Ms Sarah Hnatiuk
Principal Research Officer
House of Representatives Standing Committee
on Environment, Recreation and the Arts
Parliament House
CANBERRA ACT 2600 File: 97008096

Dear Ms Hnatiuk

BUREAU OF RESOURCE SCIENCES SUBMISSION TO INQUIRY INTO THE REGULATORY ARRANGEMENTS FOR TRADING IN GREENHOUSE GAS EMISSIONS

Please find enclosed for consideration of the Committee the Bureau of Resource Sciences Submission to the House of Representatives Inquiry into Regulatory Arrangements for Trading in Greenhouse Gas Emissions.

The Bureau of Resource Sciences has been involved for some time with definitional and measurement issues associated with greenhouse gas emissions in the Agricultural, Land Use Change & Forestry, and Energy sectors and has considerable scientific and technical expertise and experience in greenhouse gas issues.

The submission notes that Kyoto created a new tradeable commodity (aggregated anthropogenic carbon dioxide equivalents), and the need to carefully define and measure what is being traded before an international emissions trading scheme can be adopted. By way of an example, an attachment shows some details of how a carbon accounting system might be set up for trading to occur in the sectors relating to the biosphere, and, suggests why science needs to under-pin the trading mechanism adopted.

As discussed with Ian Dundas, BRS would be delighted to demonstrate to the Committee the current technology available including geographical information systems (GIS) and mega databases to accurately account for carbon. This demonstration could be arranged at Parliament House or BRS.

Dr Peter O'Brien
Executive Director

27 March 1998

Bureau of Resource Sciences Submission to the House of Representatives Inquiry into regulatory arrangements for trading in greenhouse gas emissions March 1998

1. Purpose

This submission concerns the definition, scientific understanding, measurement, monitoring, verification and compliance of greenhouse gas emissions for emissions trading purposes. This submission therefore primarily addresses the first two terms of reference (see Attachment A) of this inquiry into emissions trading. It is presented to highlight the lack of definitions, data and procedures for quantifying emissions necessary for effective trading to occur. The submission comments principally on issues relating to an international emissions trading scheme as envisaged in the Kyoto Protocol[1].

The Bureau of Resource Sciences (BRS) is a partner in the separate submission made by the Department of Primary Industry and Energy to this inquiry. BRS is the national body which compiles and issues information on Australia's resources and is making this direct submission because it considers it important to assist the inquiry in its understanding of some of the issues.

2. 'Kyoto' Creates A New Commodity

The Kyoto Protocol of 10 December 1997 has set in place a mechanism to cap the quantity of greenhouse gas emissions in participating countries such that a restriction on the quantity of emissions will inevitably change their price.

Prior to 'Kyoto' greenhouse gas emissions were not openly traded and their price was not known but could have been assumed to be approximately zero. By restricting the quantity of emissions, and permitting emissions trading between 39 specific countries or groups of countries, the Kyoto Protocol has created a new commodity and a market for it. The pricing structure for emissions will change with time once trading commences.

3. Definition of the Commodity

Six gas groups are to be measured under the Kyoto protocol in terms of an undefined "aggregate anthropogenic carbon dioxide equivalent" (Article 3.1 of Kyoto Protocol). This newly created commodity can be emitted or absorbed and it is colourless and odourless in its gaseous carbon dioxide form. Once emitted its origin cannot readily be traced. The conversion of the five non-carbon dioxide gases and groups of gases to carbon dioxide equivalents adds

[1] Kyoto Protocol here refers to the 'Kyoto Protocol to the United Nations Framework Convention on Climate Change' dated 10 December 1997 United Nations Document FCCC/CP/1997/L.7/Add.1

further complexity. These issues make it difficult to define, understand, trace and regulate emissions.

4. Measurement Monitoring and Verification of Emissions

To increase the chances of success, an emissions trading scheme must have confidence in the commodity being traded. This requires a precise and consistent and accepted set of definitions and methods of measurement of the emissions being traded.

