



WorleyParsons

resources & energy

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23 June 2011

Matthew Wright
Executive Director
Beyond Zero Emissions
Kindness House, Suite 10, Level 1
Fitzroy, VIC 3065

Ref:
File:

Dear Matthew

COMPARISON OF GREENHOUSE GAS EMISSIONS FROM AUSTRALIAN GAS VERSUS OTHER DOMESTIC AND INTERNATIONAL ENERGY SOURCES

Further to our communications and your Scope of Work, I confirm that we will be pleased to undertake this study.

As required in your Scope of Work, we will prepare a detailed, transparent, quantitative, and fully referenced report that compares the life-cycle global greenhouse gas (GHG) emissions of Australian gas when used as an energy source both domestically and overseas, versus a range of other energy sources available domestically and overseas under a range of currently legal operating practice scenarios. Specifically, we will:

- a) Estimate life cycle GHG emissions for Australian gas when used domestically or exported as LNG for power generation, considering typical CSG, shale gas and north west shelf sources and emissions ranges where data is available for the various gas fields listed.
 - The estimates will include all emissions from extraction and processing in Australia to end use combustion in Australia (domgas) and selected export countries.
 - The focus will be on China and Japan as representative for export scenarios, but considering other countries where possible.
 - The study will include estimates for fugitive emissions using available data plus 20 and 100 year GWPs for methane.
 - Estimates will be prepared for a range of emissions scenarios for fugitives and other emissions, and application of various levels of practice (best, normal and worst-but-legal) for emissions monitoring and mitigation.
 - A focus of the report will be fugitive emissions from upstream gas extraction processes, including needs for more information and monitoring. This will include reviewing information on flow back emissions and uncontrolled releases away from wells as a result of hydraulic fracturing.
- b) Prepare parallel estimates for GHG emissions from Australian black coal, considering available technologies for end combustion in Australia, China and Japan.

- c) Estimate life cycle GHG emissions, where data is available, for alternative electricity sources that gas could displace, specifically existing and new coal fired power stations, nuclear (2nd and 3rd generation), wind turbines, CST central receiver with molten salt storage and direct heating with heat pump (3-5 CoP). Life cycle assessment will be limited to emissions generated from the manufacture, production of materials, and operational maintenance for these energy sources. This is understood to be an estimate of the actual life cycle emissions for the technologies. For natural gas, life cycle emissions will primarily focus on the emissions from production, transportation, combustion and embodied emissions in the associated infrastructure.
- c) Consider developments and issues in energy markets in Australia, China and Japan, and compare life cycle emissions for gas versus other energy sources for a range of displacement scenarios.

In conducting this work we will:

- Provide an independent report providing commentary where appropriate;
- Follow established standards for LCA and for GHG accounting;
- Use publicly available data, including Environmental Impact Statements and the general literature;
- Consult with expert advisers as appropriate.

As discussed, the full final report will be made publicly available on a shared copyright basis. In gathering information, we will respect your needs for confidentiality.

Paul Hardisty will direct the work and I will be the day to day point of contact and be assisted by Rob Hynes and Mitchell Thompson. All are members of our global carbon consulting practice. Our resumés are available on request.

Our fee for the work will be \$50,000 exc. GST. We will aim to complete the work within 6 weeks of receiving your approval.

Please confirm acceptance in writing and, if they are acceptable, sign the attached Standard Conditions. Please call me if you need to discuss any aspect of the work.

We look forward to working with you.

Yours sincerely



Tom Clark

Principal Consultant

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party gives at least 7 days' notice in writing to the other Party to terminate this Agreement. If the Agreement is terminated by the Client for any reason other than the default of the Company or by the Company for the default of the Client, then the Client shall (without prejudice to the Company's accrued rights) pay to the Company all Fees and Reimbursable Expenses due together with reimbursement of any costs and expenses incurred in contemplation of it providing the Services. If the Client terminates the Agreement as a result of a default of the Company, then the Client shall pay the Company all Fees due. If the Agreement is terminated by the Company for any reason other than the default of the Client, then the Client shall (without prejudice to the Company's accrued rights) pay to the Company all Fees and Reimbursable Expenses. Where Fees are payable other than on an hourly rate basis the Fees payable pursuant to this clause shall be calculated on a pro rata basis up to and including the date of termination.

