of fuel for energy (see Chapter 2 of the Determination)
- **Fugitive emissions** from the extraction, production, flaring, processing and distribution of fossil fuels (see Chapter 3 of the Determination)
- **Industrial process emissions** where a mineral, chemical or metal product is formed using a chemical reaction that generates greenhouse gases as a by-product (see Chapter 4 of the Determination)
- **Waste** emissions from waste disposal – either in landfill, as management of wastewater or from waste incineration (see Chapter 5 of the Determination).

The most important source is fuel combustion, which accounts for over 60 per cent of the emissions reported in the national greenhouse gas inventory.

The scope of the Determination does not include land based emissions covered by the IPCC categories

'Agriculture' and 'Land Use, Land Use Change and Forestry'. Emissions from fuel combustion for land based industries are, nonetheless, covered by this Determination.

4.1 Methods of measurement

Emissions are rarely measured through direct observation and are most often estimated by reference to readily observable variables that are closely related to greenhouse gas emissions such as the quantity of fossil fuels consumed.

The Determination provides methods that allow for both direct emissions monitoring and the estimation of emissions through the tracking of observable, closely-related variables. This framework reflects the approaches of the international guidelines governing the estimation of national greenhouse gas inventories and, similarly, national practice such as for the EU *Guidelines for the Monitoring and Reporting of Greenhouse Gas Emissions* and the US Environment Protection Agency *Mandatory Reporting Rule*.

At its simplest, emissions may be estimated by reference to reportable data such as fossil fuel consumption, evidenced by invoices, and the use of specified emission factors provided in the Determination. For emissions from fuel combustion, for example, data on fuel consumption would be multiplied by a specific emission factor for that fuel to generate an emissions estimate. A similar approach has been used for over a decade in the voluntary reporting program *Greenhouse Challenge Plus* and before that, *Greenhouse Challenge*.

Greater levels of complexity and measurement effort may in some circumstances produce better estimates of emissions at facility level. This may result from, for example, sampling and analysis of a fuel consumed for its carbon content and other qualities that will affect actual emissions generated by its combustion at a facility. In Australia, this kind of approach to emissions estimation is already widely used in the electricity industry – in part for commercial reasons and in part because of the reporting processes that existed under the *Generator Efficiency Standards* program.

Direct monitoring of emissions is also potentially an important approach to emissions estimation. While not common, such direct monitoring already occurs in some form in some instances such as in the coal industry, where state legislation requires the monitoring of methane levels for health and safety reasons.

Each of these broad approaches has been incorporated into the Determination as methods for the estimation of emissions. The four methods in the Determination can be broadly described by the following:

Method 1: the National Greenhouse Accounts default method

Method 1 provides a class of estimation procedures derived directly from the methodologies used by the Department of Climate Change and Energy Efficiency for the preparation of the *National Greenhouse Accounts*. The use of methodologies from the *National Accounts* anchors method 1 within the international guidelines adopted by the UN Framework Convention on Climate Change for the estimation of greenhouse emissions.

Method 1 specifies the use of designated emission factors in the estimation of emissions. These emission factors are national average factors determined by the Department of Climate Change and Energy Efficiency using the Australian Greenhouse Emissions Information System (AGEIS).

Although significantly updated, this method is very similar in approach to that used by many corporations for

over a decade to report emission estimates under the *Greenhouse Challenge Plus* program.

Method 1 is likely to be most useful for emission sources where the source is relatively homogenous, such as from the combustion of standard liquid fossil fuels, where the emissions resulting from combustion will be very similar across most facilities.

Method 2: a facility-specific method using industry sampling and Australian or international standards listed in the Determination or equivalent for analysis of fuels and raw materials to provide more accurate estimates of emissions at facility level.

Method 2 enables corporations to undertake additional measurements – for example, the qualities of fuels consumed at a particular facility – in order to gain more accurate estimates for emissions for that particular facility.

Method 2 draws on the large body of Australian and international documentary standards prepared by standards organisations to provide the benchmarks for procedures for the analysis of, typically, the critical chemical properties of the fuels being combusted.