Currently the IPCC methodologies and inventories exist at a national and international level and are being refined iteratively. BRS has been involved in the development and improvement of some of these methodologies and inventories. These national inventories are necessarily of a simplistic and aggregated nature as their objective is to report emissions of each country in a consistent manner. They deal with national statistics and apply generic factors often using default values set by IPCC committees. Some of these generic factors are known to be inappropriate for Australia but are still used because no better data exists. BRS has been active in original research to improve the methodologies and the data for these inventories so that they are more relevant to Australian circumstances. BRS is also aware of the substantial difference in magnitude of uncertainties in emission inventories between sectors.

For detailed emissions trading to occur these methods need to become more specific and continually updated. Their measurement uncertainties in some sectors need to be substantially reduced. Their generic nature must be refined and they must become more closely targeted at the individual enterprise level. The process must be sufficiently well defined and accurate to be reliably repeated by any compliance or verification groups (Australian or foreign) involved in the trading of emissions.

For an emission trading scheme to operate between countries each item making up the total emissions must be verifiable to international standards. This activity implies effort in developing the methodologies and inventories and in educating the users of the inventories from the enterprise level upwards, not only in Australia but also overseas where our emissions trading partners will inevitably be.

For an emissions trading scheme to operate reliably, repeatably and robustly large national databases will need to be held that have strong numeric, scientific and technical credibility. The databases will need to cover the principle sectors for our emissions such as the Agriculture, Land Use Change & Forestry, and, Energy[2] sectors. They will need to be assembled in a manner that is consistent in both definition and operation. They will need to be stored in a manner that provides continuity as targets are related to historic

[2] The sectors used here are those defined by the Intergovernmental Panel on Climate Change (IPCC). There are six IPCC sectors in total. The three sectors listed here represent about 95% of Australia's total greenhouse gas emissions.

benchmark eras. BRS has been actively involved in creating and maintaining databases of this nature for emissions calculations and other national uses and is aware of the difficulties in ensuring database validity.

BRS has been and is continuing to research the mechanisms necessary to define and prepare carbon accounts of the biosphere for Australia (see details in Attachment B) and better understand energy related fugitive emissions from oil, gas and coal extraction (see details in Attachment C). This work is essential to the definition and verifiable understanding of emission sources and sinks, understanding the emissions trading market and achieving verifiable compliance with the Kyoto protocol.

5. Data Quality and Policy Making

Policy makers in this area of emissions reduction are hampered by a lack of reliable data and consequently are unable to say precisely what effects each emission reduction policy will have on emissions. With improved data their predictions of policy outcomes will become more precise but still cannot be expected to be 100% accurate due to the unpredictability of the rate and extent of policy implementation.

If reduction policies are set in place and emissions are reduced below the target for 2008 to 2012 more effort will have been put into emission reduction than was necessary. Alternatively the policies may not achieve the reductions expected and again the target missed. Compliance penalties may then be enforced. Emissions trading schemes can act as a buffer to overcome this problem.

6. Emission Trading Is An Insurance Policy

The Kyoto Protocol refers to emissions trading as being “supplemental to domestic actions for the purpose of meeting quantified emission limitation” (Article 16 bis of Kyoto Protocol). Participation in an emissions trading scheme is optional.

However if an emissions trading scheme is in place the gaps either way between performance and target can be capitalised or purchased and compliance is almost guaranteed. An emissions trading scheme gives flexibility and it provides a form of insurance policy, a way of fine tuning emissions to ensure the target is hit precisely, a way of ensuring compliance and a way of avoiding the odium of penalties for non-compliance.

7. Technical Risks of a Trading Scheme

The Kyoto Protocol is not based on a scientifically rigorous carbon budget model of the sources, sinks and fluxes of carbon on earth. Instead, both the protocol and the IPCC are based on a selection of components and arbitrary timelines that suit the immediate policy needs of the signatories. This lack of broad scientific under-pinning exposes the trading scheme, as well as other

reporting systems, to change as policy needs to evolve. Such changes can perturb the economics of the commodity market by arbitrarily increasing or decreasing the stocks of carbon available for trading.