19. Subject to clauses 15 and 23(b), each party must continue to perform its obligations under this Agreement until the date of termination. Clauses 9, 10, 11, 12, 13, 16, 17, 23(a), 27, 28 and 29 survive the termination of this Agreement for whatever reason.

On termination of this Agreement, except where agreed otherwise by the parties, the licence granted by the Company to the Client under clause 17(b) terminates and the Client must, at the direction of the Company, destroy or return Company Material. The remainder of clause 17 survives the termination of this Agreement for whatever reason.

20. If:

- a) in respect of all or part of the business or assets of either the Company, the Client or parent company of the Client:
 - i) a liquidator or provisional liquidator is appointed;
 - ii) a receiver, receiver and manager, trustee, controller, official manager or similar officer is appointed;
 - iii) an administrator is appointed, whether under Part 5.3A of the Corporations Law or otherwise; or
 - iv) an application is made for the appointment of an administrator, liquidator or provisional liquidator; or
- b) either the Company, the Client or parent company of the Client
 - i) is unable to pay its debts as and when they fall due;
 - ii) is insolvent or presumed to be insolvent under any law; or
 - iii) is an insolvent under administration as defined in section 9 of the Corporations

Law or an action is taken which could result in that event; or

- c) either the Company or the Client commits a substantial breach of this Agreement;

then the other party may immediately terminate the Agreement by giving written notice.

Fees and Payment

21. The Fees are for performance of the services specified in the Engagement Letter. If:

- a) the Company performs services different or additional to those specified in the Engagement Letter ; or
- b) the nature of the Services changes; or
- c) the cost associated with the provision of the Services is increased due to the imposition of, or increase in, the amount of any government tax (other than income tax), fee or charge; or
- d) the Services are suspended other than by reason of breach by the Company;

the Company will be entitled to an additional fee agreed between the Client and the Company or, if no agreement is reached, then as reasonably determined by the Company.

22. The Company may submit invoices to the Client for payment of its Fees and Reimbursable Expenses at monthly intervals or options of 7/14/21/30 days and at the completion of the Services. Invoices must be supported with evidence to the Client's satisfaction substantiating the amounts claimed in the invoice. Subject to clause 24 payment of the amount referred to in an invoice is due from the Client within 15 days (Company standard payment terms) of the date printed on the Company's invoice.

23. If the Client does not pay the amount of the invoice (standard payment terms 15 days) when it is due.

- (a) the Company is entitled to:
 - (i) charge interest to the Client at the rate of 1.25% per month from the date of the invoice until the date of payment in full; and
 - (ii) suspend the provision of the Services until the date of payment in full.

- (b) the Client shall indemnify and hold the Company harmless from all costs and/or expenses (including, but not limited to legal costs) of and connected with the recovery of any Fees and/or Reimbursable Expenses due and owing pursuant to this Agreement.

24. If the Client disputes any part of any invoice submitted by the Company, the Client must pay the undisputed balance in full. In the event that any part of a disputed amount is subsequently agreed or determined to be due, the Client must

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circumstances of its disclosure, is or could reasonably be expected to be regarded as confidential to a party and includes concepts, technical and operational information owned or used by a party and details of any clients, customers or suppliers of a party.

- b) The Company must not disclose, or allow to be disclosed to any person, any of the Confidential Information of the Client without the prior written consent of the Client.
- c) The Client must not disclose, or allow to be disclosed to any person, any of the Confidential Information of the Company without the prior written consent of the Company.
- d) The Company must only use Confidential Information of the Client for the purpose for which it was disclosed and must not make use of such Confidential Information or any part of it to the competitive disadvantage of the Client.
- e) The Client must only use Confidential Information of the Company for the purpose for which it was disclosed and must not make use of such Confidential Information or any part of it to the competitive disadvantage of the Company.
- f) The Company shall be entitled to retain a copy of all documents related to the Project for its records, subject to its continuing obligations under this clause.

Intellectual Property

17.

- a) For the purposes of this clause:
 - i) "Company Material" means any concept, product methodology, technique, procedure, algorithm, management tool, workshop manual, proprietary software, data file, libraries, idea, designs, invention, know-how, process or other intellectual capital developed, discovered or used by the Company in the course of providing the Services, and includes all drawings, specifications and other material provided by the Company; and
 - ii) "Intellectual Property Rights" means all statutory or other proprietary rights (including moral rights) in respect of copyright, trade mark (including the trade mark), design, patent, circuit layout rights, trade or business or company names, domain names, and any rights to registration of such rights whether created before or after the commencement of this Agreement;
- b) All Intellectual Property Rights the Company creates or develops or has created or developed in connection with Company Material vest in the Company. The Company grants the Client a royalty free, non transferable, non exclusive, revocable licence to use the Company Material solely

in connection with the Services for the duration of this Agreement, subject to the Company receiving full and unabated payment for the Services.