Method 2 is likely to be most useful for fuels which exhibit some variability in key qualities, such as carbon content, from source to source. This is the case for coal in Australia.

Method 2 is based on existing technical guidelines used by reporters under the Generator Efficiency Standards program. The possibility to report using this, higher order, approach is extended by the Determination from the electricity industry to all major consumers of fossil fuels.

Method 3: a facility-specific method using Australian or international standards listed in the Determination or equivalent standards for both sampling and analysis of fuels and raw materials

Method 3 is very similar to method 2, except that it requires reporters to comply with Australian or equivalent documentary standards for sampling (of fuels or raw materials) as well as documentary standards for the analysis of fuels.

Method 4: direct monitoring of emission systems, either on a continuous or periodic basis.

Method 4 provides for a different approach to the estimation of emissions. Rather than analysing the chemical properties of inputs (or in some cases, products), method 4 aims to directly monitor greenhouse emissions arising from an activity. This approach can provide a higher level of accuracy in certain circumstances, depending on the type of emission process, however, it is more likely to be more data intensive than other approaches. Such monitoring already occurs, for example, in underground coal mines reflecting the nature of the emission process and the importance of relatively accurate data to support health and safety objectives.

As for methods 2 and 3, there is a substantial body of documented procedures on monitoring practices and state and territory government regulatory experience that provide the principal sources of guidance for the establishment of such systems.

In particular four methods have been described which provide a framework for emissions estimation for a range of purposes.

By drawing on existing emission estimation practices where possible the Determination aimed to minimise the

reporting burden on corporations. As indicated above, there are some instances where higher methods (2, 3 and 4 set out below) already reflect current commercial or regulatory practice.

The provision for reporters to select methods for the estimation of emissions also allows reporters to make their own judgments to balance the costs of using the higher methods with the benefits of potentially improved emission estimates.

4.2 General principles of measuring emissions

The *NGER Measurement Determination* sets out four general principles for measuring emissions:

Estimates for this Determination must be prepared in accordance with the following principles:

- transparency – emission estimates must be documented and verifiable;
- comparability – emission estimates using a particular method and produced by a registered corporation in an industry sector must be comparable with emission estimates produced by similar corporations in that industry sector using the same method and consistent with the emission estimates published by the Department in the National Greenhouse Accounts;
- accuracy – having regard to the availability of reasonable resources by a registered corporation and the requirements of this Determination, uncertainties in emission estimates must be minimised and any estimates must neither be over nor under estimates of the true values at a 95% confidence level;
- completeness – all identifiable emission sources within the energy, industrial process and waste sectors as identified by the National Inventory Report must be accounted for.[2]

[2] Note: An amendment is proposed to the completeness principal in section 2.1.1 of this document.

5 Appendix 2: List of submissions received

1. Adelaide Brighton Ltd
2. Alinta Energy
3. Australian Asphalt Pavement Association
4. Australian Coal Association
5. Australian Constructors Association
6. Australian Institute of Petroleum
7. Australian Petroleum Production & Exploration Association Ltd
8. BEMAX Resources LTD
9. BHP Billiton Ltd
10. BlueScope Steel Pty Ltd
11. Caltex Australia
12. Carbon Intelligence Pty Ltd
13. Civil Contractors Federation
14. CSR Ltd
15. DBNGP (WA) Transmission Pty Ltd
16. Department of Mines and Petroleum, Western Australia
17. Department of Resources, Energy and Tourism
18. Downer EDI Ltd
19. Energetics Pty Ltd
20. Energy Developments Ltd
21. Fletcher Building (Australia) Pty Ltd
22. Fulton Hogan Pty Ltd

23. Greenbase Pty Ltd
24. The Griffin Group
25. HRL Technology Pty Ltd
26. Kimbriki Environmental Enterprises Pty Ltd
27. National Generators Forum
28. OneSteel Ltd
29. Roads Australia
30. Shell Australia Ltd
31. SprayLine Surfacing Services
32. Think Brick Australia
33. TiWest Pty Ltd
34. Top Coat Asphalt Contractors Pty Ltd
35. Waste Management Association of Australia
36. Water Services Association of Australia
37. Wesfarmers Limited
38. Worley Parsons

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