The more closely the international carbon accounting mechanisms and policies mimic a true carbon budgeting system, the less will be the sovereign risks from arbitrary changes. Implementers and operators of a trading scheme should be aware of this kind of risk prior to entering the market place.

8. Conclusions

A new commodity has been created; it needs to be carefully defined before it can be measured, monitored and verified so that trading can commence on an internationally credible basis. BRS is familiar with the problems associated with definition, measurement, monitoring and verification issues relating to greenhouse gas emissions and has carefully prepared a framework for national carbon accounting systems to facilitate understanding of emissions, their reduction and trading. BRS is already working on the implementation of this framework.

An emissions trading scheme is a useful tool to ensure that a reduction target can be accurately hit. With the use of emissions trading the chances of achieving compliance are increased provided full quantification of the commodity is under-pinned by sound science.

Attachment A

Attachment to the Bureau of Resource Sciences Submission to the House of Representatives Inquiry into regulatory arrangements for trading in greenhouse gas emissions

TERMS OF REFERENCE

Parliament of the Commonwealth of Australia
House of Representatives
Standing Committee on Environment, Recreation and the Arts

The Standing Committee, chaired by the Hon Ian Causley, MP, is to carry out an inquiry into:

regulatory arrangements for trading in greenhouse gas emissions

The Committee will inquire into the regulatory arrangements that would need to be put in place to support a market in greenhouse gas emissions including:

- mechanisms for measuring, verifying, and monitoring emissions and the compliance with contracted arrangements;
- mechanisms to integrate emissions trading with the development of carbon sinks (such as timber plantations, gas aquifer reinjection, soil rehabilitation etc), including the science, measurement and security of such arrangements;
- the allocation of the right to emit greenhouse gases;
- regulatory mechanisms to support a national market and potentially an international market in emissions trading;
- possible emission traders, administration and transaction costs;
- roles and responsibilities of governments and other stakeholders;
- the impact of emission trading on the environment and industry and the economic and social welfare of the Australian community;

The Committee would welcome written submissions on this inquiry from interested individuals and organisations by 13 March 1998.

Attachment B

Attachment to the Bureau of Resource Sciences Submission to the House of Representatives Inquiry into regulatory arrangements for trading in greenhouse gas emissions

Carbon Accounting

BRS RESEARCH IN SUPPORT OF A NATIONAL CARBON ACCOUNTING SYSTEM

Background

Australia has a reasonable record of biospheric national resource monitoring. However, when detailed information, such as that needed for a National Carbon Accounting System, is required, then deficiencies in our data systems become apparent and limit our ability to respond. For example, the most recent National Greenhouse Gas Inventory declined to include Land Use Change in its estimation of Australia's total emissions because of the uncertainty of its measurement.

Despite these difficulties in understanding and measuring the greenhouse emissions from land based sources and sinks, their potential size suggests that the land use change and forestry sectors could play a very significant role in Australia's future emissions policy. Australia is currently investing in the sustainability and productivity of its considerable land based resources, through National Heritage Trust Programs such as Landcare, Farm Forestry and Bushcare. There is no national system, framework or plan to capture greenhouse benefits of programs with sink development initiatives such as Plantation 2020 Vision, Bush for Greenhouse, and the Tropical Grasslands Carbon Initiative. Australia needs to be able to quantify carbon stocks and sinks since 1990 or it will be ineffective at providing the data required for greenhouse emission trading. BRS has therefore agreed that a comprehensive National Carbon Accounting System is required.

Objectives of a National Carbon Accounting System

1. To establish an accounting framework and one-stop service to operationalise the planning and monitoring of Australia's emission reduction and sink enhancement programs in the landbased sectors.

2. To provide data sets required to produce credible emission projections from land based sources.

3. To enhance Australia's capacity to claim credit for its carbon sink enhancement programs by capturing the full greenhouse potential of government and private sector initiatives in land management and revegetation activities.