- c) Other than as set out in (b), the Client acknowledges that nothing in this clause operates to grant to the Client any right, claim, title or interest in or to any Company Material. The Company Material must not be disclosed to third parties without the Company's prior written consent. The supply to or use of any of Company Material by the Client prior to full and unabated payment being made to the Company does not imply granting of a licence for its use.
- d) Subject to clauses 10, 11, 12 and 13, the Company warrants to the Client that the Company Material does not infringe the Intellectual Property Rights of any third party and indemnifies the Client against breach of that warranty. This indemnity does not apply if any infringement or alleged infringement arises from:
 - i) the use of the Company Material in combination by any means and in any form with other goods not specifically approved by the Company where that combined usage gives rise to the infringement;
 - ii) use of the Company Material in a manner or for a purpose not reasonably contemplated or authorised by the Company, including bureau, application service provider or other arrangements where the benefit or use of the Company Material is provided to a third party;
 - iii) modification or alteration of the Company Material (with or without the Company's specific written approval);
 - iv) any transaction entered into by the Client relating to the Company Material, without the Company's prior written consent; or
 - v) where other than the most recent version of the Company Material is in use and a subsequent release does not infringe upon the third party's Intellectual Property Rights.
- e) The Client grants to the Company a non exclusive licence to use the Client's Intellectual Property Rights, including any software, to the extent necessary for Company to provide the Services.
- f) Subject to clauses 10, 12 and 13, the Client warrants to the Company that any document, material or design provided by the Client does not infringe the Intellectual Property Rights of any third party and indemnifies the Company against breach of that warranty.

Duration of Agreement

- 18. Subject to clause 20, the Agreement continues until completion of the Services unless either

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Limitations of Liability & Third Party Indemnity

10. Notwithstanding any other clause of this Agreement,

- a) neither Party is liable to the other in contract, in tort (including but not limited to negligence), in equity, by operation of statute or otherwise for any kind of:
 - i) indirect or consequential loss or damage;
 - ii) loss of opportunity;
 - iii) loss of revenue;
 - iv) loss of profit or anticipated profit;
 - v) loss of contracts;
 - vi) loss of goodwill;
 - vii) loss arising from business interruption; or
 - viii) liability arising out of or in connection with pollution or contamination;

arising out of or in connection with this Agreement incurred or suffered by a party, or any other person.

- b) the Client shall indemnify, defend and hold harmless the Company and its respective subsidiaries and/or affiliates and the officers, agents, employees and authorised representatives of the foregoing from and against any and all claims, demands, suits, actions, legal or administrative proceedings whatsoever and howsoever arising that are, or may be, made by or on behalf of any third parties and from any losses or damages of any name or nature (including solicitor's costs, expenses and interest) arising therefrom or in connection therewith whether arising before the completion of the Agreement or Services or after completion of the Agreement or the Services and in any manner caused, or claimed to be caused, occasioned or contributed to in whole or in part, by reason of any act, omission fault or negligence (whether active or passive) of the Company, its lower tier suppliers, subcontractors or anyone acting or purporting to act under its direction or control or on the Company's behalf.

This indemnity shall expressly include indemnity by the Client to the company for property damage and injury to or death of any third party including any person who is employed by or acting under the direction or control of the Client.

11. The liability of the Company in respect of any claim arising out of or in connection with this Agreement, the Services, the Project or otherwise, whether arising in contract (including but not limited to warranties and implied warranties), in tort (including but not limited to negligence), in equity, by operation of statute or otherwise is limited solely to the repetition by the Company of the Services which are shown to be deficient. The Company will be liable to re-

perform its Services to rectify such deficient Services only up to a cost to the Company which does not exceed the amount of Fees paid in respect of such deficient Services.

12. The liability of the Client and the Company to each other whether arising in contract, in tort (including but not limited to negligence), in equity, by operation of statute or otherwise must be reduced proportionately to the extent that a breach of contract, the failure to comply with a Relevant Law, or the negligent act or omission of a party or its consultants, agents or other contractors contributed to the loss, damage, costs, claims, liability, expense, outgoing or payment incurred by the other party.

Services provided for Exclusive Benefit of Client

13. The Services are provided for the exclusive benefit of the Client and the Company accepts no liability to any person other than the Client in respect of any claim arising out of or in connection with the Services, the Project or any relationship established by this Agreement whether arising in contract, in tort (including but not limited to negligence), in equity, by operation of statute or under any Law or otherwise. If the Client:

- (a) allows any third party to enjoy the benefit of the Services; or
- (b) instructs the Company to provide a third party with any report, drawing or other product of the Company's Services

the Client pursuant to clause 10(b) hereby agrees to indemnify and hold harmless the Company against any claim by that third party.

Insurance

14. The Company and the Client must each have insurance cover for any loss or damage in adequate amounts and for the risks each bears under this Agreement as required by statute or otherwise as is reasonable in the circumstances. The Company and the Client must each have a Public Liability insurance policy for an amount adequate to cover any risk that party bears under this Agreement.

Inability to Perform Agreement

15. If the Company or the Client become unable in part or whole to perform this Agreement as a result of an event outside the reasonable control of that party it must promptly notify the other party and suspend performance under this Agreement (other than under clauses 21, 22 and 23) while the event or its consequence continues and resume performance as soon as practicable.

Confidential Information

16.
 - a) "Confidential Information" means all information which, by its nature or by the

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Definitions

"**Agreement**" is defined in clause 1.

"**Client**" means the person or entity identified as the Client at page 5 of these Standard Conditions of Contract, its representatives and authorised agents.

"**Company**" means the company identified as the Company at page 5 of these Standard Conditions of Contract.

"**Engagement Letter**" means the letter from the Company to the Client dated **23 June 2011**.

"**Fees**" means the fees set out in the Engagement Letter. "GST" means the Goods and Services Tax imposed under A New System (Goods and Services Tax) Act 1999.

"**Project**" is defined in the Engagement Letter.

"**Reimbursable Expenses**" means all expenses reasonably incurred by the Company in performing the Services or, where specified in the Engagement Letter, as defined in the Engagement Letter.

"**Relevant Law**" and "**Relevant Jurisdiction**" are as detailed at page 5 of these Standard Conditions of Contract.

"**Services**" means the services to be provided by the Company to the Client as stated in the Engagement Letter and such further services as are agreed between the Client and the Company.

Standard Conditions of Contract:

The Agreement

1. The "**Agreement**" means the agreement for the Company to provide the Services to the Client. The Agreement comprises the Engagement Letter, these Standard Conditions of Contract and any other documents referred to in the Engagement Letter. The Agreement represents the entire understanding of the parties and supersedes all prior agreements, arrangements, representations or understandings (if any) of the parties in respect of matters dealt with by this Agreement. The Client agrees that it has not relied on any such matters in deciding whether to enter into this Agreement. The documents which are part of the Agreement are mutually explanatory. If there is any ambiguity or discrepancy in the documents, the order of precedence shall be firstly the Engagement Letter, secondly these Standard Conditions of Contract and thirdly any other documents referred to in the Engagement Letter, unless the parties agree otherwise in writing.

Retrospectivity

2. The Agreement applies to the performance of the Services regardless of whether the Agreement was in force at the time the Services were performed.

Providing the Services

3. The Company must exercise reasonable care, skill and diligence in providing the Services.

4. The Company will provide the Services in a manner which, where it is within the Company's control, facilitates the timely completion of the Project.

5. The Company will, where required by this Agreement and practicable, coordinate the provision of the Services with the activities of other parties engaged by the Client and at the direction of the Client.

6. The Client must, within a time that does not delay the Company in providing the Services, make available to the Company all the information, documents and other details, access and permissions required for the Company to provide the Services.

7. If the Company considers the Client has not sufficiently complied with clause 6 to enable the Company to provide the Services in accordance with this Agreement, the Company may advise the Client. The Client must then promptly provide the further assistance necessary.

Change in Scope or Timing of Services

8. If the Company or the Client become aware of any matter which will change or has changed the scope or timing of the Services or the Project, then it will as soon as practicable give notice to the other party of the matter and as far as practicable, details of the change.