4. To make the carbon accounting information systems readily available to stakeholders.

5. To facilitate increased private sector and community investment in commercial and conservation revegetation.

6. To examine priorities for research required to improve the understanding which underpins the management of Australia's land-based greenhouse sinks and sources.

Description of the National Carbon Accounting System:

A National Carbon Accounting System should:

- provide a comprehensive framework and the scientific services necessary to account for the nation's land based carbon to an internationally credible standard,

- ideally be based on a digital land use database to allow carbon stocks to be accounted at a property level,

    ◊ This database, which is currently being designed jointly by BRS and the Australian Bureau of Statistics, will allow changes in land use and carbon sequestration to be accounted at a property level through the normal collection of census data.

- allow carbon stocks to be verified by satellite monitoring and audited by on-ground sampling procedures,

    ◊ This form of carbon accounting based on carbon stocks, which has recently been adopted by IPCC, would enable Australia to benefit from full 'carbon value' of its land based activities.

- be strongly underpinned by scientific work to establish an internationally credible biomass and soil carbon map of Australia.

    ◊ The land use database would also be supported by scientific work to establish the carbon stocks in Australia's largest potential sinks, the forests and tropical grasslands. This work would establish the biomass and soil carbon of Australia's 155 million hectares of forests and 80 million hectares of tropical grasslands.

- establish a national framework and associated scientific methodology to properly capture the carbon sequestration capacity of current NHT programs such as Farm Forestry, the National Vegetation Initiative, Bushcare and other measures proposed in this memorandum such as Plantations 2020 Vision and Bush for Greenhouse.

Key activities and outputs

This National Carbon Accounting System could be delivered through existing structures in BRS and other government agencies. BRS is already making significant advances in research, scientific understanding and data generation in support of the National Carbon Accounting System including:

- Developing a strategic framework and plan.

- Developing comprehensive, accurate and detailed spatial carbon databases including

    <u>Baseline databases</u>

    1. Area of vegetation and non-vegetation covers in 1990 by type (e.g., plantation, native forest and woodland) -(e.g., Figure 1)
    2. Above/below ground vegetation biomass (carbon) - (e.g., Figure 2)
    3. Above/below ground biomass (carbon) increment (sink capacity)
    4. Soil carbon

Change databases (updated at least every five years)

1. Land cover change since 1990 with emphasis on revegetation (e.g., National Vegetation Initiative), plantation establishment (e.g., 2020 Vision) and on-farm forestry.
2. Area of significant vegetation growth (e.g., > 1 tonne biomass per annum) additional to areas revegetated since 1990.
3. Decomposition rates of dead above/below ground biomass.
4. Rates of soil carbon release or gain associated with land use change

Monitoring capability

1. Implementation of remote sensing technology for monitoring changes in vegetation cover, land use, above ground biomass and above ground biomass increment.

2. Use of biospheric models for monitoring and predicting soil carbon dynamics following land use change, above and below ground biomass increment and decomposition rates.

- Defining carbon measurement methodologies and protocols
  - standardising methods for estimating carbon sources and providing guidelines for its application for planning and operation at the project and individual level.
- Enhancing Australia's inventory capacity in vegetation and soils
  - including improvement to the methodology and data input to the National Greenhouse Gas Inventory.
- Undertaking limited and targeted R&D to address knowledge and information gaps.
- Providing tools required for vegetation carbon offsets and a potential future carbon credit trading system.

Expected Outcomes

The National Carbon Accounting System, if implemented, would provide critical support for the most cost effective way of achieving a major reduction in Australia's net greenhouse emissions. It would underpin credible delivery of reductions of up to 65-90 Mt and 100-125 Mt CO_2 in 2010 and 2020 respectively, for a government investment of less than 50 cents/tonne.

This measure would deliver or underpin the delivery of the following:

- An internationally credible National Carbon Accounting System for Australia's land-based sources and sinks.
- Increased investment in commercial and conservation revegetation, through the incentive of quantifiable carbon accounts as a basis for carbon offsets in voluntary industry agreements and future carbon trading.