Work at the Client's Premises

9. Where servants, agents or sub-contractors of the Company carry out work at the Client's premises, the Company, its servants, agents or sub-contractors carrying out work at the Client's premises will comply with any reasonable direction of the Client regarding occupational health and safety. The Client must maintain at those premises the safety procedures, equipment and standards necessary to comply with any Relevant Law and to ensure a safe workplace. For that purpose any servants, agents or subcontractors of the Company are deemed to be under the control of the Client. The Client is fully responsible for, and must indemnify and hold harmless the Company against any claim, loss or damage of any kind whether arising in contract, in tort (including but not limited to negligence), in equity, by statute or otherwise, arising in any way out of the failure of the Client to comply with the requirements of this paragraph.

Where servants, agents or sub-contractors of the Company carry out work under the direction of the Client, the Client will be fully responsible for, and must indemnify and hold harmless the Company against any claim, loss or damage of any kind, whether arising in contract, in tort (including but not limited to negligence), in equity or by statute connected in any way with the Services, Project or relationship established by this Agreement, in respect of the acts or omissions of the Company, its servants, agents or sub-contractors.

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pay the amount withheld together with interest in accordance with clause 23(a).

25. In determining the Fees and Reimbursable Expenses the Company may add an amount for GST which is lawfully required to be remitted by the Company.

No Assignment

26. Neither the Company nor the Client may assign its respective rights and obligations under this Agreement without the written consent of the other party.

Severance

27. If any part of the Agreement is contrary to law, it will not affect the enforceability of other provisions, or parts of provisions.

Relevant Law and Jurisdiction

28. The Services to be performed pursuant to the Agreement will be performed in accordance with the Relevant Law.

29. The Courts of the Relevant Jurisdiction have non-exclusive jurisdiction to resolve any dispute arising out of this Agreement or the performance of the Services unless the parties otherwise agree in writing to an alternative dispute resolution procedure.


The Relevant Law is Australian Law.

The Relevant Jurisdiction is Australia..

Signed and dated on behalf of the Client as acceptance of clauses 1 to 29 inclusive

Client name Beyond Zero Emissions Inc.

Client ABN 48 554 925 975

Signed 

Name Matthew Wright


Position Executive Director

Date 24 June 2011

Signed and dated on behalf of the Company

Company name WORLEYPARSONS LIMITED

Company ABN 17 096 090 158

Signed 

Name NICK HOULDSWORTH

Position ENVIRONMENTAL MANAGER

BEYOND ZERO EMISSIONS / WORLEY PARSONS

**SCOPE OF WORK FOR COMPARISON OF GREENHOUSE GAS EMISSIONS FROM
AUSTRALIAN GAS – VERSUS - OTHER DOMESTIC AND INTERNATIONAL ENERGY SOURCES**

Version 20110614

OBJECTIVE AND OVERVIEW OF THIS STUDY COMPARISON

Beyond Zero Emissions requests that Worley Parsons prepare a detailed, transparent, quantitative, and fully referenced report that compares the life-cycle global greenhouse impact of Australian gas when used as an energy source both domestically and overseas, versus a range of other energy sources available domestically and overseas under a range of currently legal operating practice scenarios. The report shall be suitable for publication on the Beyond Zero Emissions website and elsewhere.

BACKGROUND AND REASON FOR THE STUDY

Frequent public statements are made by fossil gas proponents that their fuel of choice is a “clean” energy source or at least one that is significantly “cleaner” than coal. Specifically, this study comparison will explore the claims made recently APPEA (<http://www.smh.com.au/environment/csg-a-queensland-success-story-20110530-1fcdv.html>)

Contrasting APPEA’s claims, independent research done by Dr. Robert W. Howarth of Cornell University <http://www.beyondzeroemissions.org/media/radio/professor-robert-w-howarth-cornell-university-talks-shale-gas-emissions-and-110315> has shown that when the full lifecycle impacts of natural gas are assessed, including in particular gas venting, leakage, and other fugitive emissions, and when the recent NASA-suggested 20-year global warming potential factor for methane of 105 is applied, natural gas may be no better than coal and in some cases possibly worse. Furthermore, the United States Environmental Protection Agency has recently revised some factors for fugitive emissions and gas venting upward by 8,850 times.

http://www.epa.gov/climatechange/emissions/downloads10/Subpart-W_TSD.pdf

Also contrasting APPEA’s claims is BZE’s view that Australian gas imported to Asia is likely to be used to support growth in energy demand and will many cases be substituted for investments in renewable energy sources.

Beyond Zero Emissions wish to investigate this matter with specific attention to the actual practices in the Australian coal seam gas industry and to the actual energy options currently being built in those major countries where Australian LNG is being imported.

ADDITIONAL DETAIL REGARDING ASSUMPTIONS, SCOPE OF WORK AND DELIVERABLES

This section provides additional detail regarding study assumptions, scope of work and deliverables.

The Meaning of “Lifecycle”

The 2008 Worley report (“Greenhouse Gas Emissions Study of Australian LNG”, originally prepared 7th August 2008, modified for public release, March 2011) uses the term “lifecycle”, but does not attempt to quantify the GHG emissions associated with fabricating & constructing any plant equipment. To do so credibly would be an enormous task. So that basis is accepted. However, the report will need to be clear about what is meant by the term “lifecycle”.

Australian Gas Sources

Emissions impacts are to be determined for the following Australian gas sources:

- Kipper conventional gas field, Gippsland, Victoria, for domestic use only
- Queensland Surat-Bowen Basin coal seam gas, for domestic and Gladstone LNG export uses
- Queensland Galilee Basin coal seam gas, for domestic and Gladstone LNG export uses
- Cooper-Eromanga Basin shale gas, for domestic and Port Bonython LNG export uses
- New South Wales Gunnedah basin coal seam gas, for domestic and Newcastle LNG export uses
- New South Wales Clarence-Morton basin coal seam gas, for domestic and Newcastle LNG export uses
- New South Wales Sydney basin coal seam gas, for domestic use
- North West Shelf conventional gas, Western Australia, for domestic and Karratha LNG export uses
- Gorgon conventional gas, Western Australia, for LNG export use – including the range of outcomes assuming complete success and complete failure of CO₂ sequestration
- Prelude conventional gas, floating facility offshore Western Australia, for LNG export use

All coal seam and shale gas cases should include the full range of feasible carbon dioxide concentrations naturally occurring within these gases.

Alternative Domestic Australian Energy Sources

The study shall compare Australian domestic use of gas (OCGT, CCGT, and direct heating uses) versus domestic energy alternatives such as electricity generation from “new-investment” coal (e.g. Kogan Creek or IGCC), wind, and concentrating solar thermal (CST) central receiver (e.g. Gemasolar and Rice/Tonopah), and the use of electricity to power direct-heating conversion devices such as commercially available high-efficiency COP-5 heat pumps. See <http://energy.unimelb.edu.au/index.php?page=technical-publication-series> as a reference regarding wind and CST costs.

Alternative Overseas Australian Energy Sources

The study shall consider that LNG is exported from Australia to China, India, Japan, and Korea, and shall compare the use of Australian gas in those countries versus the full range of “new-investment”, commercially-available energy options available in those countries. “New investment” means the full range of energy options that are being built today in those countries.

Operating Practices

Operating practices to be considered and described and to be used as the basis for calculation scenarios shall range from “best global practice” to “normal current practice”, to “worst-yet-still- legal practice”. “Best” and “worst” refer to greenhouse gas outcomes.

A qualitative and emissions-quantitative comparison of Australian coal seam gas practice to best known practice (e.g. http://www.rmotc.doe.gov/PDFs/CBM_Separator.pdf) are to be described.

The report shall comment on the likelihood of community acceptance of flaring as a means to reduce fugitive GHG emissions during coal seam gas field operations in New South Wales and Queensland.

Inadequate Data

Where data that would allow confident quantification of emissions is limited or not available (e.g. the level of fugitive methane emitted during coal seam gas production operations), recommendations shall be made as to how adequate data can be obtained or what field tests are required.

Gas Facility Operations

Emissions for the full life-cycle of gas production and transmission are to be assessed, including the emissions from generation of energy required for gas treating, CO₂ removal and venting, compression, refrigeration, liquefaction, pipeline transmission, ocean shipping, regasification, etc.

Fugitive Emissions

The study is to provide quantitative and fully-referenced description of the fugitive emissions associated with production of the range of major Australian natural gas sources listed above. The fugitive emissions that may result from all aspects of natural gas production, transmission, distribution and end use are to be described including but not limited to:

- drilling operations, including probabilistically assessed uncontrolled well incidents such as blow-outs
- uncontrolled releases to the land-surface and atmosphere via induced (via fracturing or “fracking”) and naturally occurring cracks in the rock strata
- well completions and well “clean-up”
- flow-back water production
- well operations
- infield gas-gathering operations
- gas processing plant and compressions operations
- gas transmission pipeline operations
- gas reticulation system operations
- fugitive emissions at end-user site

Furthermore, this study shall include an assessment and a report on the uncertainties and adequacy of the fugitive emissions quantification, reporting, and regulation currently applied with respect to present and future production of “unconventional” gas in Australia.