This National Carbon Accounting System would also increase the confidence in the estimation of greenhouse sources and sinks in the National Greenhouse Gas Inventory. This would enhance the scientific rigour and international credibility of the inventory and would improve its utility in the formulation of greenhouse policy and monitoring of response actions.

The provision of a sound scientific base and agreed technical protocols to measure and record the net carbon value of our land based sinks would allow Australia to use its comprehensive approach to greenhouse negotiations to full advantage. The sound scientifically based substantiation of the nation's current and developing carbon sinks would also represent a firm base for our greenhouse gas emissions policy development.

Figure 1

Figure 2

Attachment C

Attachment to the Bureau of Resource Sciences Submission to the House of Representatives Inquiry into regulatory arrangements for trading in greenhouse gas emissions

Fugitive Emissions

BRS REVIEW OF POTENTIAL FOR FUGITIVE EMISSIONS TRADING

Introduction

The Energy sector is one of the six sectors defined by the Intergovernmental Panel for Climate Change (IPCC). The two major subdivisions of the Energy category are Fuel Combustion (which is includes Stationary Sources and Transport - Mobile Sources) and Fugitive Emissions. The Fugitive Emissions sub-sector covers emissions of greenhouse gases from fuel production, transmission, storage and distribution, where the fuels specifically addressed are coal, crude oil and natural gas. It is the second largest producer of methane emissions (after agriculture) in the 1990 emissions data reported by the National Greenhouse Gas Inventory Committee, in May 1996. Methane from fugitive emissions amount to 22% of Australia's total emissions of methane.

Australia's fugitive emissions (mainly methane and carbon dioxide) have been assessed as 29.3 Mt (5.8% of total national emissions) on a carbon dioxide equivalent basis in 1990 (see table below). It must be stressed that these figures are very uncertain, as there are serious deficiencies in knowledge of fugitive emissions as they are by-products or leaks from commercial processes; measurement and reporting of such emissions has not been seen as a priority in the past.

	Methane	**Carbon dioxide**	**Carbon dioxide equivalent of all emissions**
Greenhouse source	**thousand tonnes**	**million tonnes**	**million tonnes**
Coal Mining Fugitive Emissions	757.3	0	15.9
Oil and Natural Gas Systems Fugitive Emissions	455.6	3.8	13.4
TOTAL Fugitive Emissions	1212.9	3.8	29.3
TOTAL AUSTRALIAN EMISSIONS	5589.7	394.8	505.5

Source: NGGIC (1996), *National Greenhouse Gas inventory 1990,* National Greenhouse Gas Inventory Committee, May 1996, Canberra.

Emissions trading and fugitive emissions

For emissions trading to work, there must be a very accurate and comprehensive method for measuring or estimating emissions, or a uniform (preferably international) method for estimating emissions where they are difficult or impossible to measure directly. There must also be methods for reducing emissions in the industry, or trade with other industries if emissions reductions are impossible or uneconomic.

While there are a number of areas where there are potential difficulties in measuring emissions, it is a characteristic of both the coal and petroleum industries that a relatively small number of significant producing mines and fields result in the majority of emissions. Thus monitoring emissions need not be a highly complex task. The major exception is gas distribution (where there are a large number of pipelines of varying integrity). Even here, however, there are methods for estimating emissions.

Therefore the potential exists to trade in emissions, given the adoption of rigorous methodology for measuring or estimating emissions, and the numerous methods available for emissions reduction. The situation for each industry is outlined below.

Coal

Sources

Fugitive emissions arise mainly from deep underground coal mines. Open cut black coal mines are assessed to contribute only about 30% of emissions, although they represent 70% of black coal production. Brown coal is assessed to have zero emissions. About 3% of emissions occur in post mining activities such as transport. Note that no assessment has been made of carbon dioxide emissions from coal mines, which certainly occur but are less significant than methane emissions which have a greater greenhouse effect.

Measurement

Methane contents of coal generally increase with depth. Estimation of emissions from coal mining is a difficult task, however, as coal seams vary greatly in methane and carbon dioxide content at the same depth, even in areas of consistent coal quality. There is also debate about methods used to estimate emissions. Some organisations report results based on monitoring of return air quality, while others simply assume an average emissions per tonne of coal, and apply it to the tonnes produced. This is the approach used in the Greenhouse Gas Inventory. Emissions are, however, not a linear function of coal production in underground mines.

While mining tonnages are known accurately, measurements of the emissions resulting from underground mining depends on either assuming an average methane content of the coal mined, or measuring air quality. Methane extracted in advance of mining must also be accounted for.

Alternatives for reduction

The options for reducing methane emissions are to selectively mine low emissions coal or to install a gas drainage system, either during mining (by drilling from underground) or before coal mining commences (by pre-drainage from well drilled from the surface). This introduces the possibility of commercial recovery of methane for use as a fuel in the mine, or for sale. This is already done at some locations in Australia.

Oil and natural gas production

Sources

The major sources of greenhouse emissions from the petroleum exploration and production industry are believed to be leaks of methane from gas production and processing facilities, methane leaks from gas distribution pipelines, flaring of gas and oil in field production facilities (resulting in both carbon dioxide and methane emissions), and carbon dioxide venting from gas processing plants. The relative importance of each source is still unknown as major deficiencies exist in the methodology for estimating leakage rates.

Measurement

Because of their nature, measurement of the extent of leaks, both accidental and as part of operations, is very difficult. In gas transmissions and distribution pipelines, leaks can be estimated by comparing gas produced with gas sold, leading to an ‘unaccounted for’ gas

figure. Part of this can be attributed to losses of various kinds, the rest can be attributed to leaks.

Flaring and venting figures are more readily monitored. Most **flared** gas arises from a few high-rate oil production facilities which do not have gas pipelines installed or in operation, such as the floating production, storage and offloading (FPSO) vessels offshore from northwestern Australia. Very little flaring occurs in major integrated oil and gas projects such as Gippsland. Thus relatively few flares contribute most of the emissions, and monitoring of the vast majority of flaring would not be difficult.

Venting of methane occurs mainly in a number of onshore wells where a flare is not used and no pipelines or compressors are available. Venting of carbon dioxide occurs mainly in a few gas plants which operate on a few high carbon dioxide content fields or at a few gas plants which produce low carbon dioxide content gas, but at high rates.

Alternatives for reduction

Because of the varied sources of greenhouse fugitive emissions from petroleum, a wide variety of strategies are available to reduce emissions.

Leaks may be reduced by reducing pipeline pressures on a seasonal basis, by leak detection and replacement of pipelines (particularly in the case of older gas distribution pipelines in cities), by improved practices in compressor operation and when purging gas pipelines, by various methods to improve seals on equipment, cool tanks and pipelines, and in many other ways.

Venting of methane can be reduced by selectively producing only those fields with gas gathering pipelines in operation, or by reinjection into a reservoir. Flaring, which results in reduced greenhouse gas emissions, is preferable to venting where other alternative facilities are not available. Methane emissions from flaring (i.e.uncombusted methane) can be reduced by improved flare tip design.

Flaring of methane can be reduced by gas gathering and compression projects for gas associated with oil production. The gas gathered can be sold via a pipeline, reinjected into the reservoir, used to generate electricity or as fuel on site, or used as a feedstock for methanol or LNG production. Flaring of LPG can be reduced by LPG recovery from the flare gas into the crude oil stream, to produce a higher vapour pressure crude.

Venting of reservoir-sourced carbon dioxide can be reduced by selectively producing from low carbon dioxide gas fields, or by using it for enhanced oil recovery, or for methanol production, or by reinjecting into a reservoir (as at Natuna in offshore Indonesia). Methods for deep ocean disposal of carbon dioxide may be available in the future.