Comment is to be made and references provided regarding current Australian practice and regulations relating to the control and reporting of greenhouse gas fugitive emissions (including NGERs, etc.) Illustrate, via NGERs reporting methods (<http://www.climatechange.gov.au/reporting>) to what extent coal seam gas operators must report on fugitives and what methods / assumptions / factors are used. Compare NGERs with US EPA assumptions / methods. Comment on whether NGERs assumptions represent best practice.

Commentary is to be provided on whether data provided in the Environmental Effects Statements for LNG projects (QCLNG, GLNG, APLNG, Prelude, Gorgon, Pluto), reflect the full range of possible fugitive emissions outcomes that may be experienced in practice. Can the factors used be guaranteed to reflect the specific conditions to be found in the operation of these facilities? For example, where fugitive emissions estimates are based on factors from other countries (US API) or similar but not identical operations, are these adequate?

Commentary shall be made on technologies that may be applied (now or within the next 5 years) for measuring methane release to the surface from fracturing or rock strata (e.g. laser <http://www.epa.gov/ttn/chief/conference/ei15/session14/chambers.pdf>, satellite <http://www.telegraph.co.uk/earth/environment/globalwarming/4110714/Satellite-will-show-how-the-earth-breathes.html>), or other surface measurement techniques).

Global Warming Potential

Separate calculations of emissions impacts are to be done on 20 year and 100 year Global Warming Potential bases. Calculations shall also be done considering the recent NASA research (<http://www.sciencemag.org/content/326/5953/716>) that indicates higher Global Warming Potential for methane (i.e. 105) when interactions with aerosols are considered. The report shall comment on the likely timing of when international bodies (e.g. UN IPCC) and domestic regulations will take 20-year Global Warming Potential into account.

Example References

BZE provides the following additional references as background and expects that these and similar references shall be used in preparing the report.

US EPA http://www.epa.gov/climatechange/emissions/downloads10/Subpart-W_TSD.pdf

http://cce.cornell.edu/EnergyClimateChange/NaturalGasDev/Documents/PDFs/SKONE_NG_LC_GHG_Profile_Cornell_12MAY11_Final.PDF See esp. Pg 21.

All about CBM (U.S. name for CSG)

<http://www.all-llc.com/publicdownloads/CBMPRIMERFINAL.pdf>

US Life Cycle Analysis of onshore versus LNG import - says onshore is more greenhouse intensive which evens out versus imports http://www.adv-res.com/pdf/ARI_LCA_NOV_10_08.pdf

http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=5790968

<http://teeic.anl.gov/documents/docs/library/WindRiverDraftV3Emission.pdf> See esp. page 17. Natural gas and CBM well emission estimated at 0.045 tpy/well as per EnCana stack test.

Coal Seam Gas / Coal Bed Methane, pg 28.

http://netl.doe.gov/energy-analyses/pubs/NG_LC_GHG_PRES_12MAY11.pdf

A sub critical plant gets replaced with an Ultra Super Critical

<http://www.businessweek.com/news/2010-07-28/china-may-cap-coal-output-by-2015-to-cut-emissions.html>

China to cap coal at 3.8 Billion tonnes per year from 2015

http://www.powermag.com/coal/Chinas-Five-Year-Plan-Is-Heavy-on-Non-Fossil-Generation_3611.html

Beijing to Go Coal-Less in 2015

<http://sustainablecitiescollective.com/thecityfix/24128/beijing-go-coal-less-2015>

Beijing to control coal use below 20Mt by 2015 cutting 7Mt from city consumption

<http://en.sxcoal.com/53800/NewsShow.html>

China 2015 coal recovery rate to hit 40 pct <http://en.sxcoal.com/618/33696/DataShow.html>

China to cap coal use at 4 bln tonnes by 2015 China aimed to cut the amount of energy and carbon dioxide emissions needed for every unit of gross domestic product by 16 to 17 percent from this year to the end of 2015.

http://www.china.org.cn/business/2011-03/04/content_22054259.htm

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<http://www.electricityforum.com/news/oct10/Chinesecoalgenerationcapacitytoreach933GW.html>

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